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Perceived Self-Efficacy and Everyday Problem Solving Among Young and Older Adults

Daniele Artistico
University of Rome "La Sapienza"

Daniel Cervone
University of Illinois at Chicago

Lina Pezzuti
University of Rome "La Sapienza"

This research tested the hypothesis that age differences in both self-efficacy perceptions and problem-solving performance would vary as a function of the ecological relevance of problems to young and older adults. The authors developed novel everyday problem-solving stimuli that were ecologically representative of problems commonly confronted by young adults (young-adult problems), older adults (older adult problems), or both (common problems). Performance on an abstract problem solving task lacking in ecological representativeness (the Tower of Hanoi problem) also was examined. Although young persons had higher self-efficacy beliefs and performance levels on the Tower of Hanoi task problem and the young-adult problems, this pattern reversed in the domain of older adult problems, where the self-efficacy beliefs and performance of older persons exceeded those of the young.

Many factors contribute to variations in cognitive performance across the life course. With increasing age, people experience decreases in cognitive processing speed (Birren & Fisher, 1995; Scheibel, 1996; Willott, 1999) and working memory capacity (e.g., Raz, 2000; Rypma, Prabhakaran, Desmond, & Gabrieli, 2001; Salthouse, 1990). These are changes that might, in principle, manifest themselves in virtually any context requiring complex cognitive skills (Salthouse, 2000). However, increasing age is also commonly accompanied by increasing knowledge and expertise (P.B. Baltes, 1997). Enhanced knowledge may enable older adults to compensate for losses in processing speed and capacity (P.B. Baltes & Baltes, 1990). Such benefits are most likely in problem-solving contexts in which individuals invest effort to develop requisite skills and task strategies (M.M. Baltes & Lang, 1997; P.B. Baltes & Staudinger, 2000) or interact with others to discuss problems (Staudinger & Baltes, 1996). These considerations imply that investigations of age-related variations in cognitive performance must attend carefully to the particular domain in which performance is assessed (Allaire & Marsiske, 2002). As is true earlier in life (Freitas & Downey, 1998), the capacity of individuals to cope with life challenges in adulthood may vary from one social context to another (Berg, Meegan, & Deviney, 1998).

Everyday Problem Solving

A valuable domain for examining prospective age-related and context-dependent variations in cognitive performance is everyday problem solving, that is, problem solving in which individuals solve problems that resemble those they confront outside of the laboratory in their everyday life (Willis, 1996). Although the tasks categorized under the rubric of "everyday problems" are not a homogenous group (Berg & Klaczynski, 1996),[1] they generally differ from traditional lab-based cognitive assessments, such as IQ tests, arithmetic problems, or assessments of working memory, in significant respects (Cornelius, 1984). The traditional tasks are ones that older adults rarely encounter in their daily life, that

Daniele Artistico, Department of Psychology, University of Rome "La Sapienza," Rome, Italy; Daniel Cervone, Department of Psychology, University of Illinois at Chicago; Lina Pezzuti, Department of Developmental and Social Psychology, University of Rome "La Sapienza."

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Correspondence concerning this article should be addressed to either Daniele Artistico, who is now at the University of Illinois at Chicago, or Daniel Cervone, Department of Psychology (MC 285), University of Illinois at Chicago (UIC), 1007 West Harrison Street, Chicago, Illinois 60607-7139. E-mail: daniele.artistico@uniroma1.it (dartis1@uic.edu) or dcervone@uic.edu

[1] Investigators have used a heterogeneous collection of measures to assess everyday problem solving (Allaire & Marsiske, 1999), which itself is a multidimensional construct (Marsiske & Willis, 1995). The purpose of the present work is not to characterize the domain of cognition that falls under the rubric of everyday problem solving, but to explore the impact of variations in the ecological relevance of ill-structured problems on self-efficacy beliefs and the ability to generate problem solutions (Allaire & Marsiske, 2002).

constitute problems for which there generally is only one logically correct solution, and in which that solution is reached primarily through abstract logical reasoning (Heidrich & Denney, 1994). In everyday problem-solving tasks, in contrast, the problems are ecologically representative of individuals' daily challenges, there often are multiple viable solutions to a given problem, and the generation of solutions requires drawing on personal knowledge gained through social experience (Allaire & Marsiske, 2002; P.B. Baltes, Staudinger, & Lindenberger, 1999). Such knowledge enables individuals to analyze a problem in diverse ways and to generate multiple problem solutions; this capacity is critical, despite the fact that people generally pursue only one strategy for solving a given problem, because in daily life unexpected contingencies may interfere with a preferred solution, forcing the individual to devise novel strategic options (Sinnott, 1989).

Performance on traditional laboratory tasks tends to decrease linearly after early adulthood (P.B. Baltes & Mayer, 1999; Birren & Schaie, 1996). A different age-related pattern, however, has been found on ecologically relevant everyday problems (Denney, 1990). Work by Denney and colleagues (Denney & Palmer, 1981; Denney & Pearce, 1989; Denney, Pearce, & Palmer, 1982) indicates that performance in this domain increases from young adulthood to middle age, but then decreases in older adulthood. Such results are not found uniformly; older adults occasionally outperform younger adults (Cornelius & Caspi, 1987) and performance on some everyday problems correlates highly with traditional cognitive ability measures (Allaire & Marsiske, 1999). However, the overall pattern of findings suggests that laboratory tasks and everyday problems constitute distinct domains. Yet findings also suggest that although experience may moderate age-related declines on everyday problems, "experience cannot completely nullify the effects of aging" (Denney, 1990, p. 340). Even in domains of relevance to older individuals, young adults may outperform older adults (Morrow, Menard, Stine-Morrow, Teller, & Bryant, 2001; Schaie, 1996).

