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Practical problem solving efficacy among older and young adults

Glenn Shean[1], Barbara Haskins[2]

[1]Psychology Department, College of William & Mary, PO Box 8795, Williamsburg, Virginia 23187
[2]Clinical Psychologist Intern, Portsmouth Naval Hospital, Portsmouth, Virginia

Email address

gdshea@gmail.com(G. Shean), brhaskins@gmail.com(B. Haskins)

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Abstract: We compared the relationship between general cognitive ability, social cognition and the ability to understand and make decisions about practical problems among groups of college age and older adults. Results indicated that both general cognitive functioning and social cognitive ability were related to practical problem solving ability among older adults. In contrast college age adults practical problem solving was related to only general cognitive ability. Results indicate that social cognitive ability may compensate for age related decline in general cognitive functions among older adults and allow for continued competence in practical problem solving as speed of processing and short term memory functions decline.

Keywords: Social Cognition, General Cognitive Ability, Problem Solving, Age

1. Introduction

Many older individuals are able to manage the requirements of practical problem solving effectively despite age related declines in cognitive processes. Evidence indicates these individuals adopt strategies that involve multidimensional approaches to problem solving that include combinations of analytic, social cognitive and domain relevant experience based knowledge (Erickson, Raji, Lopez, Becker, and Rosano, 2010; Finucane, Mertz, Slovic, and Schmidt, 2005; Salthouse, 1991). Allaire and Marsiske (1999) for example examined older adults' ability to engage in practical problem solving and found that an important contributor to older persons' performance, in addition to cognitive functioning, had to do with the ability to recognize and respond appropriately to social and contextual cues. Sullivan and Ruffman (2004) reported that performance on an emotion recognition task was independently related to problem solving, and that emotion recognition was independent of declines in fluid cognitive ability among older adults. Other researchers have also reported that social cognitive abilities remain relatively unaffected by age-related decline in general cognitive ability (Keightley, Winocur, Burianova, Honganishkul, and Grady, 2006).

Evidence indicates that older individuals develop a framework of declarative, social skills, and domain-specific knowledge, in addition to general cognitive abilities, that they can draw upon in order to maintain competence in relevant areas (Salthouse, 1991, 1996; Finucane, Mertz, Slovic, and Schmidt, 2005; Yates and Palatano, 1999). The "person-task-fit" model of problem solving described by Finucane et al. (2005) posits that effective problem-solving by older adults often occurs via multiple task related processing via modalities that involve combinations of analytic, emotional, social and experience based processes (Damasio, 1994; Kahneman, 2003). Where younger adults tend to rely on compensatory decision-making rules that involve high processing loads, in which alternatives are evaluated, summed, weighed and averaged; older adults tend to rely on interpersonal, and experience based abilities and knowledge to solve practical problems (Johnson, 1990; Labouvie-Vief, 1982; Sinnot, 1989). In order to further investigate the relationship between age and practical problem solving this study compared relative contributions of analytic, and social cognitive processes (non-verbal affect recognition) to the abilities of groups of college age and older adults to engage in practical problem solving decisions about nutritional labels and health insurance program benefits, options and costs.

2. Method

Participants. A sample of 61 older adults was recruited from a geriatric health research center, an independent living home for senior citizens, and a university affiliated elder college program, mean age of older participants was 69.66 years (range = 57- 83 years, *SD* = 7.67); years of college mean 5.36, SD= 1.48); thirty- nine were females, 22 males. Older participants were pre-screened to exclude those with a history of stroke, uncorrected visual limitations, or who were currently taking antipsychotic, or Alzheimer's medications. College age participants were recruited a mid-sized university, and consisted of 66 participants, average age 18.82 years (range = 18-22 years, *SD* = 1.05); years of college (mean 1.26, SD= .64), 35 were females 31 males.

Procedure. Each participant completed measures in the following order: demographics, the Test of Premorbid Functioning Vocabulary Test, WAIS-III matrix reasoning sub-test, the Diagnostic Analysis of Non-Verbal Accuracy-2 (DANVA-2) Facial Affect Recognition, and DANVA-2 Adult Postures Test, and practical problem solving questions. Older adults were offered the choice of $15 cash or the same amount contributed to a charity or organization of their choice. College students received 1.5 hours of research participation credit for their Introductory Psychology course.

