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The multi-pronged research program is aimed at developing and empirically evaluating an integrated component approach that determines how critical task characteristics and human operator characteristics interact to produce degraded performance under high workload conditions. The approach involves four major facets: (1) a synthetic task platform modeled on the U.S.A.F. Airborne Warning and Control Systems (AWACs) Weapons Director tasks; (2) a basic processes model of human information processing dimensions; (3) a model of individual differences characteristics; and (4) a military-relevant simulation for testing and validation of the integrated process/ individual-fifferences model. The project was started on April 1, 1997, and continued until December 15, 1997, when the principal and senior investigators relocated from the University of Minnesota to the Georgia Institute of Technology. The project continues at Georgia Tech, but this report covers the startup part of the effort that was funded at the University of Minnesota.

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Cognitive Modeling and Task Analysis:
Basic Processes and Individual Differences

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FINAL REPORT
(Period 4/1/97 - 12/15/97)

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Summary

The multi-pronged research program is aimed at developing and empirically evaluating an integrated component approach that determines how critical task characteristics and human operator characteristics interact to produce degraded performance under high workload conditions. The approach involves four major facets: (1) a synthetic task platform modeled on the U.S.A.F. Airborne Warning and Control Systems (AWACs) Weapons Director tasks; (2) a basic processes model of human information processing dimensions; (3) a model of individual differences characteristics; and (4) a military-relevant simulation for testing and validation of the integrated process/individual-differences model. The project was started on April 1, 1997, and continued until December 15, 1997, when the principal and senior investigators relocated from the University of Minnesota to the Georgia Institute of Technology. The project continues at Georgia Tech, but this report covers the startup part of the effort that was funded at the University of Minnesota.

Table of Contents

I.   Introduction

The multi-pronged research program is aimed at developing and empirically evaluating an integrated component approach that determines how critical task characteristics and human operator characteristics interact to produce degraded performance under high workload conditions. The approach involves four major facets: (1) the use of a multiple-component synthetic task platform modeled on the U.S.A.F. Airborne Warning and Control Systems (AWACs) Weapons Director tasks for extensive evaluation of the determinants of degraded performance and errors; (2) a basic processes model of human information processing dimensions (derived from extant cognitive/information processing theories); (3) a model of individual differences characteristics (from the U.S.A.F. Cognitive Abilities Measurement [CAM] model and extant theories of the cognitive ability and non-ability determinants of individual differences in skill acquisition); and (4) a military-relevant simulation for testing and validation of the integrated process/individual-differences model (namely, air traffic control [Terminal Radar Approach Control -- TRACON]). The outcome of this research program will include: (a) A computerized multiple component synthetic task platform, (b) A model of critical basic information processing capabilities and limitations that operate singly or in conjunction to lead to commission and/or omission errors in complex task performance; (c) A model of critical ability traits and non-ability traits that independently or interactively contribute to individual differences in complex-task performance; and (d) A substantial database that demonstrates how these modeling developments can be generalized to other tasks that are DoD relevant.

II.   Current Research

Up to December 15, 1997 (7½ months into the project, when the project was closed-out at the University of Minnesota), we focused our attention on the specification for and development of the Multiple Component Synthetic Task Platform (MCSTP). We had numerous meetings among the research staff and the software development contractors, as well as ongoing discussions with USAF research scientists. During the first post-kickoff meeting with USAF research scientists (May 16), the PI (Ackerman) met with several scientists and discussed the potential for sharing of ideas, strategies, and resources in the research and development effort (in particular, contacts were made with Dr. Samuel Schifflett, Dr. Linda Elliott, Dr. Patrick Kyllonen, Dr. Ellen Hall, and others). On July 1, 1997, Ackerman, along with two representatives from PTS (Kim Pearson, President, and David Pickett, Senior Programmer/Analyst) met with Drs. Shifflett and Elliott, and the AWACS simulator programming staff at Brooks AFB. In addition, we held brief meetings with several other USAF investigators, to receive and present updates on potential collaborative efforts. The programmers, in particular, were greatly aided by cooperation from the contractors who work with Drs. Shifflett and Elliott. In November, the PI met with Dr. Elizabeth Martin at the Williams AFB, in a consultation regarding other New World Vista components (namely the UAV simulation effort).

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Over the past 7½ months, the MCSTP software platform has started to take shape. Several features have now been incorporated into the core program, including maps, strike force displays, real-time display updates, and communications modules. We have also engaged in performing research on the aptitude and knowledge foundations that will serve as the psychological prediction components of the integrated task design and evaluation. Although we have not reached a point where significant data have been obtained, the project is still on schedule for the major empirical studies to be conducted this year and next year, at the Georgia Institute of Technology. Although there has been some disorganization in re-starting the laboratory at Georgia Tech (mostly in terms of unpacking equipment, and setup of networking capabilities), the contractor programming staff has maintained a remarkable degree of continuity in their efforts, and we remain confident of meeting our original program objectives.

III. Publications during the grant period

Ackerman, P. L., & Heggestad, E. D. (1997). Intelligence, personality, and interests: Evidence for overlapping traits. *Psychological Bulletin, 121,* 219-245.

Ackerman, P. L. (1997). Personality, self-concept, interests, and intelligence: Which construct doesn't fit? *Journal of Personality, 65(2),* 171-204.

Ackerman, P. L. (1997). What's intelligence got to do with it? A review of E. Hunt (1995). *Will we be smart enough: A cognitive task analysis of the coming workplace. Contemporary Psychology, 42,* 692-695.

Kanfer, R. & Heggestad, E. (1997). Motivational traits and skills: A person-centered approach to work motivation. In L. L. Cummings and B. M. Staw (Eds.), *Research in Organizational Behavior* (Vol. 19, pp. 1-57). JAI Press, Greenwich, CT.

Ackerman, P. L. (1998). Adult intelligence: Sketch of a theory and applications to learning & education, pp. 143-156. In M. C. Smith & T. Pourchot (Eds.) *Adult learning and development: Perspectives from educational psychology.* Mahwah, NJ: Lawrence Erlbaum Associates.

Ackerman, P. L. (In press). Traits and knowledge as determinants of learning and individual differences: Putting it all together. Chapter to appear in P. L. Ackerman, P. C. Kyllonen, & R. D. Roberts (Editors), *The Future of Learning and Individual Differences Research: Processes, Traits, and Content.* Washington, DC: American Psychological Association.

Ackerman, P. L. (In press). *Aptitude Tests.* To appear in A. E. Kazdin (Ed.) *Encyclopedia of Psychology.* Washington, DC/New York, NY: American Psychological Association/Oxford University Press

IV. Presentations during the grant period

Ackerman, P. L. & Kanfer, R. (1997, May). *Trait approaches to adult development and performance.* Joint Invited Address presented to the annual American Psychological Society convention, Washington, DC.

Ackerman, P. L. (1997, July). *Trait complexes, adult intellectual development, and Knowledge structures.* Symposium paper presented at the International Society for the Study of Individual Differences convention, Aarhus, Denmark.

Ackerman, P. L. (1997, July). *Personality, self-concept, interests, and intelligence: Which construct doesn't fit?* Invited Symposium paper presented at the International Society for the Study of Individual Differences convention, Aarhus, Denmark.

Kanfer, R. & Heggestad, E. D. (1997, July). *Motivational Traits and Skills: A Personality-Oriented Perspective.* Paper presented at the International Society for the Study of Individual Differences convention, Aarhus, Denmark.