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OLDER ADULTS' PERFORMANCE ON INSTRUMENTAL ACTIVITIES OF DAILY LIVING (IADLS) AND MENTAL ABILITIES

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Figure 1

The purpose of this presentation, like others in this symposium, is to examine the relationship between traditional psychometric measures of intelligence and measures of practical intelligence or everyday problem solving.

Commonly agreed upon criterion tasks for the assessment of real-life competence have not yet been systematically developed by researchers in this area.

Figure 2

In defining a set of relevant everyday problem-solving situations, we have chosen to use Lawton & Brody's (1969) notion of the Instrumental Activities of Daily Living (IADLs) to guide our selection of everyday problem-solving tasks. The figure shows the 8 categories of everyday activities identified by Lawton & Brody. Research has suggested that declining ability to perform IADLs is associated with increasing service use, institutionalization, and mortality. Thus, the IADLS were chosen as a task selection criterion because of their wide acceptance as a method of assessing older adults' functional competence to live independently in the community. We see "practical intelligence" as the set of cognitive skills contributing to the maintenance of functional independence in the community.

The present research is also guided by an hierarchical view of the relationship between these two kinds of intellectual assessment. Traditional, abstract measures of intelligence are seen as markers of basic and universal

cognitive abilities ("genotypes") which underly more complex cognitive performances in the real world ("phenotypes"). Everyday task performance is seen as the hierarchical integration of the underlying primary mental abilities into complex behaviors designed to meet the demands of daily life. Ultimately, everyday task performance is probably the multiply-determined outcome of the individuals' cognitive, affective, social and physical capabilities, but for the present purposes we are attempting to explore the relationship between the underlying cognitive components and real-life task performance.

Building upon prior empirical and theoretical work, we expect to find a significant relationship between traditional intellectual competencies and performance on tasks of daily living. What should we expect the nature of that relationship be? Several studies, including those by Camp et al. (1989), Cornelius & Caspi (1987), & Willis & Schaie (1986) have found that there is a significant relationship between both traditional fluid and crystallized measures of intelligence, and several diverse attempts to measure "everyday" adult cognition. The magnitude of that relationship has varied greatly from study to study (from a low correlation of 0.26 in the Cornelius & Caspi study, to a high of over 0.80 in the Willis & Schaie study).

Figure 3

The present study attempted to further examine the relationship between traditional measures of adult intelligence and two methods of assessing everyday intelligence. First, we sought to investigate the relationship between 7 primary mental ability factors and the Everyday Problems Test (EPT).

The EPI is a paper-and-pencil measure of older adults' comprehension of everyday printed materials which fall in the IADL domains. Second, we sought to investigate the relationship between traditional intellectual ability factors and observational assessments of older adults' ability to perform selected tasks of daily living.

Subjects

Before examining the main study questions, we briefly consider the sample. The subjects were 202 older adults who resided in a life care community in southern Florida. The subjects included 136 females, and 66 males, and were somewhat educationally advantaged, with a mean of 15 years of schooling. The participants had a mean age of 77.8, ranging from 66 to 93 years of age. All of the participants were Caucasian. The majority of the subjects reported their health, hearing, and vision to be good to very good.

Measures

Figure 4

Three broad categories of measures were considered in this study. The first category included traditional psychometric measures of intelligence; the second category included paper-and-pencil measures of the ability to comprehend everyday printed materials. In the third component of the study, a subsample of 62 individuals participated a study in which their actual performance on everyday problems from 3 selected IADL domains was assessed via behavioral observation. We consider each of these measurement categories in more detail:

1. Traditional measures of intelligence

At least two measures of each of 7 primary mental abilities were administered to the older adults. The measures were administered under standardized, speeded conditions; some measures were adapted for use with older adults, by reducing the number of test stimuli or enlarging the size of the stimuli on the printed page. Details of the specific measures used can be provided later; at the moment we will summarize the seven primary mental ability factors represented in our data.