Two considerations, however, raise the possibility that extant data underestimate the performance capabilities of older adults. One is that the methods used in previous work may not have been sufficient to identify problems of maximal ecological relevance to older adults. For example, Denney and Pearce (1989) selected, on rational grounds, 10 problems that initially were nominated by a sample of only 10 older adults. More careful item selection procedures, involving larger pools of prospective problem-solving items that are generated and rated by larger populations of older adults, may identify domains in which older adults perform at superior levels. Pursuing this possibility was one goal of the present research. Second, it is important to recognize that age-related declines generally are found at the level of the population mean (e.g., Schaie, 1996). Some significant portion of older adults may experience little or no decrements. There is as much heterogeneity in older age (P.B. Baltes & Baltes, 1990) as earlier in life, and many older adults demonstrate self-resilience in the later years (P.B. Baltes et al., 1999; P.B. Baltes & Mayer, 1999). A complete portrait of the resilience and capacities of older adults thus may require that investigators attend to potential variations within this age group (also see Berg, Meegan, & Deviney, 1998). The necessity of studying such intraindividual, contextualized patterns of performance is becoming increasingly apparent to investigators throughout the study of personality and social development (Blanchard-Fields & Hess, 1999; Blanchard-Fields, Chen, & Norris, 1997; Caprara & Cervone, 2000; Cervone & Mischel, 2002; Cervone & Shoda, 1999; Mendoza-Denton, Ayduk, Mischel, Shoda, & Testa, 2001).

Self-Efficacy Beliefs and Cognitive Performance

Because older persons may maintain high levels of performance within domains in which they exert the goal-directed effort required to attain knowledge and develop task strategies (Folkman, Lazarus, Pimpley, & Novaceck, 1987; Ruth & Coleman, 1996), a critical scientific challenge is to identify the psychological factors that determine whether older individuals exert this goal-directed effort (Lang & Carstensen, 2002; Lang & Heckhausen, 2001; Staudinger, Freund, Linden, & Maas, 1999). One such factor that has been explored in the study of cognitive performance among older adults is perceived self-efficacy (Berry, 1999; Berry & West, 1993; Dittman-Kohli, Lachman, Kiegel, & Baltes, 1991; Lachman & Jelalian, 1984; McDougall, 1998). Self-efficacy perceptions are appraisals of one's capability to attain a given type or level of performance in designated settings (Bandura, 1977, 1997). Much work indicates that subjective appraisals of personal efficacy contribute to human adjustment and achievement and that they do so partly by determining whether people undertake valued activities and persist on challenging tasks (e.g., Bandura & Cervone, 1983, 1986; Cervone & Peake, 1986; Peake & Cervone, 1989; Stock & Cervone, 1990). On stressful tasks, self-efficacy appraisals predict levels of intellectual performance (Bandura, Cioffi, Taylor, & Brouillard, 1988). Importantly, although efficacy beliefs are built primarily on past experiences of performance mastery (Bandura, 1977), self-efficacy appraisals predict future levels of cognitive performance even after controlling for the effects of past attainments (Cervone, Jiwani, & Wood, 1991; Cervone & Wood, 1995). In research with older populations, individuals with a higher sense of self-efficacy outperform those with a low sense of personal efficacy on memory, meta-memory, and cognitive tasks (e.g., Berry, 1999; Berry, West, & Dennehey, 1989; Devolder, Brigham, & Pressley, 1990; Hertzog, Dixon, & Hultsch, 1990; Seeman, McAvay, Merril, Albert, & Rodin, 1996).

Individuals with a higher sense of self-efficacy for problem-solving performance, then, may be more likely to exert the effort required to generate strategies for solving cognitive problems (Bandura, 1986, 1989). Among older adults those with higher self-efficacy beliefs would be expected to engage more fully in cognitive tasks and thus attain superior performance (e.g., Lachman & Jelalian, 1984).

Self-efficacy appraisals commonly vary as a function of social context. People routinely display high self-efficacy appraisals in some contexts and low efficacy appraisals in others (Cervone, 1997, 1999; Cervone, Shadel, & Jencius, 2001; Cervone & Williams, 1992). These contextualized variations in self-efficacy appraisal, then, may be an underlying process that contributes to observed contextualized variations in problem-solving performance in young and older adults. Specifically, individuals may have a higher sense of self-efficacy, and thereby experience greater performance success, when problems are ecologically representative of domains in which they have gained experience in their everyday life (Berry & West, 1993; Lachman & Jelalian, 1984). In principle, in selected contexts, the self-efficacy beliefs and cogni-

tive performance of older individuals may match or even exceed those of young adults. This possibility was a primary focus of the present research.

Overview of Research

The present two studies explored the possibility that, when comparing older and young populations, there may not be a simple main effect in which young persons have an overall higher sense of self-efficacy than older adults on cognitive tasks. Instead, there may be Person × Context interactions in which older adults display low self-efficacy in many domains but relatively high efficacy beliefs within domains in which they experience mastery in their daily life. We predicted, then, that task characteristics and participant age would interact, with older adults expressing lower self-efficacy beliefs in unfamiliar contexts but higher confidence on tasks that are ecologically relevant to them. In the second study, we tested the hypothesis that these interactions between age and ecological relevance of problems would be found not only in measures of perceived self-efficacy, but also in performance; older adults, then, were expected to outperform younger adults on cognitive tasks of ecological relevance to their age group.

Study 1: Perceived Self-Efficacy on Ecologically Relevant Everyday Problems

To study self-efficacy perceptions on everyday problems that are of relevance to young versus older adults, preliminary studies were required in order to identify ecologically relevant problem-solving items. These included a diary study, which was designed to generate a pool of potential items; a validation study, in which we identified a subset of items that were used subsequently in the analysis of age variations in perceived self-efficacy; and the main study, in which we assessed self-efficacy beliefs among young and older adults. In all studies, stimulus materials were written in Italian, participants were volunteers, and a thorough debriefing immediately followed participants' involvement in the research procedures.

