

DEVELOPMENT OF A NON-HIGH SCHOOL DIPLOMA GRADUATE PRE-ENLISTMENT SCREENING MODEL TO ENHANCE THE FUTURE FORCE¹

Leonard A. White* & Mark C. Young
U.S. Army Research Institute for the Behavioral and Social Sciences
Arlington, VA 22202-3926

Eric D. Heggstad
Colorado State University
Fort Collins, CO 80523

Stephen Stark
University of South Florida
Tampa, FL 33620

Fritz Drasgow
University of Illinois
Champaign, IL 61820

MAJ Gene Piskator
U.S. Army Accessions Command
Fort Knox, KY 40121

ABSTRACT

This paper describes a new attrition screen for non-high school diploma graduate (NHSDG) applicants for service in the U.S. Army. A sample of 21,432 NHSDG Army accessions from FY00 through FY03 was used in the model development process. The new screen combines several indicators of adaptability from the motivational, mental, and physical fitness domains to forecast the likelihood of an NHSDG applicant failing to complete his or her first term of enlistment. Results indicate that a 40% screen would reduce overall NHSDG attrition by nearly 20% (15.3% vs. 18.9%) without adverse impact on minorities, and would close the gap between the attrition rates of NHSDG and high school diploma graduates by nearly 60%. Implementation options for FY05 and future directions are discussed.

1. BACKGROUND

First-term enlisted attrition continues to be a persistent problem for the Army. This type of turnover is disruptive, degrades unit performance, and wastes valuable training and recruiting resources. As the Army transforms to the Future Force, to include a temporary increase in size while simultaneously fighting the Global War On Terror, effective attrition management in conjunction with recruiting and retention programs will be a key requirement for its effectiveness.

The Army, and the other Services, place a premium on recruiting high school diploma graduates (HSDGs), because earning a high school diploma or its equivalent is predictive of an individual's potential for adapting to military life. The first-term attrition rate among HSDGs is about two-thirds the rate for non-high school diploma graduates (NHSDG). Historically, approximately half of the NHSDG recruits fail to complete their initial term of

¹ All statements expressed in this paper are those of the authors and do not necessarily reflect the official opinions of the U.S. Army Research Institute or the Department of the Army. Correspondence concerning this article should be addressed to Dr. Len White or Dr. Mark Young, 2511 Jefferson Davis Highway, Arlington, VA 22202-3926.

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 00 DEC 2004	2. REPORT TYPE N/A	3. DATES COVERED -			
4. TITLE AND SUBTITLE Development Of A Non-High School Diploma Graduate Pre-Enlistment Screening Model To Enhance The Future Force1		5a. CONTRACT NUMBER			
		5b. GRANT NUMBER			
		5c. PROGRAM ELEMENT NUMBER			
6. AUTHOR(S)		5d. PROJECT NUMBER			
		5e. TASK NUMBER			
		5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences Arlington, VA 22202-3926; Colorado State University Fort Collins, CO 80523		8. PERFORMING ORGANIZATION REPORT NUMBER			
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)			
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)			
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADM001736, Proceedings for the Army Science Conference (24th) Held on 29 November - 2 December 2005 in Orlando, Florida.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 7	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

enlistment. Although some NHSDGs do make very good Soldiers, collectively their high attrition is costly to the Army, reduces available manpower for deployment, and reduces the pool of potential NCOs for the Future Force.

The Army currently faces a very challenging recruiting environment, and these difficulties are likely to continue well into the future. Due to their relatively high first-term attrition rates, the Department of Defense's Office of Accession Policy has limited NHSDGs to 10% of Regular Army enlisted accessions. However, these potential NHSDG recruits are relatively plentiful, accounting for approximately 20% of the youth market. Given the recruiting challenges and the tight recruiting budgets, there is a continuing interest in recruiting NHSDGs. The U.S. Army Accessions Command recognizes the need for improved NHSDG attrition screening to make recruiting from this market more viable, and to reduce the costs associated with meeting the Army's yearly recruiting goals.

This paper describes the development of a new measure that can be used during pre-enlistment processing to reduce first-term attrition among NHSDGs by identifying applicants with higher adaptability for Army life. The new screen combines several indicators to forecast the likelihood of an NHSDG applicant failing to complete initial entry training and his or her first term of service. The goal of this effort is to develop, in coordination with the U.S. Army Accessions Command and the Army G-1, a new NHSDG attrition screen for implementation in FY05. Some of the findings presented here were briefed at the September meeting of the Joint-Service Manpower Accession Policy Working Group (MAPWG; Young, Heggstad, White, Drasgow & Stark, 2004).