Measures. Demographic information included age, education, information about chronic medical conditions, and current medications.

General Cognitive Function Two measures were used to estimate general cognitive function scores were standardized and summed to attain an estimate of general cognitive functioning.

A. Test of Pre-morbid Functioning (TOPF). The TOPF provides an estimate of an individual's level of intellectual functioning before the onset of decline or illness. Participants were asked to read and pronounce a list of 70 words that have irregular grapheme-to-phoneme translation, testing was discontinued after 5 consecutive mispronounced words (Pearson, 2009).

B. Matrix Reasoning. The matrix reasoning subtest of WAIS-III includes four types of nonverbal reasoning tasks: pattern completion, classification, analogy, and serial reasoning (Wechsler, 1997) that measure visual processing, induction, visualization, visual-perceptual organization, reasoning ability, classification ability, ability to form analogies, attention to detail, concentration, spatial ability, and visual-perceptual discrimination (Sattler and Ryan, 2008).

Social Cognition. Two measures of the ability to correctly identify non-verbal expressions of affect were included as indicators of social cognitive functioning.

A. Diagnostic Analysis of Nonverbal Accuracy2 (DANVA2)-Facial Affect Recognition.

Participants were shown a series of facial photos presented for two seconds, after which the participant was asked to choose one of four descriptors (happy, sad, angry, or fearful). The total number of exposures was 24. The DANVA-2 has been demonstrated to have good reliability (Nowicki and Carton, 1993).

DANVA2-Adult Postures Test. Participants were shown 24 photographs of an equal number of happy, sad, angry and fearful emotions of high and low intensities in both standing and seated postures (Pitterman and Nowicki, 2002). To create posture stimuli, four adults posed in 50 predetermined posture combinations based on theoretical assumptions offered by Argyle (1975) for communicating affect and 16 supplementary postures. Each picture was presented for two seconds.

Table 1. *Sample Nutrition Questions*

Chili Brand A		**Chili Brand B**	
Nutrition Facts Serving Size 1 cup (236 g) Servings Per Container about 2		**Nutrition Facts** Serving Size 1 cup (236 g) Servings Per Container about 2	
Amount Per Serving		Amount Per Serving	
Calories 410	Calories from Fat 270	Calories 190	Calories from Fat 25
	% of Daily Values*		% of Daily Values*
Total Fat30g	48%	Total Fat 3g	5%
Saturated Fat 5g	20%	Saturated Fat1g	5%
Cholest. 75mg	25%	Cholest. 75mg	25%
Sodium 950mg	39%	Sodium 1250mg	52%
Total Carbohydrate 16g	5%	Total Carbohydrate 6g	5%
Dietary Fiber 4g	14%	Dietary Fiber 3g	14%
Sugars 3g		Sugars 3g	
Protein 20g		Protein 19g	
Vitamin A 26%	Vitamin C 0%	Vitamin A 25%	Vitamin C 0%
Calcium 4%	Iron 18%	Calcium 3%	Iron 25%
*Percent Daily Values are based on a 2,000 calorie diet		*Percent Daily Values are based on a 2,000 calorie diet	

Everyday Problem Solving. Scores were computed for seventeen questions about choices based on actual product nutrition labels, and insurance option tables adapted from the Medicare 2006 Information Booklet published by NIH and an Anthem Blue Cross/Blue Shield insurance information booklet. Questions were modeled after the format described by Allaire and Mariske (1999) and presented in the form of a series of questions of increasing complexity of choices related to nutritional labels on food items and between various insurance plans that varied in terms of deductibles, drug benefits, maximum benefits, and duration of coverage. Sample questions are presented in Tables 1 and 2. Total scores were based on the number of items answered correctly.

1. Miss Braum needs to avoid foods that are high in fat, sugar, saturated fat, and carbohydrates. Which can of chili would overall be best for her?