Preliminary Studies: Development of Stimulus Materials

Diary Study

A preliminary aim was to identify problems whose content was ecologically representative of everyday problems faced by young and older adults. To this end, a daily diary study was conducted. Forty participants living in Rome took part in the diary study. They represented two groups of 20 persons (10 male, 10 female) each. A young adult group consisted of undergraduate students aged 20–29 years ($M = 24.15$, $SD = 2.46$; men and women did not differ in mean age, $t(18) = -0.10$, $p > .92$. An older adult group consisted of retired senior citizens aged 65–75 years ($M = 70.70$, $SD = 3.21$); men and women did not differ in mean age, $t(18) = 0.40$, $p > .68$. Young adults ($M = 14.45$, $SD = 1.12$) and older adults ($M = 14.25$, $SD = 2.45$) did not differ in mean years of education, $t(38) = 0.68$, $p > .49$.

For 1 week, participants kept a daily diary in which they recorded problematic situations they faced each day and how they coped with them. Using a diary booklet provided by the experimenter, they recorded private or public situations where it was difficult to cope either because of stress or the degree of effort required to achieve a solution. At the end of week, the completed diary was returned to the experimenter. Two judges (a 37-year-old man and a 33-year-old woman) independently coded each entry according to whether it represented a genuine problem; a circumstance was judged to be a genuine problem if the individual faced pressure or stress in solving it. Even if listed by participants, a simple choice or preference such as "the problem of" deciding which television show to watch was not coded as a problem. Interjudge agreement regarding whether a circumstance was a real problem was high; the Cochran index exceeded .95. Fewer than 10 problems were coded by both judges as not being real problems. This diary procedure resulted in the identification of 91 problems, 44 of which were relevant to older adults and 47 to young adults. The 91 problems were included in a questionnaire that was administered in the next step of the research.

Validation of the Problems

Our next goal was to identify a small number of problems that could serve as stimuli in subsequent work. We desired problems that both young and old participants would view as important but that varied in their frequency, with some problems being frequently experienced by older adults, some by younger adults, and others by both groups.

A new sample of 100 participants in Rome (50 young adults: mean age = 25.08 years, $SD = 2.09$; 50 older adults: mean age = 70.44 years, $SD = 3.36$; both sexes were represented equally) with the same socio demographic characteristics as those in the diary study participated in a questionnaire-based study. Again, within both groups, there were no mean age differences between men and women: young adults, $t(48) = 1.21$, $p > .23$; older adults, $t(48) = -0.17$, $p > .86$. Years of education were not statistically different between young adults ($M = 14.20$, $SD = 2.16$) and older adults ($M = 15.00$, $SD = 3.48$; 3 older adult participants did not report their years of education), $t(95) = -1.37$, $p > .17$.

Participants, tested individually, were presented with the 91 problems identified in the diary study, with the text describing the actor confronting the given problem merely as "a person," with no description of the actor's age. Participants evaluated three aspects of each problem: (a) intelligibility ("Is this problem written in a clear concise style?" [yes or no]); (b) problem importance ("In your opinion would this problem really matter if it occurred to a person?", with responses given on a 5-point scale ranging from 1 [*not at all*] to 5 [*totally*]; note that the item did not ask if the problem currently was of importance to the given participant, but whether it would be personally significant to an individual if, hypothetically, it were to occur); and (c) problem frequency ("How often did the problem occur in the last year of your life?", with responses given on a 7-point scale ranging from 1 [*never*] to 7 [*always*]; feedback from participants in pretesting indicated that a scale of wider range was useful to capture the variability and gradations in subjective ratings of frequency). Instructions for completing the task were provided on a cover page of the questionnaire. After participants read these instructions, the experimenter discussed the task with them to ensure that they understood the instructions thoroughly.

After data collection, we examined participants' ratings to identify a subset of problems that was judged as being clear and of high

importance. Within this subset, we searched for problems that occurred to young versus older participants with differential frequency. Fifteen items were judged to meet these criteria. We subjected importance and frequency of responses to these items to analyses of variance (ANOVAs; see Table 1). For the common problems, young and older participants did not differ in their ratings of problem importance or frequency. For the young adult problems, older and young persons judged the tasks as equally important but the young judged that the problems occurred to them with significantly greater frequency. Regarding the older adult problems, older persons judged these to have occurred with much greater frequency; they also judged them to be more important in three of the five cases, though the magnitude of age differences in importance ratings was much smaller than in ratings of frequency. Because the problem sets possessed the desired characteristic of being differentially experienced by young versus older adults, they were used subsequently.

Main Study

Study 1 examined levels of perceived self-efficacy for the ecological problems developed and tested in the procedures described above. We anticipated an interaction between type of problem and participant age; specifically, participants were predicted to display the highest levels of self-efficacy on the problems of ecological relevance to them. No age differences were expected on the problems that were common to members of both groups. In making these predictions, our reasoning was that the ecologically relevant problems are ones in which individuals generally develop mastery in their day-to-day life and that mastery experiences are the primary determinant of people's appraisals of their efficacy for performance (Bandura, 1977, 1982; Welch & West, 1995). Even in problem domains that initially present severe challenges, older adults may develop strategies that solve the problem at hand. For example, a problem such as taking out garbage from one's home, which may pose an insurmountable physical obstacle, might be solved by soliciting the help of physically able neighbors. In this regard, it is important that the self-efficacy questionnaire we used asked people whether they could solve designated problems, not whether they could execute one versus another solution to the problem presented. This is consistent with self-efficacy theory (Bandura, 1997), where self-efficacy perceptions are defined as appraisals of one's capability to attain designed types or levels of performance, rather than as expectations about one's ability to execute low-level acts that merely are subcomponents of valued accomplishments.