2. METHOD

A predictive validation design was used to develop and evaluate candidate models for predicting NHSDG attrition using operational data gathered from the Army's GED Plus program. The attrition predictor measures evaluated in the models included the AIM test scores collected under the Army's GED Plus program, as well as a number of supplemental measures – such as the Armed Services Vocational Aptitude Battery (ASVAB) subtest scores -- that are routinely collected during the enlistment application process and captured on automated Army personnel databases. Gender and race were also included for assessing potential adverse impact of new screening measures. The database, subjects, measures, and procedures used in our analyses are described below.

2.1 Operational Database for Model Development

From February 2000 through January 2004, the Army implemented an experimental pilot program – GED Plus – for expanding its NHSDG recruiting market. In order to address concerns about the high attrition rate of NHSDGs, all applicants for the GED Plus program were required to obtain a passing score on the Assessment of Individual Motivation (AIM). The AIM is a 20-minute, self-report measure of motivational attributes developed by ARI that was administered as a special Army test at Military Entrance Processing Stations (MEPS) nationwide for the duration of the pilot program. (See Young, McCloy, Waters, & White, 2004, for details on AIM's use in the GED Plus program). In a large-scale validation prior to AIM's implementation in the GED Plus program, it was demonstrated that AIM – in a research context – was predictive of the first-term attrition of Army enlisted personnel, and was also more faking resistant than traditional self-report measures of motivation (Young, Heggstad, Rumsey, & White, 2000; White & Young, 2001).

2.2. Sample

The operational database from the GED Plus program was used in the research presented in this paper (see Barnes, Heggstad, Young, and White, 2004, for more details on the database). The sample consisted of 21,432 NHSDG applicants who completed AIM at the MEPS and subsequently accessed as Regular Army enlisted Soldiers. These Soldiers were tracked during their Army careers to determine their attrition status at various points after entry. In the present research, six-month attrition was used as the primary criterion for development of the attrition prediction models. Soldiers who had AIM scores and served in the Army at least six months were randomly assigned to a developmental ($N = 10,658$) or cross-validation ($N = 10,774$) sample for purposes of model development and evaluation.

2.3 Measures

Assessment of Individual Motivation (AIM). The AIM is a 27-item, self-report, paper-pencil instrument for reliably measuring six temperament constructs relevant to military performance: Dependability (Non-delinquency), Adjustment, Physical Conditioning, Leadership, Work Orientation, and Agreeableness. A forced-choice format is used to reduce fakability and to improve the accuracy of the self-report information. In addition, AIM includes an approach for detecting inaccuracies in self-reports caused by intentional or subconscious attempts to exaggerate one's capabilities. (See White & Young, 1998; Young, et al., 2004, for a detailed description of AIM).

Supplemental measures. Based on promising findings from past work (Knapp, Heggstad, & Young, 2004; White, Young, Rumsey, 2001; White & Young, 1992) and preliminary analyses of the operational database from GED Plus, several supplemental measures were chosen for more in-depth evaluation as predictors of NHSDG attrition. These measures included several ASVAB subtests, age at application, and Body Mass Index.

The ASVAB is a measure of cognitive aptitude used in the selection and classification of applicants for the Armed Services. The most promising ASVAB subtests chosen for predicting attrition were Mechanical Comprehension (MC), Math Knowledge (MK), Assembling Objects (AO), Word Knowledge (WK), and Paragraph Comprehension (PC). These measures were scored as continuous variables in the attrition prediction models.

We also examined age at time of application (1= less than 20, 0 = 20 or older) in our exploratory attrition models. Past research has shown that younger (vs. older) NHSDG Army recruits have higher first-term attrition rates (White & Young, 1992; Young & White, 1993).

Body Mass Index (BMI) was another supplemental measure that we investigated in our model development work. The height and weight data for computing BMI scores were obtained from Army personnel databases. The BMI score was computed using the following formula: $BMI = (\text{weight in kilograms}) / (\text{height in meters})^2$. To control for the effects of gender, this raw BMI score was transformed to a percentile score by ranking it separately for males and females in the sample.