A____ or B _____

2. If she selects Brand B, which categories will she be eating more of compared to Brand A?

Table 2. *Companies that offer Medicare Part B and Medigap Plan C Coverage*

Plan A	**Plan B**	
Monthly Premium	Medicare Part B monthly	Medicare Part B
premium of $88.50 plus	monthly premium of $158.50	
plus $99 fee for	plus $109 annual fee	
the Medigap plan.	for the Medigap plan	
Inpatient Hospital Care	There is a $500 deductible for	There is a $600 deductible
for days 1 – 15 and $0	for days 1-10 and $0 for	
days 11-50.	days 16-150.	
Skilled Nursing	Days 1-20 pays $50 each day	Days 1-40 $95 pays each day
Days 21-100: pays $75	Days 21-100: pays $60	
Exclusions	Certain diagnostic tests are	Nearly all diagnostic tests
excluded from coverage	are covered	

14.Which plan has the best coverage for inpatient hospital care? Plan A___ or Plan B____

15. Which plan has the lowest deductible for inpatient hospital care but pays the least for days 21-60 of skilled nursing care? Plan A___ or Plan B____

16.Which plan has the lowest payout for the first 20 days of skilled nursing care and a higher deductible for inpatient hospital care for days 1-20? Plan A___ or Plan B___

17. Suppose that after you have paid your premiums for 18 months your doctor recommends that you go into the hospital for 3 days of diagnostic testing. The charges will be approximately$1,000 per day. Which plan would seem to offer the best financial bargain coverage for diagnostic tests, but less attractive coverage for one week of skilled nursing?

Plan A___ or Plan B___

3. Results

Mean scores for the older adults were: general cognitive ability (mean = 125.10 (SD. = 4.14), social cognition (mean = 46.37, SD = 11.65); practical problem solving (mean= 9.41, SD = 2.47), years of college (mean 5.39, SD 1.48). The correlations between years of education and general cognitive ability for older adults were (R^2 .74, p<.001), education and social cognition (R^2 .06, n.s.); and social cognition and general cognition (R^2 .15, n.s.). For college students' years of college (mean = 1.26, SD .64), general cognitive ability (mean=134.91, SD = 10.08), social cognition (mean = 43.70, *SD* = 7.85), practical problem solving (mean= 10.98, *SD* = 1.82). Correlations between general cognitive ability and social cognition (R^2 .19, p<.05); education and general cognitive ability (R^2 =.20, p< .05), and education and social cognition (R^2= .06, n.s.).

Multivariate analysis of variance with age and gender groups as fixed factors, and problem solving scores, social cognition ,and general cognitive total scores as dependent variables indicated multivariate effects for Age (F = 26.86, P<.001) and the Age by Gender interaction (F = 2.84, p<.05). Between subjects effects for age were observed for health information (F= 26.86, p<.001) and general cognitive ability (F= 64.64, p<.001), with college participants scoring higher on both measures. Age groups did not differ on social cognition scores. A between subjects age by gender group interaction was observed for social cognition (F= 5.89, p<.01), with college males scoring higher than females and older females scoring higher than older males (Table 3).

Table 3. *Multivariate Analysis Gender by Age Group Means*

2. Participant * Gender						
Dependent Variable	Participant	Gender	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Everyday Health Information	1 College	Male	10.871	.245	10.387	11.355
		Female	11.094	.241	10.618	11.570
	2 Older	Male	8.947	.443	8.073	9.821
		Female	9.744	.309	9.134	10.354
Social Cognition Total	1 College	Male	54.774	1.218	52.370	57.178
		Female	52.281	1.199	49.915	54.647
	2 Older	Male	53.158	2.201	48.815	57.500
		Female	58.385	1.536	55.354	61.416
General Cognitive Ability	1 College	Male	126.484	1.096	124.321	128.647
		Female	126.344	1.079	124.215	128.473
	2 Older	Male	116.526	1.980	112.619	120.434
		Female	113.282	1.382	110.555	116.009

Analysis of covariance with problem solving scores as the dependent variable, age and gender groups as fixed factors and general cognitive ability, education, and social cognition as covariates indicated effects for the covariates general cognition ($F=23.97$, $p<.001$), and social cognition ($F = 7.95$, $p<.01$), results for fixed factors were non significant.