Method

Participants. The participants were 40 individuals living in Rome (20 men, 20 women) drawn from a population demographically similar to that studied in the development of test stimuli. Participants were (a) 20 young adults aged 20–29 years ($M = 22.90$, $SD = 2.36$), equally divided by gender, and (b) 20 older persons aged 65–75 years ($M = 70.10$, $SD = 3.60$), equally divided by gender. Once again, within both groups, there were no mean age differences between men and women: young adults, $t(18) = 0.96$, $p > .35$; older adults, $t(18) = 0.66$, $p > .52$. Years of education were not statistically different, $t(38) = -1.16$, $p > .25$, between young adults ($M = 14.25$, $SD = 2.22$) and older adults ($M = 15.20$, $SD = 2.89$). Participants took part in a study of a mixed 2 × 3 design: Age Group (young and older adults) × Problem Type (ecologically relevant to the young, the older, or both), with the latter condition being fully within-subjects.

Materials and procedure: Participants completed a questionnaire assessing their perceived self-efficacy for solving each of the 15 ecological problems identified previously. They reported their self-efficacy perceptions on scales ranging from 0 (*I cannot solve this problem*) to 100 (*I can solve this problem*). The problems were ordered randomly, with each participant completing the items in a unique random order. Cronbach's alpha indicated acceptable internal consistency for each problem type: α (common problems) = .70, α (young-adult problems) = .77, α (older adult problems) = .73. Thus, we subsequently analyzed mean levels of self-efficacy within problem type.

Results and Discussion

A 2 × 3 ANOVA revealed, as predicted, a highly significant interaction between age and problem type, $F(2, 76) = 16.82$, $p < .001$. For both groups, self-efficacy perceptions varied in accord with the ecological relevance of the problems presented. On the young adult problems, young adults ($M = 63.70$, $SD = 14.41$) perceived themselves as more efficacious than did older adults ($M = 45.25$, $SD = 21.23$), $t(38) = -3.21$, $p < .01$. Conversely, on the problems of relevance to older adults, the older adults ($M = 67.06$, $SD = 17.08$) judged themselves more efficacious than did the young adults ($M = 47.16$, $SD = 19.24$), $t(38) = -3.46$, $p < .01$. Young ($M = 54.80$, $SD = 13.50$) and older adults' ($M = 60.45$, $SD = 18.20$) self-efficacy perceptions did not differ on the common problems, $t(38) = -1.11$, $p > .27$.

As anticipated, then, there was not a simple main effect for age, $F(1, 38) = 0.36$, $p > .54$, with older adults having lower efficacy beliefs than the young. Instead, the relation of young to older adults' self-efficacy beliefs varied as a function of the type of problems that participants were considering. The finding that older adults had higher self-efficacy than the young on problems that were ecologically relevant to them raises the possibility that, on these problems, they also might be more successful than young adults in generating solutions; we examined this in our next study.

Study 2: Perceived Self-Efficacy and Problem-Solving Performance

As noted earlier, in Study 2 we pursued two goals: (a) to replicate the finding, from Study 1, that age group and task characteristics interact to influence perceived self-efficacy; and (b) to test the hypothesis that this same interaction would be found in performance on the problem-solving tasks. We also gauged the degree to which variations in perceived self-efficacy mediated the relation between age and performance.

Method

Participants

The participants were 30 students at the University of Rome "La Sapienza" and 30 older persons living in Rome who volunteered to participate. The former group was 20–29 years of age ($M = 25.73$, $SD = 2.05$), the latter 65–75 ($M = 69.70$, $SD = 3.31$). The groups contained equal numbers of men and women, and age did not vary by gender within group: young adults, $t(28) = 1.26$, $p > .28$; older adults, $t(28) = -0.16$, $p > .87$. Participants' mean number of years of education was similar to that of the

Table 1
One-Way ANOVA for Importance and Frequency of the Problems Between the Two Age Groups

Problem type	Importance			Frequency			
	Young adults	Older adults	$F(1, 98)$	Young adults	Older adults	$F(1, 98)$	From
Common							
Coping with a water and electricity black-out in a country home	3.78	4.04	2.71	2.64	2.49	0.20	Older adults
Coping with loneliness during the weekend	3.94	4.21	2.57	1.54	1.51	0.02	Older adults
Being unable to visit a sick relative in a far-away town	3.72	4.00	2.50	3.32	3.83	2.19	Older adults
Coping with chronic insomnia	3.78	3.89	0.47	1.90	2.15	0.62	Young adults
Dealing with a hostile official when making a request at a government office	3.72	3.72	0.00	2.84	2.49	0.86	Young adults
Young adult							
Not being able to understand part of an exam	4.04	3.98	0.13	3.08	1.85	13.39***	Young adults
Coping with loss of motivation to finish a degree	3.96	3.72	1.51	3.36	1.33	65.37***	Young adults
Dealing with a computer crash	3.48	3.49	0.00	3.40	1.89	25.79***	Young adults
Trying to improve one's relationship with one's partner during a difficult period	3.98	4.02	0.05	3.46	1.34	69.41***	Young adults
Coping with being shy but wanting to become less so	3.88	3.89	0.01	3.48	1.62	33.91***	Young adults
Older adult							
Trying to improve the acrimonious tone of a meeting	3.44	3.91	5.90*	1.48	3.00	16.28***	Older adults
Wanting to be visited by relatives more frequently	2.72	3.62	17.61***	1.50	3.40	45.40***	Older adults
Having blood drawn by a physician who is having difficulty with the procedure	3.22	3.62	4.05*	1.68	3.38	19.63***	Older adults
Coping with feelings of disapproval concerning one's daughter's lifestyle	3.96	4.17	1.33	1.74	3.28	17.36***	Older adults
Dealing with excessive demands by one's sons to baby-sit their children	3.84	4.17	3.00	1.74	3.77	29.70***	Older adults

Note. ANOVA = analysis of variance.
* $p < .05$. *** $p < .001$.

population in Study 1 and, again, years of education of young adults ($M = 14.83$, $SD = 2.45$) and older adults ($M = 15.20$, $SD = 2.52$) did not differ, $t(58) = 0.51$, $p > .60$.