Careful analyses of these BMI-attrition relationships in the present research revealed that both very low and very high BMI scores were associated with higher 6-month attrition for the group of NSHDGs. These relationships are consistent with the results of a recent review of injury and attrition studies which suggested that both low and high BMI scores are associated with an increased risk of injury in entry-level military training (Knapik, et al., 2004). Accordingly, the gender-normed BMI score was coded as 1 when an individual's BMI fell within the highest 5% or lowest 5% for their gender group, or 0 otherwise. Subsequent analysis indicated that these BMI-attrition relationships held up in the cross-validation sample. Past research in the Army and Air Force has also found that high BMI scores are associated with higher risk of injury and attrition among enlisted personnel (Laurence, Ramsberger, & Arabian, 1996).

Criterion Measure. Six-month attrition was chosen as the criterion for model development and evaluation. This measure was coded as 1 when the Soldier was discharged before completing 6 months of service, and as 0

otherwise. The six-month attrition rate for this sample was 18.7%. Soldiers who died or left the enlisted force to become Army officers were not included in the sample used in this research.

2.4 Model Development

Our general approach to model development was to examine the validity of each of the predictor domains both separately and in combination. From a practical standpoint, the supplemental measures are less costly to the Army as they are routinely collected during applicant processing and captured on automated Army personnel databases. Accordingly, we began by examining the predictive validity of the set of supplemental measures and then added AIM to the model to create an expanded attrition screen. The concept here was that AIM is a special test requiring additional resource expenditures to administer. To justify these added costs would require evidence that AIM shows significant incremental validity over a model based on the supplemental measures alone. All analyses were performed using the operational data from the GED Plus program.

In our analyses, we examined and compared alternative AIM scoring approaches. These included (a) the use of regression models involving the original AIM scales, (b) Item-Response-Theory (IRT) based approaches recently developed by Stephen Stark and Fritz Drasgow, as well as an earlier procedure developed by Michael Levine and Bruce Williams, and (c) empirical keying approaches. After determining which of the alternative AIM scoring procedures was the best predictor of attrition, we examined an expanded model that incorporated the supplemental measures and AIM.

To preclude capitalizing on chance, all explorations of alternative AIM scoring procedures and various combinations of the supplemental measures were performed on the developmental sample. Then, candidate models were evaluated and compared in the independent cross-validation sample by examining their validity for predicting six-month attrition and potential adverse impact at alternative cut scores.

3. RESULTS AND CONCLUSIONS

Logistic regression analyses were used to relate the explanatory variables to six-month attrition. The general form of the logistic model is $P(a_i) = 1 / (1 + \exp^{-Bx_i})$ where X_i is a vector of individual characteristics, $P(a_i)$ is the probability of attrition during a specified time period, and the B s are the parameters to be estimated relating the independent variables to the probability of attrition. The logistic specification is preferred to linear regression because (a) unlike linear regression, it will generate more interpretable predicted probabilities of attrition that range

from 0 to 1, and (b) it will provide unbiased estimates of the standard errors of the coefficients. Logistic regression is also better suited for predicting dichotomous outcomes because the assumptions of linear regression are likely to be violated (e.g., normal distribution of errors).

3.1 AIM Scoring Procedure

In our analyses, several AIM scoring procedures were examined. The empirical keying approach performed best at predicting six-month attrition in both the validation and cross-validation samples. Importantly, this new scoring procedure greatly enhanced AIM's validity against attrition ($r = -.12$, $p < .01$), relative to the validity obtained for the operational AIM ($r = -.03$) in the GED Plus program (Young et al., 2004). The validity of this new empirical key is also comparable to the validity of the original key ($r = .12$) obtained in the research setting. A closer examination of the empirically-keyed AIM items revealed a high degree of stability across the developmental and cross-validation samples, with $r = .83$, for the item validities across the two samples.

3.2 Attrition Screening Composite

The best predictors from the set of supplemental measures were related to the six-month attrition criterion, with, $R = .07$, $p < .01$, in the cross-validation sample. Next, the rescored AIM was added to the set of supplemental measures. Results showed that AIM significantly ($p < .01$) increased the prediction of 6-month attrition over a model based on the supplemental measures alone, with $R = .14$, $p < .01$, for the full model in the cross-validation sample. The overall fit for these models showed little shrinkage upon cross validation. The attrition prediction model including AIM and the supplemental measures was the best predictor of the attrition criterion, with twice the criterion-related validity of the model that used the supplemental measures alone ($R = .14$ vs. $.07$). Similar findings were obtained when we examined these relationships against 12-month attrition, with $R = .13$, for the full model. The new attrition screen will hereafter be referred to as the Tier 2 attrition screen (TTAS).