This factor structure was confirmed using LISREL VI (Joreskog & Sorbom, 1984) and was found to fit well; the analyses we will report using intellectual ability data use standardized factor scores derived from this analysis. Briefly, the seven ability factors included were:

Verbal ability, which was assessed using measures of recognition vocabulary.

Inductive reasoning, measures of which required subjects to identify patterns in novel arrays of letters, digits and words,

Figural relations, which was assessed by presenting subjects with patterns of abstract figural stimuli and asking them to identify those patterns,

Spatial Orientation, measures of which presented subjects with sequences of two dimensional figural stimuli and asked them to identify similarities and differences among figures which varied in their orientation on a 360^0 plane.

Memory span, which assessed the number of words or digits subjects could hold in active memory,

Perceptual speed, which examined the speed with which subjects could make simple visual discriminations among figural and digital stimuli,

Number addition, which examined the speed with which subjects could correctly sum two- and three-digit numbers.

Traditional analyses of these abilities, confirmed by our own second-order factor analysis, suggest that Verbal ability is a measure of crystallized intelligence, while Inductive Reasoning, Figural Relations, and Spatial Orientation are measures of fluid intelligence.

2. Everyday Problems Test (EPT). The EPT was designed for this study, and it is a paper-and-pencil, untimed measure that was administered to all subjects. Stimuli for the test were printed materials actually selected from the everyday world; none were specifically created for this study. In addition to falling within seven IADL domains, as illustrated in the figure, selected stimuli had to be age-relevant. As an example, health related stimuli did not include instructions for how to prepare baby formula, but did include instructions for the use of cough medicine and denture cleaner. The next two figures present two sample EPT stimuli.

Figure 5 followed by Figure 6

The analyses we present today are based on a total of 42 everyday printed stimuli, 6 representing each IADL domain. For each stimulus, subjects were presented with two comprehension questions. Questions required subjects either to find an answer in the printed stimulus, or to perform an operation on the information in the printed stimulus to derive an answer. Confirmatory factor analyses conducted on these items revealed that the EPT did, in fact, represent 7 highly-related IADL domains.

3. Observed tasks of daily living. 62 of the 202 older adults in this study were visited in their homes and were observed performing tasks of daily living.

Figure 7

The observational tasks developed by our coauthor, Manfred Diehl (1991), fell in 3 IADL domains (Food preparation, Medication use, and Telephone Use), and included sample problems like, following box instructions to make a microwave cake mix, setting a microwave timer, loading a pill reminder device, looking up and dialing a business phone number, and checking an itemized phone bill. Subjects received real everyday stimuli (i.e., an actual box of cake mix, an actual box of cereal), and were asked to produce a series of observable behaviors to solve a problem. Subjects were also asked to verbalize their problem-solving process. Thus, both observed physical components of the problem-solving situation and the conscious mental operations were recorded.

Comparing the two ways of assessing everyday task performance, results from confirmatory factor analyses provided evidence that the observational and paper-and-pencil measurement approaches were assessing the same latent constructs. In addition, a second confirmatory analysis showed that the two assessment strategies yielded distinct method factors, and represented non-identical aspects of task performance involving everyday printed materials.

Results

The analyses we report today considered our two main questions. First, we examined the relationship between traditional intellectual ability measures and our paper-and-pencil EPT measure of practical intelligence. Second, we examined the relationship between the observational tasks of daily living and our traditional intellectual ability measures.

Relationships between traditional intelligence measures and EPI.

This relationship was assessed in two ways. First, a multiple regression analysis was conducted to examine the relationship between the seven psychometric ability factors and the total EPI score, summed across all 84 items. Second, multiple regression analyses were conducted to examine the relative salience of each of the seven ability factors for the prediction of EPT performance on each of the 7 IADL domains contained in the EPI

Table 1

Table 1 presents the reduced-model multiple regressions of the total EPI score onto the 7-ability factor scores. Reduced model regressions present only the significant predictors which emerged in each model. The pattern of results is similar to that obtained by Willis & Schaie in 1986, with the ETS Test of Basic Skills as a measure of "practical intelligence": measures of fluid and crystallized intelligence have principal salience for the prediction of performance on the EPI. Interestingly, only fluid and crystallized predictors reached significance; Memory, Speed and Addition did not account for significant additional variance in these models.