Mean centered scores used for all continuous measures, and interaction terms were calculated for social cognition and general cognitive ability (education by general cognition; education by social cognition). Linear regression with practical problem solving total score as the dependent variable and social cognition, general cognition, gender, education, and age as independent variables (Adjusted R Square = .22, $p<.001$) indicated that general cognition (Beta = .30, $p<.001$) and social cognition (Beta = .17, $p<.01$) were independent predictors of problem solving. A separate regression equation run for college age participants with practical problem solving as the dependent measure and general cognition, social cognition, education and gender as predictors (Adjusted R Square .11, $p<.001$) indicated that general cognition was the sole predictor of problem solving (Beta = .36, $p<.001$). Replacing the mean corrected social cognition and general cognition scores with interaction terms (education by general cognition and education by social cognition) did not significantly change the results (Adjust R Square .09); education by general cognition (Beta .27, $p<.01$). The same regression equation run for older adults (Adjusted R Square .12, $p<.05$), indicated that social cognition (Beta = .28, $p<.05$) was the sole predictor of problem solving for this group. Replacing the general cognition and social cognition scores with interaction terms (Adjusted R square = .26, $p<.001$) indicated that both education by general cognitive ability (Beta .42, $p<.001$) and education by social cognition (Beta .25, $p<.05$) were independent predictors of practical problem solving for older adults.

4. Discussion

This was a study of the contributions of general cognitive ability and social cognition to practical problem solving ability among older and college age adults. Two widely used sub-tests were used to estimate general cognitive ability, and social cognitive ability was estimated using DANVA-2 measures of both facial and postural non-verbal affect recognition. Results indicated that college age participants scored higher than older adults on general cognitive ability, and were more accurate in solving practical problems related to questions about nutritional labels and health insurance options. Consistent with previous research (Staudinger, Smith, and Baltes (1992) older adults performed as well as college-age adults on the measure of social cognition involving accuracy of recognition of non-verbal expressions of affect, with an age by gender interaction. College males scored higher than females and older females scoring higher than males on accuracy of affect recognition.

Separate regression equations for college age and older adults indicated that contributors to practical problem solving ability differed between the two groups. College students' problem solving ability was based solely on general cognitive ability. Older adults' practical problem solving was independently related to both social cognitive and general cognitive ability These results are consistent with the report of Happe, Winner, and Brownell (1998) that older adults' may compensate for reduced cognitive processing abilities by increased reliance on specific

experiences and social cognitive processes. Finucane, Slovic, Hibbard, Peters, Mertz, and MacGregor (2002) reported that young and older adults may rely on different strategies to evaluate and make decisions. Results indicate that social cognitive ability functions independently of general cognitive ability, as a contributor to practical problem solving effectiveness among older adults. It may be that social cognitive skills operate as both causes and consequences of relevant lifestyle factors related to awareness of contextual cues and ongoing patterns of mental stimulation that contribute to maintenance of practical problem solving ability.

There are several limitations to the results of this study. First, the older adult participants were recruited from an "elder-college" and a retirement community, all were college educated. As such, participants were more likely to be financially secure and intellectually active than average. college sample was limited. An additional limitation was related to use of a non-standardized measure of practical problem solving, use of estimates of general cognitive ability rather than a complete intellectual assessment. Finally, social cognition remains a somewhat amorphous construct that has been assessed using many different instruments, use of the two DANVA-2 measures of affect recognition is only one aspect of this broad and somewhat poorly defined construct.

3. Conclusions

Older adults are able to engage in successful practical problem solving despite age related declines in cognitive processes. Results indicate that in contrast to college age adults, older individuals utilize combinations of analytic, social cognitive and domain relevant experience based knowledge. In this study college age participants' problem solving was associated with general cognitive ability, where as older adults problem solving was independently associated with both general cognitive ability and an indicator of social cognition, i.e., the ability to correctly identify non-verbal expressions of emotions.

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