Relationship of Psychometric Ability and Cognitive Function

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OH 1: Title Page and Co-Authors

Good Afternoon. I would like to acknowledge my co-authors and the two agencies funding the ACTIVE Trial, the National Institute on Aging and the National Institute of Nursing Research. [I would also like to acknowledge the indirect contribution of our Discussant Paul Baltes to the conceptual framework for the type of intervention research I will be presenting today. In prior cognitive intervention work at PSU and in Berlin Paul has been contributed significantly to developing theoretical frameworks for cognitive outcomes of interventions.

OH 2: Quote from Request for Application for Cooperative Trial

The RFA announcing this trial provides information on the basic design and measurement framework for the study. "the common intervention should involve training of basic abilities or skills... but the study should not intervene directly on the outcome variables." In addition, " the trial should focus on a class of outcomes measures that are basic to living independently, have a strong cognitive component.... These significant everyday tasks include but are not limited to: Communication via the telephone, remembering key events and activities, financial planning."

OH 3: Schema for ACTIVE study outcomes

These guidelines have resulted in the development of three broad classes of outcomes. The first class which we call "proximal" or "training-specific" outcomes, are measures of the trained abilities. They allow us to assess training effectiveness directly. The ACTIVE trial involves three interventions focusing on: Memory, Reasoning, and Speed of Processing.

Given our commitment to assessment of outcomes with multiple measures, each of the abilities trained is represented by two or more markers.

The next level of outcome is denoted as "primary" outcomes and refers to the functional status outcomes in this trial. According to the RFA a primary goal of the trial is to assess whether basic ability training can influence levels of everyday functioning and rates of functional decline in a population of elders. Hence, there are an extensive array of measures of primary outcome.

The third class of intervention outcomes are denoted as "secondary" outcomes and reflect health status, perceived health, health service utilization, institutionalization, and mortality.

Several of the presentations in this symposium will focus largely on issues related to the primary functioning outcome measures. This presentation will discuss the relationship between proximal outcome measures, that is measures of the abilities to be trained and one of the primary outcome measures, namely the EPT. Presentations by Dr. Ball and Dr. Marsiske will deal with factors associated with other measures of primary outcomes. The presentation by Dr. Morris will deal in part with the "secondary" outcome measures.

OH 4: Overview of Proximal and Primary (Functional) Outcome Measures

The next figure presents an overview of proximal and primary outcome measures in greater detail. The proximal measures for each of the 3 interventions are listed in the top of the table. The primary functional outcomes are listed below. In general, our selection of primary outcomes is

based on the domains of activities represented in the Instrumental Activities of Daily Living (IADLs; Lawton & Brody, 1969) which are considered critical for the maintenance of independent living in our society.

OH 5: Everyday Problems Test

This presentation focuses on one of the cognitive primary outcome measures, namely the Everyday Problems Test (EPT) and its relationship to several of the ability measures (Proximal outcomes). The aim of the EPT is to assess problem solving ability in the context of cognitively demanding IADL tasks. For the ACTIVE trial, a 28-item short form was developed to assess problem solving with respect to each of the IADL domains. The ACTIVE EPT version has shown acceptable reliability and stability characteristics.

The EPT has been shown to be significantly related to self- and proxy ratings of the Lawton & Brody (1969) IADL domains. The EPT has also found to be significantly related to the OTDL, another ACTIVE primary outcome measure in which the elderly are required to perform simulated IADL tasks. The EPT has been shown to represent tasks rated as important and common across ethnic and geographic group. We are especially pleased to report that there are two poster sessions on Monday morning dealing with the EPT and African American elderly populations, presented by Dr. Keith Whitfield and colleagues including Tamara Baker-Thomas who is a research trainee on the ACTIVE project at PSU.

OH 6: Exemplar of Everyday Problems Test

The next overhead presents one stimuli from the EPT -- a medication label. The protocol for the EPT involves the elder being shown a stimuli, such as a taxi rate schedule, a medication label, or a listing of emergency phone numbers. The elder is required to solve two problems which can be answered based on the information contained in the stimuli, and to write the answer on the test form. The measure is unspeeded. The score is the number of correct responses.