Table 2

Turning to Table 2, we examine the reduced model multiple regressions in which the ability factors are used as predictors of each of the 7 scales from the EPI. In general, with the exception of the Health and Shopping scales, the largest standardized regression weights were obtained for the Figural Relations factor, which is a relatively "pure" marker of fluid intelligence. Verbal ability, commonly taken as a marker of crystallized intelligence, was a significant predictor of each of the IADL scales. Inductive Reasoning and Spatial Orientation, other fluid intelligence factors, were significant predictors of subjects' performance on 4 of the 7 IADL domains. Since these

two predictors were highly correlated with Figural Relations, it is not surprising that they they account for little additional variance. Finally, there is a relatively small beta weight for the Memory Span factor on two IADL scales--Telephone Use and Housekeeping/Laundry. It is not surprising that memory span is not a major predictor of EPI performance, since subjects were allowed to look at the printed stimuli while answering questions, thus reducing the memory load.

Relationships between traditional intelligence measures and observational tasks.

An analogous procedure was used to assess the relationship between observational task performance and intellectual ability in the reduced sample of 62 individuals who participated in the observational substudy. First, we examined the regression of the total observational score, summed across the three task domains, on the ability predictors. Then, we examined the ability predictors separately for each OTDL scale. Table 3 summarizes these regression results.

Table 3

Performance on each of the three observational task domains, as well as their summed total, was predicted by each of the 7 ability factor scores. As the reduced models in Table 3 show, for each of these analyses, only the Figural Relations factor score reached the .05 criterion of statistical significance. In general, the R^2 values for these models are slightly less than the values obtained for the EPI with the larger sample.

Conclusions

Summarizing our findings, we have found that there is a substantial relationship between traditional intellectual ability measures and our more

recent measures of everyday problem solving. First, we found that there were relatively strong relationships between the primary mental abilities and the EPI, our paper-and-pencil assessment of older adults' comprehension of everyday printed materials. The intellectual abilities accounted for 65% of the variance in the total measure, and for 35 to 51% of the variance in the individual subscales of the measure. Second, we found that intellectual abilities are predictive of everyday task performance, even as we move away from the shared method variance of paper-and-pencil assessments. In fact, there are strikingly few differences in the patterns of relationships of our intellectual ability measures with either paper-and-pencil or observational assessments of everyday task performance. The abilities account for 44% of the variance in the total observational task score, and for between 20 and 36% of the variance in the observational task domains. Fluid intelligence (specifically Figural Relations) emerged as the best predictor of both our methods of assessing everyday tasks, although the crystallized predictor of Verbal ability was a significant predictor of each of our 7 EPI scales.

These findings imply that traditional intellectual abilities are an important component of the ability to deal with everyday printed materials. This argues against theoretical notions of practical and traditional psychometric forms of intelligence as distinct constructs. It further suggests that we can use our understanding of the developmental course of traditional intellectual abilities to help understand the developmental trajectory of everyday problem solving.

At the same time, we acknowledge that there are a number of unanswered questions. Is crystallized intelligence less related to our measures of everyday task performance because of the way we have measured crystallized

intelligence? Traditional psychometric approaches to the measurement of crystallized intelligence use measures of verbal knowledge; but one might argue other domain-specific knowledge bases might be more related to everyday task performance.

We must also ask why memory span has shown little relationship to our measures of everyday problem solving. Several answers suggest themselves. First, we reduced the memory load on subjects by allowing them to look at the printed stimuli while answering questions about them. Second, our measure of memory span is an absolute capacity measure (the number of pieces of information subjects can hold in short-term memory), and does not, theoretically, assess individuals' working memory. Finally, recent work by Salthouse (eg., 1991) suggests that memory and speed may be components underlying even fluid and crystallized intelligence performance, and may exert their effects on everyday cognition indirectly through these abilities.