The TTAS includes four measures; (a) gender-normed BMI, (b) ASVAB Math Knowledge, (c) ASVAB Word Knowledge, and (d) the empirically-keyed AIM. Figure 1 presents a decile plot showing the relationship between TTAS scores and 6-month attrition in the cross-validation sample. For the results presented in Figure 1, TTAS scores were transformed to a percentile score such that low scores were associated with higher attrition rates.

As shown in Figure 1, Soldiers scoring between the first and tenth percentile on the TTAS (1st decile) had the highest 6-month attrition rate (30%). In contrast, Soldiers

with TTAS scores above the 80th percentile (deciles 9 and 10) had lower attrition rates that were comparable to that of HSDGs. The six-month attrition rate for HSDGs is 12.7%, as shown by the horizontal dotted line in Figure 1.

The TTAS has utility for reducing attrition. Screening out 40% of otherwise qualified NHSDGs with this measure could reduce the gap in 6-month attrition between NHSDG and HSDG by about 58%. There is also evidence that the duty performance of NHSDGs as a group would be increased as a consequence of attrition screening (White, et al., 2001; Young & White, 1993). In addition, NHSDG who complete their first enlistment term are more likely to reenlist than their HSDG counterparts (Strickland, in preparation). Any impacts of enhanced duty performance will be multiplied by subsequent reenlistments as newer NHSDG recruits help build the Future Force NCO ranks.

Importantly, we found no evidence that using TTAS for applicant screening would adversely impact minority groups – at any cut score. Also, use of this screen would not adversely impact females at moderate (below 30 or 40%) cutoff scores. Note, since females have much higher attrition rates than males it is not surprising that a high cut score would have such an impact on this high-risk group (Knapik, et al., 2004; Laurence et al., 1996).

Our findings show there is considerable promise in implementing models incorporating multiple measures to predict attrition. First-term attrition is a highly complex phenomenon, which is influenced by many factors. It is unrealistic to expect that such a complex outcome could be effectively predicted by a single measure. Our new attrition screen demonstrates the value of using a broad profile covering a range of factors – including physical, cognitive, and motivational – that are relevant to first-term attrition. Through the implementation of effective attrition screening models of the type being investigated here, we believe that this “whole person” assessment approach can help the Army enhance the quality of its non-graduate enlisted Soldiers who will help build the Future Force.

Recent investigations of temperament/personality measures have raised concerns that predictive relationships from a research context may sometimes fail to generalize to an operational setting where the test information is used for personnel decisions (Stark, Chernyshenko, Chan, Lee, & Drasgow, 2001; Young, 2003; Young, White, Heggstad, & Barnes, 2004). However, as the TTAS was developed using data collected on applicants under conditions where the test results counted and were used for enlistment processing, we are confident that its predictive validity will continue to hold in future applications and testing.