OH 7: ACTIVE Pilot Sample

The data to be reported come from the baseline data of the pilot sample for the ACTIVE project. In the pilot 170 elders were randomized into the study. The mean age was 75 years (SD = 6.2; Range 65 - 93 years). The sample was primarily female and approximately one-quarter of the sample were married. A wide range of educational levels is represented with approximately one-third of the sample having less than a high school education, one-third having 12 years of education and one-third having some post secondary education. Over half of the sample was African American.

OH 8: Correlation of Proximal Outcome Ability Measures and EPT

The next table shows the correlation of the ability measures and the demographic variables with the EPT. All of the ability measures, Word Series, Vocabulary, Useful Field of View and the Auditory Verbal Learning Test were significantly correlated with the EPT. The Useful Field of View shows a negative correlation since it measures speed of processing or latency. Education was also significantly correlated with the EPT.

Path analysis was used to examine a structural model of relations among the person variables, basic abilities, and the EPT. A recursive model in which all exogenous variables were predictors of all mediating variables and the criterion variable was examined; all cognitive abilities were specified to be predictors of the EPT. The fit of this model was χ^2 (6) = 83.41; RMSEA = 0.29; CFI = .81. This model had a number of nonsignificant paths ($p > .05$).

OH 9: Path Analysis Model

A reduced model retaining the statistically significant paths was estimated and is shown in the next figure [χ^2 (11) = 87.006; RMSEA = 0.21; CFI = .81. This model was not significantly worse than that of the first recursive model. As shown in the figure, the only exogenous variable having a significant direct effect on the EPT was education. This effect was positive indicating that those with higher education performed better on the EPT. Education also had an indirect effect on the EPT through each of the four cognitive abilities. The path from education to the UFOV is negative given that the UFOV measures latency.

Age had only an indirect effect on the EPT through the cognitive abilities. With respect to three of the cognitive abilities, Word Series, UFOV and the Auditory Verbal Learning Test older people did less well on the EPT. However, the positive path from age to Vocabulary indicates that older adults did better on this measure of verbal ability.

The indirect effect of age was less than that for education for three of the cognitive abilities, Word Series, Vocabulary, and the Auditory Verbal Learning Test. The indirect effect of age and education were comparable with respect to the UFOV. Gender showed an indirect effect on the EPT only through the AVLT, indicating that women performed better on the AVLT than men.

All of the cognitive abilities had significant direct effects on the EPT. Word Series representing Inductive Reasoning and Vocabulary representing Verbal ability had more salient direct effects on the EPT than did the UFOV and AVLT.

OH 10: Direct, Indirect, and Total Effects

The next table presents the direct, indirect, and total effects of the exogenous and mediating variables on the criterion. Education has the largest total effect. The largest direct effect was for Word Series.

In summary, the effect of the person variables of age and gender were indirect and were mediated through their effects on the cognitive abilities. In contrast, education had both significant indirect and direct effects on the EPT. Approximately two-thirds of the impact of education was indirect, mediated through the cognitive abilities. The strong association between education and the abilities and also with the EPT has been found in prior research with expanded versions of the EPT. The EPT requires many of the skills such as reading ability, computational skills, and reasoning that have been found in prior research to be associated with education. The impact of gender on measures of memory indicating that women perform at a higher

level on memory tests than men has also been reported in prior research (Hultsch, 1997; Schaie, 1997).

The significant direct effects of all four abilities on the EPT supports prior findings in that performance on the EPT involves multiple abilities, including reasoning, verbal, and memory ability. Performance of complex tasks of daily living such as sampled on the EPT are multidimensional and cannot be construed as having a simple one-to-one relationship with any single primary ability. At the same time the magnitude of effect of the cognitive abilities on the EPT does vary with Word Series representing Fluid Intelligence and Vocabulary representing Crystallized Intelligence showing more salient effects than for the more basic abilities of speed of processing and verbal memory.

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.