Do the relationships found in these data hold for the universe of everyday problem-solving tasks? Our sample of tasks is limited to performance on everyday printed materials falling within 7 domains. In choosing such tasks, we have minimized the socio-affective content of our everyday problems, and our paper-and-pencil measure shares many features in common with traditional intelligence measures (minimal ambiguity of the problem; one correct solution to the problem). At the same time, it must be noted that the observational tasks in this study did have a higher socio-affective component (they involved one-on-one interaction with an experimenter), and there was actually a continuum of correctness, rather than a simple right-wrong answer. Yet, as noted, the pattern of relationships between these observational tasks and intellectual abilities was very similar to those found with our paper-and-

pencil measure. To us, this implies that traditional measures of intelligence may reflect abilities underlying a fairly broad array of everyday tasks.

Finally, the question can be asked: what have these results told us about the role of traditional intellectual abilities in everyday functional competence, or the ability to maintain independence? Ultimately, the question requires longitudinal research, as we follow-up individuals tested with our measures of "practical" and "traditional" intelligence. How are individuals' trajectories of independence and functional competence predicted by our measures? Based on today's results, we hypothesize that individuals' intellectual competence may be an important component of their ability to maintain functional independence.

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Figure 1.

Instrumental Activities of Daily Living (Lawton & Brody, 1969):

- Food Preparation
- Medication Use
- Telephone Use
- Shopping
- Financial Management
- Housekeeping
- Laundry
- Transportation

Figure 2.

MAJOR ISSUES

1. To investigate the relationship between 7 primary mental ability factors and the Everyday Problems Test (EPT). The EPT is a paper-and-pencil measure of older adults' comprehension of everyday printed materials which fall in the IADL domains.

2. To investigate the relationship between traditional intellectual ability factors and observational assessments of older adults' performance on selected tasks of daily living.

Figure 3.

MEASURES

Primary Mental Abilities
- > Verbal Ability
- > Figural Relations
- > Spatial Orientation
- > Inductive Reasoning
- > Memory Span
- > Perceptual Speed
- > Addition

Everyday Problems Test
- > Food Preparation
- > Health and Medication Use
- > Telephone Use
- > Shopping and Consumerism
- > Financial Management
- > Housekeeping and Laundry
- > Transportation

Observational Tasks of Daily Living (N = 62)
- > Food Preparation
- > Medication Use
- > Telephone Use

Figure 4.

Directions: Use of Cough Medicine

Indications: Temporarily Relieves Cough Due to Minor Throat and Bronchial Irritation as May Occur with a Cold.

DIRECTIONS: Follow dosage below:
Do Not Exceed 4 Doses in a 24-Hour Period.

ADULT DOSE (and children 12 years and over): 2 teaspoonfuls every 6 to 8 hrs.

CHILD DOSE
6 yrs. to under 12 yrs.
1 teaspoonful every 6 to 8 hrs.
2 yrs. to under 6 yrs.
1/2 teaspoonful every 6 to 8 hrs.
Under 2—Consult Your Doctor.

Warnings—A persistent cough may be a sign of a serious condition. If cough persists for more than 1 week, tends to recur, or is accompanied by fever, rash, or persistent headache, consult a doctor. Do not take this product for persistent or chronic cough such as occurs with smoking, asthma, emphysema, or if cough is accompanied by excessive phlegm (mucus) unless directed by a doctor.