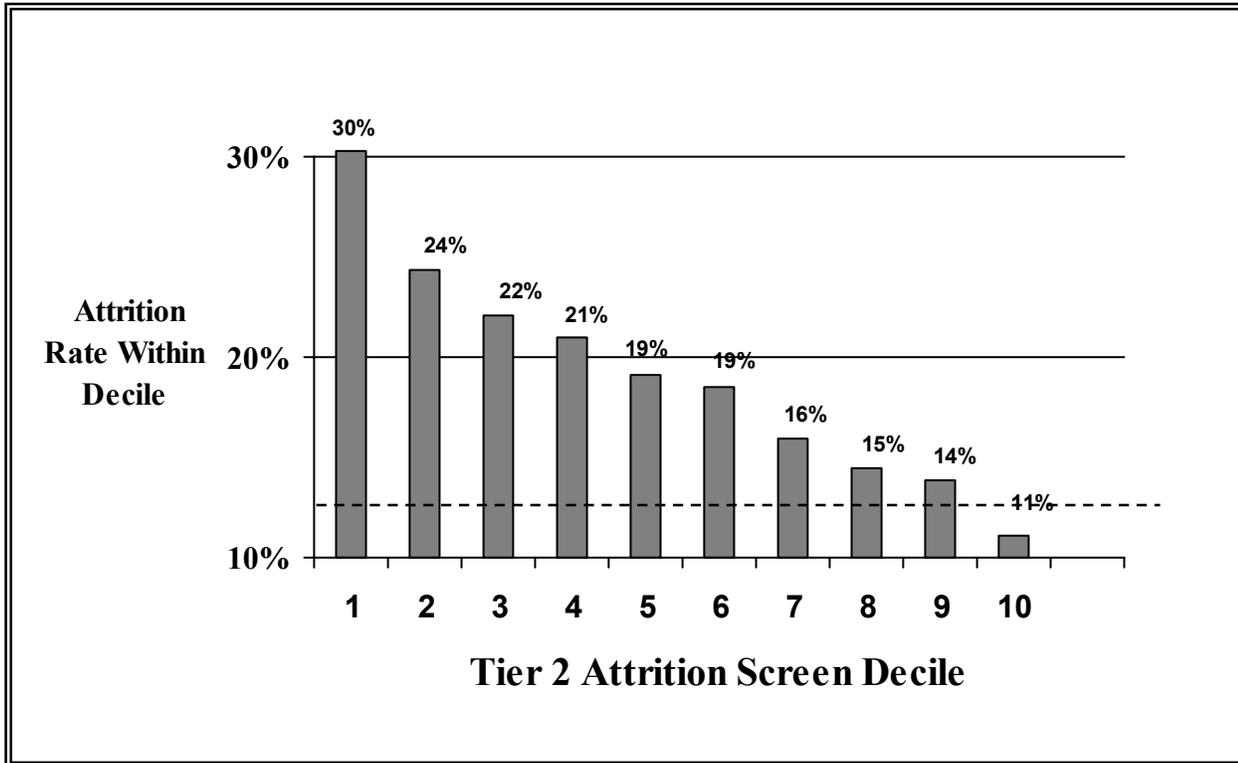


Figure 1. Relationship between the Tier 2 Attrition Screen and 6-month attrition in the cross-validation sample ($N = 10,744$ NHSDGs; $r = -.14$). Overall, NHSDG attrition in the sample is 18.9%. The dotted horizontal line shows the observed 6-month attrition rate of 12.7% for HSDG (Tier I) recruits during this time period.

3.3 Implementation Options and Directions

The Army's ability to identify high-attrition risk NHSDG applicants is a necessary but not sufficient first step in reducing NHSDG attrition. In addition to being able to identify high-attrition risk NHSDG applicants, the Army must also be able to cost-effectively recruit these applicants. If pre-enlistment screening tests are not accurate enough, it may be more efficient for the Army to recruit costly HSDGs rather than relatively inexpensive NHSDGs. The ultimate utility of a pre-enlistment attrition screening program is not only based on the screen's accuracy, but also on recruiting and training costs (White et al., 2001; White, Nord, Mael, & Young, 1993). To test the utility of ARI's NHSDG pre-enlistment screening model, the Army is planning on conducting an operational test of the NHSDG pre-enlistment screening model during FY05 and FY06. The Tier 2 Attrition Screen (TTAS) program will require all Tier 2 education credential Regular Army applicants to

take the AIM test. Note, only NHSDGs with an alternative education credential (e.g., GED) are included within Tier 2. Applicants who score well enough on the TTAS to be designated as low-attrition risk will be offered enlistment incentives similar to HSDG applicants. Those NHSDG applicants who do not score well enough on the TTAS will still be allowed to enlist if they meet all other enlistment criteria, but without Tier I (e.g., HSDG) monetary or education incentives. In this manner, the Army can test the predictive validity of the NHSDG pre-enlistment screening model under operational conditions without "screening out" otherwise qualified NHSDG applicants. Results from this operational test will be used to devise a future TTAS program which would actually "screen out" NHSDG applicants in order to lower Army attrition. A goal of the TTAS program is to be able to identify and recruit NHSDG applicants who will have lower attrition rates comparable to that of Tier 1 (HSDG) Soldiers. Screening high-attrition risk NHSDG applicants may be viable when the Army recruiting environment

improves. Results from the FY05-FY06 TTAS operational test may also provide valuable lessons which may prove helpful if the Army decides to use such an approach in the management of HSDG attrition. Additional measures for the TTAS and expanded applications to HSDG may also emerge from research such as ARI's Select21 program which is investigating a broad range of new predictors of enlisted job performance for the 21st Century Soldier (see Heffner, Tremble, Campbell, & Saeger, 2003, for details on the Select21 program).

Additionally, the Department of Defense has begun the necessary work to field a computer-based AIM which would dramatically decrease applicant processing time.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Jeffrey Barnes for his assistance in preparing the database used in this research and Cesar Juarez for his contributions to this work.