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

_____

_____ ☐

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

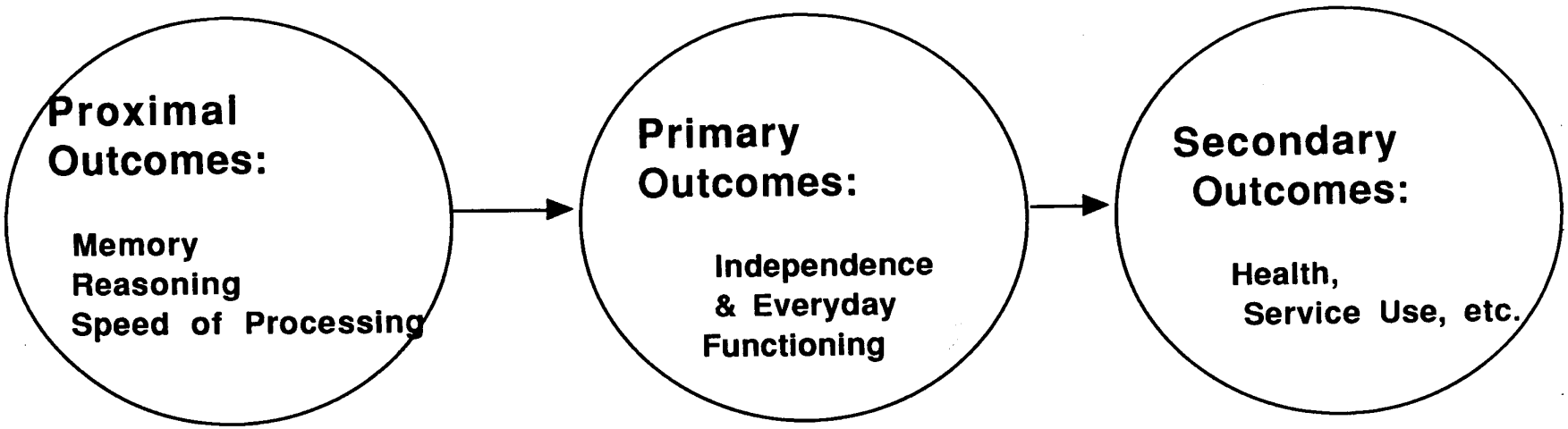
_____

_____ ☐

"The common intervention should involve training of basic abilities or skills ... thus the study should not intervene directly on the outcome variables."

"the trial should focus on a class of outcome measures that are basic to living independently, have a strong cognitive component, and whose decline has been associated with loss of independence. These significant everyday tasks include but are not limited to: Communicating via the telephone, remembering key events and activities, financial planning."

ACTIVE: Three Levels of Outcome



Overview of Proximal and Primary Outcomes in ACTIVE

Proximal Outcomes

Memory

Auditory Verbal Learning Test (AVLT)
Hopkins Verbal Learning Test (HVLT)
Rivermead Paragraph Recall

Reasoning

Word Series
Letter Series
Letter Sets

Speed of Processing

Useful Field of View
Complex Reaction Time
Digit Symbol Substitution

Primary Outcomes

Everyday Problems Test (EPT)
Observed Tasks of Daily Living (OTDL)
Timed IADL
Driving/Life Space/Falls

MDS IADL Performance
MDS IADL Capacity

Everyday Problems Test (EPT)
(Willis & Marsiske, 1993)

Aim: **Assessment of problem solving ability in context of cognitively demanding IADL-type tasks**

Description:

- **28-item short form**
- **Significantly related to self- and proxy-IADL ratings**
- **Significantly related to performance-based IADL measures - OTDL**
- **Studied in African American samples**