Materials and Procedure

Assessments of mental ability and perceived self-efficacy. Prior to the main study, participants completed the Wisconsin Card Sorting Test (WCST; Grant & Berg, 1948) to provide a standardized measure of mental ability. All participants were within the normal range of intelligence according to WCST age norms (Grant & Berg, 1948). Specifically, the average IQ scores of young persons on the WCST were within the range of normality: perseverative error IQ = 101.1 (row score: $M = 7.73$, $SD = 4.77$); nonperseverative error IQ = 102.3 (row score: $M = 6.60$, $SD = 4.67$). In the older adult group, the average nonperseverative error score was below the mean but within the first standard deviation (IQ = 85.6; row score: $M = 18.40$, $SD = 8.99$), and the average perseverative error score IQ was 101.4 (row score: $M = 13.17$, $SD = 8.69$). Within-group correlational analyses relating WCST scores to problem-solving performance among young and older adults revealed small, generally nonsignificant relations between IQ and the performance indices. Participants, tested individually, took part in the main study approximately 1 week after the WCST assessment.

The main study was conducted by a second experimenter. Participants worked on four tasks: the Tower of Hanoi problem (Anzai & Simon, 1979) and the three different types of ecologically relevant everyday problems developed and used in Study 1. This yielded a 2 × 4 design: Participant Group (young and older adults) × Problem Type (traditional problem, ecological problems: common, young-adult, old-adult), with the latter factor being a within-subjects variable.

Participants' perceptions of self-efficacy on these four problem types were assessed after they had received descriptions of the tasks but prior to their performing them or seeing a specific example problem. Self-efficacy assessments adhered closely to the measurement principles of self-efficacy theory (Bandura, 1977, 1997; Cervone, 1985) but differed in their format as compared to the parallel assessments of Study 1. We introduced this variation for two reasons. First, we wished here to relate variations in self-referent beliefs to variations in overall levels of performance on each task. We therefore designed the self-efficacy assessment to directly assess self-perceptions of participants' capabilities for overall performance. Second, we desired a rating scale that was applicable to the Tower of Hanoi problem. To this end, for the common, young-adult and older-adult problems, participants completed five items assessing their confidence (on 0–100 scales) in attaining each of five levels of performance, namely, the solution of one, two, three, four, or all five of the problems. For the Tower of Hanoi problem, they completed a 5-item scale assessing their confidence, from 0 to 100, in attaining performance levels ranging from *I can solve Tower of Hanoi puzzle within 30 moves*, to *I can solve Tower of Hanoi puzzle within 10 moves*. For each scale, internal reliability was high ($\alpha > .90$); mean self-efficacy levels, within problem type, thus served as the index of efficacy beliefs.

Assessment of problem solving. To simplify the procedures for participants, we first administered procedures (self-efficacy measures, then performance measures) for the traditional cognitive problem and the five common ecological problems. After a short break, the same procedures for the five young-adult-oriented and five older adult-oriented problems were administered. The order of presentation of the young-adult versus older adult problems was determined randomly for each participant; there were no order effects on performance on the young adult, $F(1, 58) = 0.09$, $p > .75$, or older adult problems, $F(1, 58) = 0.35$, $p > .55$.

The experimenter carefully explained the traditional problem-solving task, the Tower of Hanoi problem, in which three pegs are aligned on a board and three disks of different size are stacked on a peg at one end. The task is to transfer the disks to the peg at the other end while adhering to two constraints: not placing a larger disk on a smaller disk and moving one disk at a time (Anzai & Simon, 1979). The goal is to solve the task in the fewest moves possible. The experimenter recorded both the number of moves taken to solve the problem and the time taken to reach a solution; these two indices of performance, which were significantly correlated, $r(58) = .73$, $p < .001$, were standardized and combined into a single performance index. To represent performance on a positively oriented scale, we computed *T* scores and reversed their sign by multiplying the original *T* score by −1 and adding 100.

For the second task, the common ecological problems, participants received the five common problems identified previously as being of equal frequency and importance to young and older adults. The instructions provided to the participants explained that they were to listen carefully to each problem and then to provide as many relevant solutions as possible. To ensure that we assessed the maximal number of solutions participants could provide (cf. Denney, Tozier, & Schlotthauer, 1992), participants were explicitly encouraged to provide a solution even if it were one that they themselves may not choose to adopt. In addition, when participants had finished providing solutions to a given problem, the experimenter asked if they could think of any additional solutions, before moving to the next problem. In the instructions, the experimenter did not stipulate a number of problems that participants were expected to provide or a time limit for performing the task. Participants were informed that their responses would be tape recorded. After these instructions, participants completed the self-efficacy scales for the Tower of Hanoi and common ecological problem. After completing the two self-efficacy scales, they performed the Tower of Hanoi problem and then the common ecological problems.

After a break of about 10 min, the experimenter explained the remainder of the study. Participants were informed that they were to solve 10 new real-life problems, 5 of which were typical problems for young adults and 5 typical problems for older people. The problem-solving session proceeded exactly as was the case with the common ecological problems. After the instructions, but prior to working on either the young adult or the older adult tasks, participants completed self-efficacy scales for solving typical young adult problems and typical older-adult problems. After completing the task, participants were debriefed thoroughly.