3. What is the maximum number of teaspoons you should take in 24 hours?

_____

_____

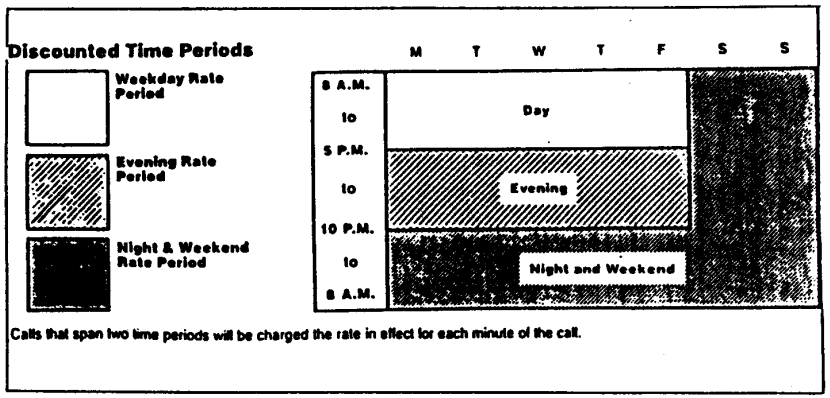
4. Mr. Jones smokes and has a smoker's cough. What is the maximum number of doses he should take per day?

_____

_____

Figure 5.

Charts: Telephone Discounted Time Periods



61. Your son and daughter live in the same city out-of-state. You call your daughter at 11:37 a.m. on Saturday. You call your son at 9:30 p.m. on Wednesday. Both calls last 5 minutes. Which call is cheaper?

_____

_____

62. If your call begins at 4:57 p.m. on Monday, and lasts for 7 minutes, what is/are the applicable rate(s) for your call?

_____

_____

Figure 6.

Observed Tasks of Daily Living: IADL Domains represented and sample tasks.

Domain 1: Food Preparation

Sample Tasks:

> Setting the Timer of a Microwave Oven

> Mixing a Cake Mix

> Comparing Nutritional Information of Two Different Cereals

Domain 2: Medication Use

Sample Tasks:

> Comprehending Information of Medicine Bottle Label

> Loading a Pill Reminder

> Filling out a Patient Record

Domain 3: Telephone Use

Sample Tasks:

> Dialing a Business Phone Number

> Activating Call Forward

> Checking Itemized Calls on a Phone Bill

Subjects received a total of 9 Food Preparation Tasks, 13 Medication Use Tasks, and 9 Phone Use Tasks.

Figure 7.

Table 1. Summary of reduced-model multiple regressions: Intellectual ability predictors of total EPT performance (N = 202).

Dependent variable:

Everyday Problems Test (84 items)

Ability Predictors	Standard. B-Weight	Model R2
Figural Rel.	0.37***	
Verbal	0.31***	
Spatial Or.	0.14*	
Inductive Reas.	0.15*	0.65

* $p < .05$

*** $p < .001$

Table 2. Summary of reduced-model multiple regressions: Intellectual ability predictors of EPT-IADL scale performance (N = 202).

IADL Domain	Ability Predictors	Standard. B-weight	Model R^2
Food prep.	Figural Rel.	0.38	
	Verbal	0.19	
	Spatial Or.	0.17	0.38
Medication	Verbal	0.39	
	Figural Rel.	0.29	
	Spatial Or.	0.17	0.48
Phone Use	Figural Rel.	0.41	
	Memory Span	0.16	
	Verbal	0.17	0.39
Shopping	Verbal	0.34	
	Inductive Reas.	0.33	0.35
Finance	Figural Rel.	0.33	
	Verbal	0.25	
	Inductive Reas.	0.24	0.51
Household/ Laundry	Figural Rel.	0.30	
	Verbal	0.28	
	Memory Span	0.19	0.40
Transport.	Figural Rel.	0.46	
	Verbal	0.28	0.44

Table 3. Summary of reduced-model multiple regressions: Intellectual ability predictors of OTDL scale performance (N = 62).

IADL Domain	Ability Predictors	Standard. B-weight	Model R^2
Total score	Figural Rel.	0.66	0.44
Food prep.	Figural Rel.	0.31	0.27
Medication	Figural Rel.	0.30	0.36
Phone Use	Figural Rel.	0.27	0.20

Note: All beta-weights significant at $p < .05$.