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SEMIANNUAL TECHNICAL REPORT FOR THE PROJECT
PSYCHOMETRIC DEVELOPMENTS RELATED TO
TESTS AND SELECTION

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Project Summary

Recent theoretical developments in the areas of latent variable modeling, random coefficient modeling, multilevel modeling, missing data theory, and empirical Bayes estimation provide interesting research opportunities for the psychometric modeling of the relationship between job performance and test performance. These developments suggest new approaches to the assessment of predictive validity of tests as well as to problems of selection and assignment. The purpose of the project is to use these theories as a basis for developing new psychometric methods that have the potential for better understanding the predictive validity of tests like the ASVAB and improving the selection and assignment of recruits for military jobs.

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Progress to Date

The project started 5/01/93. This starting date is about one year later than what was proposed, the reason being lack of ONR-MPT funding. According to the proposal, Jin-Wen Yang Hsu was to work with the PI as research associate given her previous experience with selection modeling in a predictive validity context. At this late date, however, she was no longer available but moved to Miami to start an assistant professorship. This change has, however, not hampered the work in that an excellent new Ph.D., Guanghan Liu, was hired in June after he received his Ph.D. in Statistics from the Mathematics Department at UCLA. Dr. Liu had the opportunity to learn relevant techniques from Dr. Yang Hsu before she left UCLA.

Project activities in three areas will be reported: gaining access to suitable U.S. military data, understanding predictive validity from a latent variable perspective, and Monte Carlo studies of a conventional method for assessing predictive strength. These activities are in line with the original research proposal.

Gaining access to U.S. military data

As discussed in the research proposal, it is clear that analyses of U.S. military data relevant to assessing predictive validity of the ASVAB are valuable both to illustrate the proposed methodology in the project and to determine which further methodology development was needed. As soon as the project started, I therefore discussed data issues with the contacts I had: Laurie Wise at DMDC, Anne Mavor at NAS/NRC, Jane Arabian at the

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Pentagon, and John Wolfe at NPRDC. It may be of interest to report on a summary of the process for trying to get data.

As a member of the NRC committee on Military Enlistment Standards, I had learned about HumRRO's work on the Linkage Project using the JPM hands-on job performance measures. I thought it would be valuable to be able to use these data to enable future comparisons of their linkage equation with the prediction equation my project would give. This led to a specific interest in the Army's Project A data and the nine Batch A MOS jobs, although data from all services would be valuable. I contacted Anne Mavor at NRC to be able to gain access to the Project A data via HumRRO, but further discussions with Army representatives indicated that it would be better to obtain the data via them. Jane Arabian discussed my interest in data at the July 1993 meeting with the Manpower Accession Policy Working Group. It became clear that it would be easiest to gain access to data from Project A, while data collected by the other services may take longer to access, mainly because some data sets were still being analyzed (such as the ECAT data) and not fully explored by the originators of the data. In terms of the Project A data, I would only be given access to the Concurrent Validity data at this point, not the more interesting data from the Longitudinal Validity Study. I tried to reach Major Jim Thomas about data access and was referred to Mr. Ron Patsy at the Headquarters Department of the Army. A data request letter was sent to him on August 12 (the data request letter is enclosed). He agreed to have Mike Rumsey at ARI help me with access to the Concurrent Validity data. Rumsey informed me that data could be produced by AIR and referred me to Gregory Wilson for the specific data layout. After some delays, I was able to clarify my data request to Wilson. At AIR,

I also talked to Norm Peterson who was very helpful in terms of describing variables collected. It was finally possible on October 6 to send a purchase order for \$250 to cover data production costs for the nine Batch A MOS jobs from the Concurrent Validity Study from UCLA to AIR. The data tape has not yet arrived.

Understanding Predictive Validity from a Latent Variable Perspective

The research proposal identified seven research strands to be studied in this project. Work has begun on two of those strands. Within the first strand, *Predictive Validity from a Latent Variable Perspective*, software has been written for investigating differences in predictive validity assessment using three different methods: regression analysis with observed test scores as predictors; regression analysis with factor scores as predictors; and structural equation modeling with latent variables. With a given latent variable model for a set of test scores, it is asked how the different methods represent incremental validity contributed by added subtests. This is a typical question asked in the context of proposed additions to ASVAB in terms of new cognitive predictors. Questions of significance of predictor composites are also considered. The project currently investigates what advantage latent variable models have, if any, for identifying and correctly estimating the predictive strength of minor factors operating in a test battery. Initial work indicates that the predictive strengths of neither minor nor major factors are correctly described when latent variable methods are not used. Implications for selection in terms of composites of observed test scores are being investigated (this also leads to research strand 5: Issues of Selection and Assignment by Latent Variable Models).

Monte Carlo studies of a conventional method for assessing predictive strength

Another research strand of the proposal is labelled *Issues of Selective Samples*. Here, the key issue of correctly assessing predictive validity from the sample of individuals selected into a training program or a job is considered. Several different techniques for drawing inference to the population of applicants are to be studied in the project. It was decided that an important starting point would be to consider the most commonly employed approach to this problem. This method uses Pearson- Lawley corrections (adjustments for restriction of range). In the context of latent variable modeling, an adjustment is made to the covariance matrix for the selected sample and the latent variable analysis carried out on this matrix. This appears to be one of the methods considered in the ECAT study. Software has been written for Monte Carlo studies of the sampling behavior of this common estimator. It appears not to have been rigorously studied previously. The performance of this estimator is now being compared to that of the factor score estimator and the theoretically-optimal maximum likelihood estimator which have been studied to a certain extent in pilot work for the project (for background, see the original proposal).