4. References

- Barnes, J.D., Heggstad, E.D., Young, M.C., & White, L. A. (2004). Overview of AIM databases. In Knapp, D.J., Heggstad, E.D., & Young, M.C. (Eds.), *Understanding and Improving the Assessment of Individual Motivation (AIM) in the Army's GED Plus Program*. (ARI Study Note 2004-03). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.
- Heffner, T.S., Tremble, T., Campbell, R.C. & Sager, C.E. (2003). Anticipating the future for first-tour soldiers. In D.J. Knapp (Chair), *Selecting Soldiers for the Future Force: The Army's Select21 Project*. Symposium conducted at the 2003 International Military Testing Association.
- Knapik, Jones, Sharp, Darakjy, Jones, Hauret, & Piskator, G. (2004). *The Case For Pre-Enlistment Physical Fitness Testing: Research and Recommendations*. USACHPPM Report No. 12-HF-01Q9D-04.
- Laurence, J. H., Ramsberger, P. F., & Arabian, J. M. (1996). *Education Credential Tier Evaluation*. Human Resources Research Organization, Alexandria, VA.
- Stark, S., Chernyshenko, O.S., Chan, K.Y., Lee, W.C., & Drasgow, F. (2001). Effects of the testing situation on item responding: Cause for concern. *Journal of Applied Psychology*, 86, 943-953.
- Strickland, W. J. (In preparation). *A Longitudinal Study of First Term Attrition and Reenlistment Among FY1999 Enlisted Accessions*. Alexandria, VA: Human Resources Research Organization.
- White, L.A., Nord, R.D., Mael, F.A., & Young, M.C. (1993). The Assessment of Background and Life Experiences (ABLE). In T.Trent and J.H. Laurence (Eds.), *Adaptability Screening for the Armed Forces*. Washington, D.C.: Office of the Assistant Secretary of Defense (Force Management and Personnel).
- White, L.A., Young, M.C., & Rumsey, M.G. (2001). Assessment of Background and Life Experiences (ABLE) implementation issues and related research. In J.P. Campbell & D.J. Knapp (Eds.), *Exploring the limits in personnel selection and classification* (pp. 526 – 558). Mahwah, NJ: Erlbaum.
- White, L.A. & Young, M. C. (1998, August). *Development and validation of the Assessment of Individual Motivation (AIM)*. Paper presented at the annual meeting of the American Psychological Association, San Francisco, CA.
- White, L.A., & Young, M.C. (1992, October). A compensatory screening model for reducing first-term attrition in the U.S. Army. *Proceedings of the 34th Annual Conference of the Military Testing Association* (pp 140-145), San Diego, CA.
- Young, M.C. (2003, June). Effects of retesting on a new Army measure of motivational attributes: Implications for response distortion, test validity, and operational use. Paper presented at the annual meeting of the International Public Management Association Assessment Council (IPMAAC) as part of the symposium titled *Entry-Level Testing in the Public Sector: Identifying and Managing the Unexpected Applicant*, Baltimore, MD.
- Young, M.C., Heggstad, E.D., White, L.A., Drasgow, F., & Stark, S. (2004, September). *Update on Army Tier 2 Attrition Screening Research Involving AIM*. Briefing presented to the Manpower Accession Policy Working Group (MAPWG), Monterey, CA.
- Young, M.C., Heggstad, E.D., Rumsey, M.G., & White, L.A. (2000, August). *Army pre-implementation research findings on the Assessment of Individual Motivation (AIM)*. Paper presented at the annual meeting of the American Psychological Association, Washington, DC.
- Young, M. C., McCloy, R.A., Waters, B.K., & White, L.A. (2004). Introduction: An overview of AIM and the preliminary efforts to support its operational use. In Knapp, D.J., Heggstad, E.D., & Young, M.C. (Eds.), *Understanding and Improving the Assessment of Individual Motivation (AIM) in the Army's GED Plus Program*. (ARI Study Note 2004-03). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.
- Young, M.C., & White, L.A. (1998). *Development of a measure to predict Soldier attrition and motivation*. Paper presented at the 21st Army Science Conference, Norfolk, VA.
- Young, M.C., & White, L.A. (1993, November). Army compensatory screening model for selecting non-high school diploma graduates. *Proceedings of the 35th Annual Conference of the Military Testing Association* (pp. 617-622), Williamsburg, VA.
- Young, M.C., White, L.A., Heggstad, E.D., and Barnes, J.D. (2004, July). *Operational validation of the Army's new pre-enlistment screening measure*. Paper presented at the annual meeting of the American Psychological Association, Honolulu, HI.