Scoring. In scoring performance on the common, young-adult, and older adult problems, two judges (both middle-aged adults) who were uninformed as to the participants' age group independently rated the number of solutions generated by each participant; the judges' ratings for the common problems were highly related, $r(58) = .94$. Interjudge agreement for the older adult, $r(58) = .98$, and young adult, $r(58) = .99$, problems was high. The few disagreements were resolved in discussion between the raters. Responses that were not semantically related to the problem at hand or that did not provide any reasonable possibility of solving the problem were coded as not being a solution. The internal reliability of the performance measures was acceptable in the common ($\alpha = .65$), older adult ($\alpha = .84$), and young adult ($\alpha = .88$) domains.

Results

In light of evidence that the salience of interpersonal everyday problems can vary across the life course (Berg, Strough, Calderone, Sansone, & Weir, 1998; Strough, Berg, & Sansone, 1996), preliminary analyses examined the possibility that self-efficacy beliefs and performance might vary as a function of whether content of the ecological problems was in the domain of achievement versus interpersonal behavior. We coded each of the 15 problems as being achievement oriented, interpersonal in orientation, or both (see Table 2). As can be seen, the pattern of group differences obtained within the young and older adult problem types was replicated across the alternative (achievement vs. interpersonal) contexts; for example, young adults displayed higher

Table 2
Mean Levels of Performance (Raw Scores) on Problem-Solving Items

Problem type	Young adults	Older adults
Common		
Coping with loneliness during the weekend (AI)	3.17	2.90
Coping with chronic insomnia (A)	3.83	3.31
Coping with a water and electricity black-out in a country home (A)	3.33*	2.76
Being unable to visit a sick relative in a far-away town (I)	2.50	2.55
Dealing with a hostile official when making a request at a government office (I)	2.97**	2.14
Young adult		
Dealing with a computer crash (A)	3.40***	1.93
Coping with loss of motivation to finish a degree (A)	3.93***	1.79
Not being able to understand part of an exam (A)	4.03***	2.35
Coping with being shy but wanting to become less so (I)	3.30***	1.83
Trying to improve one's relationship with one's partner during a difficult period (I)	3.97***	2.24
Older adult		
Having blood drawn by a physician who is having difficulty with the procedure (AI)	1.93	3.10***
Trying to improve the acrimonious tone of a meeting (I)	1.43	2.93***
Wanting to be visited by relatives more frequently (I)	2.27	3.76***
Dealing with excessive demands by one's sons to baby-sit their children (I)	1.83	2.69**
Coping with feelings of disapproval concerning one's daughter's lifestyle (I)	1.70	2.96***

Note. A = Achievement; I = Interpersonal.
* $p < .05$. ** $p < .01$. *** $p < .001$.

efficacy beliefs and performance on two young-adult-related interpersonal problems.[2]

Age-Group Differences in Perceived Self-Efficacy and Performance

Table 3 reports mean levels of self-efficacy as a function of participant age group and problem type (traditional, common, young-adult, and older adult problems). As shown, self-efficacy levels varied substantially as a function of age and problem type. Young adults had higher levels of self-efficacy on the traditional and young-adult-oriented problems. In contrast, older adults had a higher sense of self-efficacy than the young on the older adult problems. The overall interaction term was highly significant, $F(3, 174) = 52.70$, $p < .001$, $MSE = 111.86$. Young adults had significantly higher efficacy perceptions than older adults on the Tower of Hanoi problem, $t(58) = 4.92$, $p < .001$, and the young-adult problems, $t(58) = 7.44$, $p < .001$. Age differences were highly significant on the older adult problems, but in the opposite direction, $t(58) = -4.62$, $p < .001$. On the common problems, the efficacy perceptions of young and older adults did not differ, $t(58) = 1.16$, $p > .24$.

Table 2 also reports mean levels of performance on the tasks. Performance levels generally paralleled variations in levels of self-efficacy. Of particular note here is that the older adults not only equaled, but also outperformed young adults on the everyday problems that were ecologically relevant to older adult populations. In contrast, young adults generated more solutions on the other three types of problems. Again, the overall interaction was highly significant, $F(3, 174) = 60.94$, $p < .001$, $MSE = 42.66$. Analyses of age variations on each of the four problems considered separately revealed that young adults outperformed older adults on the Tower of Hanoi problem, $t(58) = 4.28$, $p < .001$; the common problems, $t(58) = 2.82$, $p < .01$; and the young-adult problems, $t(58) = 13.67$, $p < .001$, whereas older adults outperformed young adults on the older adult problems, $t(58) = -7.24$, $p < .001$.

Mediational Analyses

In addition to group differences in self-efficacy perceptions and performance, another question of interest is whether variations in perceived self-efficacy mediated the relation between age and performance. In other words, to what degree do self-efficacy processes account for the observed age variations in cognitive problem solving? We considered this question separately for each of the problem-solving tasks.

Self-efficacy perceptions and performance proved to be significantly correlated for each of the four tasks: the Tower of Hanoi problem, $r(58) = .59$, $p < .001$; common problems, $r(58) = .37$, $p < .01$; young-adult problems, $r(58) = .69$, $p < .001$; and older adult problems, $r(58) = .68$, $p < .001$. In light of these results, we evaluated the mediational role of self-efficacy perceptions via the three-step procedure outlined by Baron and Kenny (1986), in which one computes equations that regress (1) the mediator (self-efficacy) on the independent variable (age); (2) the dependent variable (performance) on the independent variable, and (3) the dependent variable on both the independent variable and the mediator (i.e., age and self-efficacy).

On the Tower of Hanoi problem, beta coefficients in both Steps 1 and 2 were highly significant (see Table 4). When performance was regressed on both perceived self-efficacy and age in

[2] We note that achievement/interpersonal coding may be ambiguous because many circumstances combine both demands; the internal reliability of the achievement ($\alpha = .64$) and interpersonal domains ($\alpha = .58$) was only moderate. However, the precise categorizations are inconsequential to the present results because age group differences were found to be uniform across items, within problem type.