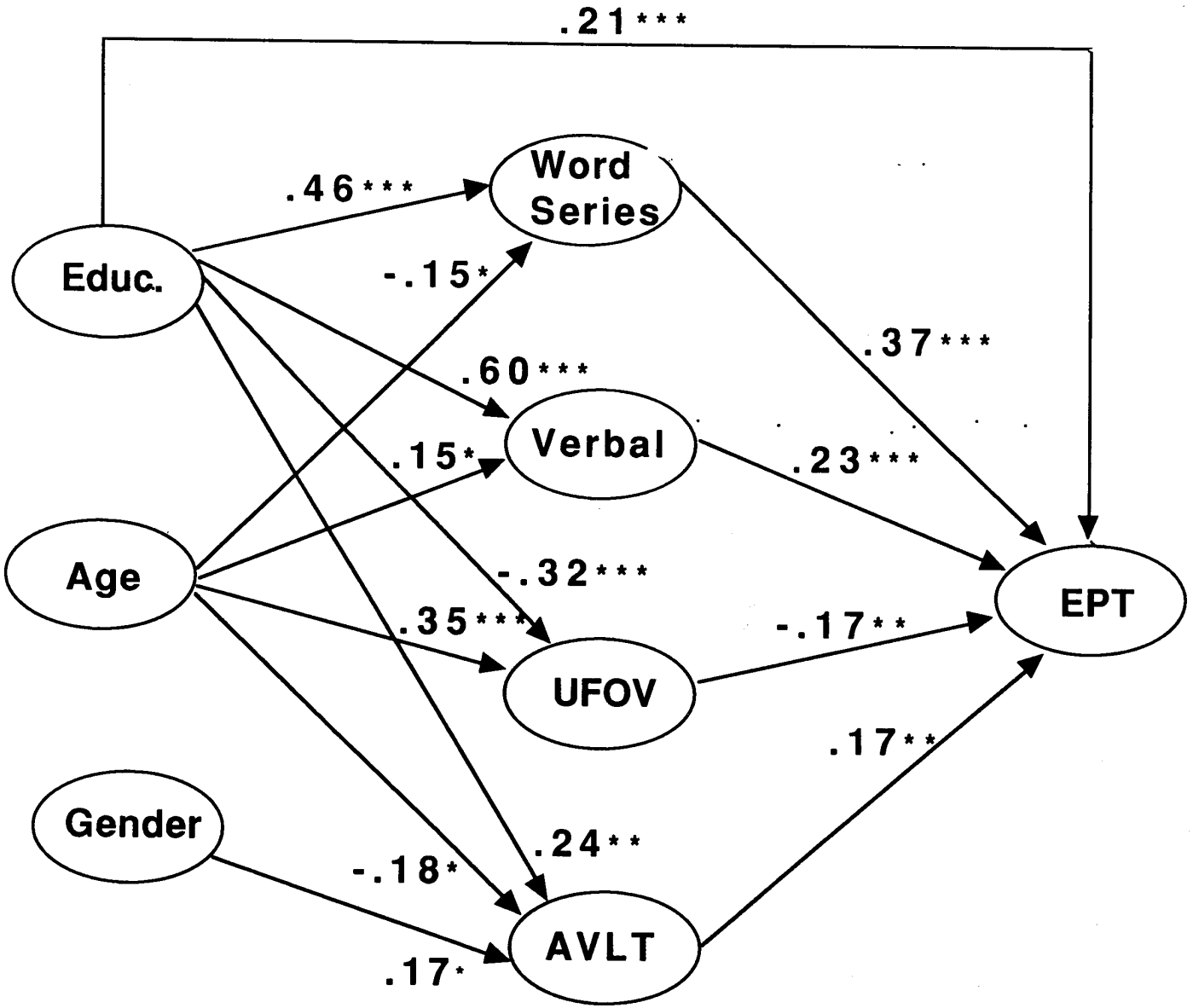
Pilot Sample Characteristics

Ramdomized (n = 170)

	%	Mean	Range
Age		74.2	65 - 89
Gender: Female	82.9		
Married	25.4		
Education: < 12 yrs	31.8		
12 yrs	32.3		
> 12 yrs	35.9		
Race: AA	55.9		

Relationship of EPT and Selected Cognitive Abilities

	EPT
Word Series	.69
UFOV	- .47
Vocabulary	.64
AVLT	.50
Age	-.20
Education	.63
Gender	.00


.21***
Word Series
.46***
Educ.
-.15*
.37***
.60***
Verbal
.15*
.23***
Age
-.32***
EPT
.35***
-.17**
UFOV
.17**
Gender
.24**
-.18*
AVLT
.17*

Direct, Indirect, and Total Effects
of Person and Cognitive Variables
on Older Adults Performance on EPT

Predictor Variable	Direct Effect	Indirect Effect	Total Effect
Age	.00	-.11*	-.11*
Education	.21**	.40***	.61***
Gender	.00	.03	.03
Word Series	.37***	.00	.37***
Vocabulary	.23***	.00	.23***
Useful Field of View	-.17**	.00	-.17**
Auditory Verbal Learning	.17**	.00	.17**

Summary

1. The effect of the person variables of age and gender were indirect and were mediated through their influence on the cognitive abilities.

2. In contrast, education had both significant indirect and direct effects on the EPT. Approximately two-thirds of the impact of education was indirect, mediated through the cognitive abilities.

3. The impact of gender on measures of memory indicating that women perform at a higher level on memory tests than men has also been reported in prior research

4. The significant direct effects of all four abilities on the EPT supports prior findings that performance on the EPT involves multiple abilities. The magnitude of effect does vary with Word Series representing Fluid Intelligence and Vocabulary representing Crystallized Intelligence showing more salient effects.