Table 3
Levels of Problem-Solving Performance and Perceived Self-Efficacy Among Young and Older Adults

Variable	Tower of Hanoi				Common problems				Young adult problems				Older adult problems			
	Young adults		Older adults		Young adults		Older adults		Young adults		Older adults		Young adults		Older adults	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Self-efficacy	82.0	17.2	60.0	17.5	71.3	13.2	66.6	18.3	81.2	12.4	54.3	15.6	55.7	13.9	72.5	14.4
Problem solving (*T* scores)	54.5	6.3	45.5	9.7	53.4	11.3	46.6	7.2	58.7	6.0	41.3	3.5	43.2	4.8	56.8	9.3

Equation 3, age group was not a significant predictor of performance, $t(57) = -1.82$, $p > .07$; the mediational effect of perceived self-efficacy was shown to be significant by Sobel and Goodman tests ($ps < .01$; Preacher & Leonardelli, 2001; also see Kenny, 2001). The data suggest, then, that variations in perceived self-efficacy mediated the age differences observed on the Tower of Hanoi problem. On the common ecological problems, in contrast, self-efficacy beliefs were not a significant mediator. Step 1 of the mediational analysis revealed that age and efficacy beliefs on these problems were not significantly linked, $F(1, 58) = 1.02$, $p >$ .30. On both the young-adult and the older adult problems, self-efficacy perceptions proved partly to mediate the relation between age group and performance (see Table 4). On both problems, self-efficacy perceptions and age, as well as age and performance, were significantly related. In the third equation, the beta coefficient for age as a predictor of performance decreased in size compared to its size in the second equation; however, age remained a significant predictor for both the young-adult problems, $t(57) = -8.49$, $p < .001$, and the older adult problems, $t(57) = 5.05$, $p < .001$.

General Discussion

Two ideas guided the current research. The first was the possibility that the declines in cognitive performance often found among older persons would be less apparent within a performance domain of ecological relevance to this age group. The second was that self-efficacy perceptions would contribute to older persons' resiliently high performance in this domain. Both hypotheses received significant support.

The findings supported our hypothesis of an interaction between age group and task characteristics with respect to perceived self-efficacy and problem-solving performance. Compared to young participants, older participants had lower perceived self-efficacy and performance on a traditional cognitive task, the Tower of Hanoi problem. On everyday problem solving tasks that were common to both older and young adults, the differences between the two groups were somewhat smaller; nonetheless, older persons still generated fewer problem solutions than did young adults. On ecological problems that were common among young adults, young adult participants had higher levels of self-efficacy and substantially outperformed older participants. However, when we examined everyday problems of ecological relevance to older adults, precisely the reverse pattern was observed: Older adults displayed higher self-efficacy perceptions and generated more viable solutions to the problems than did young adults.

Mediational analyses provided evidence for the role of self-efficacy perceptions in cognitive performance. Perceived self-efficacy partially or fully mediated the relations between age and performance on all problem types other than the common problems; that is, the everyday problem solving tasks that were common to the experiences of young and older adults. On all of the other tasks, higher levels of self-efficacy predicted higher levels of performance both prior to and after considering the effects of age. Self-efficacy perceptions were linked particularly strongly to performance on the Tower of Hanoi problem, fully mediating the relation between performance and age. On the older adult and young-adult problems, self-efficacy perceptions only partly mediated this relation; in other words, controlling for self-efficacy

Table 4
Testing Mediational Role of Perceived Self-Efficacy in Relations Between Age and Performance

	Self-efficacy on age			Performance on age			Performance on age (controlling for self-efficacy)		
Problem type	*B*	*SE B*	β	*B*	*SE B*	β	*B*	*SE B*	β
Tower of Hanoi	−.49	.10	−.53***	−.20	.05	−.47***	−.09	.05	−.22
Common	−.09	.09	−.13	−.14	−.06	−.32*	−.13	−.05	−.28*
Young adult	−.59	.08	−.68***	−.39	.03	−.87***	−.33	.04	−.74***
Older adult	.39	.08	.54***	.32	.04	.71***	.22	.04	.48***

* $p < .05$. *** $p < .001$.

perceptions lowered the relation between age and performance, yet that relation remained statistically significant. On both problems, self-efficacy perceptions and age, as well as age and performance, were significantly related.

Previous research (e.g., Denney & Pearce, 1989) had provided little evidence that the performance of older adults could exceed that of young adults in any domain of problem solving. In contrast, the present findings indicate that when facing problems of high ecological relevance to them, older persons are able to generate viable solutions to a degree that not only may equal but may significantly surpass younger adults. The difference between our findings and those of previous research may reflect a number of factors. The older adults in our samples were relatively highly educated compared to local norms for their age group; in principle, older adults of lower educational level may display lower self-efficacy beliefs and performance. Participants in our study were explicitly instructed to provide a solution even if they themselves were unlikely to use it in practice; other instructional sets may be appropriate to capture participants' typical problem-solving tendencies, yet may underestimate their maximal capacity to devise solutions (cf. Berg, Meegan, & Klaczynski, 1999; Denney & Pearce, 1989). Of potentially greater importance is that we used particularly detailed procedures for identifying ecologically relevant stimuli. These procedures included a diary study that, in combination with subsequent validation procedures, was successful in identifying ecologically representative problems faced by young and older adults. It was in the domain of older-adult problems, in which members of this age group have more frequent mastery experiences, that older adults displayed high perceptions of self-efficacy and performance. Our findings suggest that in future work seeking to characterize the problem-solving capacities of older adults, investigators should ensure that the problem-solving stimuli that are used are of maximal ecological relevance to the particular population under study. In principle, ecological relevance could be maximized by focusing not only at the level of the group, but also on the individual case; idiographic methodologies could be used to identify problem domains of particular relevance to the individual.

There are two qualifications to statements about the role of subjective self-efficacy appraisals in cognitive performance among the older adults. First, efficacy perceptions only partly accounted for age-group differences. Factors unrelated to subjective self-appraisals clearly contributed substantially to age-related performance differences. In general, even after considering the effects of mastery and expertise, some differences among young and older adults will still be found (Morrow et al., 2001). Second, the relations between self-efficacy perceptions and performance were correlational. We did not experimentally manipulate self-efficacy judgments within a given task. Much research outside of the domain of problem-solving performance among older adults has done so and has shown that experimentally induced variations in self-efficacy appraisal lead to corresponding variations in performance (reviewed in Bandura, 1997; Caprara & Cervone, 2000; Cervone & Scott, 1995). An interesting task for future research is to explore the impact of experimentally induced variations in self-efficacy in the present domain of investigation.

From the perspective of our research participants, the young-adult and older adult problems used in Study 2 differed in two respects: in their cognitive content and in the fact that the problems were recognizable as ones that are typical of the everyday experiences of one versus the other age group. Self-efficacy perceptions and performance, then, may have been affected not only by appraisals of the content of the problems but by stereotypic beliefs about the performance domains. We intentionally included problems that varied in both their content and their association with young versus older adults because of our overarching goal of ecological representativeness. In the real world, problems vary simultaneously in their cognitive content and in the age-related stereotypes they may generate. In future work, however, it may be useful to devise methods of controlling the content of problems while varying the degree to which the problems elicit age-linked stereotypes (cf. Denney & Pearce, 1989; Levy, 1996).

One other respect in which a subset of the problems in the present study differed, from the perspective of older and younger adults, is that older adults judged that some of the older adult problems were of greater personal importance. Perceived importance, however, does not explain the observed results. Young and older adults differed in their performance on all five of the older adult problems considered separately (see Table 2); in other words, they differed even on the subset of problems that was not judged to be differentially important.

One positive implication of our results concerns its implications for interventions. A goal of research on aging is to develop interventions that empower older adults by providing them with strategies to confront the challenges of aging. A self-efficacy focus, which highlights the contexts across which self-appraisals may vary and the motivational processes linking self-appraisals to performance outcomes (Bandura, 1997; Cervone, 1997), could be

useful for understanding the circumstances in which individuals are motivated to develop cognitive strategies. High efficacy beliefs may foster goal setting, strategy use, and other self-regulatory processes (cf. West, Welch, & Thorn, 2001) that enable people to devise novel methods for circumventing enduring problems. For example, an older person who has given up driving may actively work to become socially involved with her neighbors, who then can serve as a resource for personal transportation when needed. A high sense of personal efficacy may contribute to the planning and effort required to develop such inventive strategies.

Another future direction for research would be to respond to Berry's (1999) call for a more "holistic" approach to the study of self-efficacy judgment that takes into account "the social-situational sources" of self-efficacy and addresses the ways in which efficacy judgments are "constructed contemporaneously in response to a demand" by considering how individuals draw upon "schematic representation(s) of the self" (all quotes p. 89; also see Berry & West, 1993; Cavanaugh, Feldman, & Hertzog, 1998). Just such processes have been explored (though not among the older adults) in recent work (Cervone, 1997, 1999; Cervone et al., 2001). Findings suggest that salient beliefs about the self, or self-schemas, can foster consistently high and low self-efficacy beliefs across diverse schema-relevant situations. Applied to issues of cognitive performance and the older adults, this work suggests that older persons may develop salient self-representations that could come to mind in diverse settings and foster low self-efficacy appraisals in those settings. The assessment task, then, would be to tap self-representations, situational beliefs, and contextualized self-appraisals in order to obtain a holistic portrait of the social–cognitive personality structures and processes of the individual.

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Appendix

List of the Problems Used in the Research

Note: In Study 1, the actor in each item of the stimulus materials was described as "a person." In Study 2, in the young-adult and older adult problems, the actor was identified as a young adult/student or an older person. The actor was described as "a person" in the common problems in both studies.

Common Problems

A person living in the country is the victim of a black-out that causes there to be no electricity or water service. What should she/he do?

A person feels lonely during the weekend. What should she/he do?

A person has a relative with serious health problems who lives in a far away city of the same country. Unfortunately the person cannot travel to see the relative. What should she/he do?

A person recently finds himself/herself having difficulties getting to sleep at night. What should she/he do?

A person asks for information that is on record about himself at a government office. The official at the office rudely replies by saying that he does not want to give the data to the person. What should she/he do?

Young-Adult Problems

While taking a test (a person/a student) is not able to understand a very important part of the exam. What should she/he do?

(A person/A student) realizes that he/she is not sufficiently motivated to finish a course of studies in which he/she is enrolled. What should she/he do?

(A person/A student) is working on a computer but it suddenly shuts down and seems impossible to restart. What should she/he do?

(A person/A young person) is experiencing a very difficult period with her/his partner, and she/he wants to do something to improve the relationship. What should she/he do?

(A person/A young person) who avoids social situations because of extreme shyness wants to change this. What should she/he do?

Older Adult Problems

(A person/An older person) finds that meetings of the members of her condominium association are disrupted by a lot of disagreements and arguing among the members. She/he wants to improve the tone of the meetings. What should she/he do?

(A person/An older person) who lives alone wants to see her/his children, nieces, and nephews more frequently. What should she/he do?

(A person/An older person) is having a blood analysis with a very inexpert physician who, after many trials, is not able to find the right position for inserting the needle into his or her arm. The person experiences much pain as a result. What should she/he do?

(A person/An older person) strongly disagrees with the lifestyle of her/his daughter, but the person doesn't know how to approach the situation with the daughter. What should she/he do?

(A person/An older person) feels that her/his sons are too intrusive with her/his privacy because they frequently ask him/her to be a baby-sitter for the grandchildren. This situation is quite inconvenient for the person, who has many other issues to deal with during the week. What should she/he do?

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