



Web-Based Assessment: Issues and Applications in Personnel Selection

**John A. Weiner
Psychological Services, Inc.**

June 22, 2004

IPMAAC 28th Annual Conference on Personnel Assessment

Web-Based Assessment: Issues and Applications

Introduction

“Computers in the future may have only 1,000 vacuum tubes and perhaps weigh 1.5 tons.”

- Popular Mechanics, March 1949

50 years later: Pentium 4 processor is released Y2K

- contains 42,000,000 transistors



Web-Based Assessment: Issues and Applications

Introduction

The use of technology-based assessment continues to increase as systems become more practical and cost-effective

- “Moore’s Law” (1965) has held true -- computer information processing capability doubles about every 2 years
- *Technology-based assessments now rival paper-based program costs*

This session examines key issues that emerge when employers adopt Web-Based Testing (WBT)

- **Practical issues:**
 - Why adopt WBT? What benefits do employers value and leverage?
 - When to adopt? When is WBT a good fit?
- **Technical Issues:**
 - What are Technology requirements and considerations for users?
 - What are important Psychometric considerations and how are they addressed?
- **Case Studies:**
 - Discussion will draw from experience in developing and implementing PSI’s new WBT platform -- **ATLAS**
 - Examples will be provided including public and private sector programs

Web-Based Assessment: Issues and Applications

Leveraging Benefits of WBT

Why do employers adopt WBT?

- **Consider these potential benefits in determining whether WBT will be valued in your setting.**
 - ❑ **Efficiency:** reduced staff time for test preparation, administration, scoring, reporting, information management
 - ❑ **Reliability:** scoring & data management are more accurate and efficient
 - ❑ **Speed:** reduced time for decision-making enables reaching more top candidates before they accept other positions - reduces testing volume
 - ❑ **Security:** reduced likelihood of lost test booklet or materials – before, during, after testing
 - ❑ **Flexibility:** 24/7 remote delivery helps expand recruitment, reach a broader candidate pool,
 - ❑ **Integrated functions:** assessment information can be merged with with HR systems - simple applicant tracking or complete talent management system
 - ❑ **Data Mining & Warehousing:** opportunities learn from data
 - optimize test use and interpretation
 - evaluate program effectiveness (utility, norms, trends)

Web-Based Assessment: Issues and Applications Leveraging Benefits of WBT

What are the cost considerations?

- **The assessments:**
 - WBTs are now priced the same as paper-pencil forms
- **Technology:**
 - A single PC & DSL line costs less than \$1,200 annually, and can easily test 500 to 1,000 candidates annually
 - assume 2-4 candidates tested daily
 - Requires tech support - often leveraged from other areas of the organization
- **Potential cost savings**
 - printing; shipping; storage; security; disposal
 - *scanning hardware; data entry*
 - staff: administration, scoring, reporting, data management
 - *every 10% of admin staff time saved may be worth \$3,000 or more per year*

Web-Based Assessment: Issues and Applications

Practical Considerations for Implementing WBT

What types of assessment programs are well-suited for WBT?

- **Continuous testing, “rolling recruitment”**
 - smaller, more frequent sessions (up to 30 candidates is common)
- **Wide range of assessments**
 - Knowledge, skills, abilities, personality, attitudes
- **Appropriate physical environment**
 - Same as paper-pencil: quiet, comfortable, free from distraction
- **Proctoring**
 - Normally required for cognitive ability testing
 - Different role for proctor - verify and supervise
- **Unproctored delivery**
 - Appropriate for certain types of assessments
 - Applicant screening: job applications, certain personality, biodata, preliminary skill screening
- **Existing technology and support**
 - Hardware & software (e.g., training labs, work stations, kiosks)
 - Requirement: basic PC, web browser (IE), internet connection
 - IT support – most organizations have staff to support business systems

Web-Based Assessment: Issues and Applications

Example - Implementing WBT

Example #1 – New California Entry-level Corrections Officer Exam

- **Assessment: 2-hour power test battery delivered on PSI's ATLAS platform**
 - Cognitive Ability – Reading comp, writing skills, reasoning & perceptual abilities
 - Work Attitudes: Big-5 dimensions – conscientiousness, agreeableness, etc.
- **Setting: County Probation Departments**
 - 2 large Southern California counties
 - 1 established testing lab, 30 web-connected PCs
 - 1 first time web testing, 20 PCs
 - 2 small northern California counties
 - First time web testing, 1 web-connected PC
- **Implementation**
 - Staff training – PSI provided “Webinar” training on test delivery, reporting
 - System set-up & pretest – technology guidelines; simulate loaded conditions
 - Administration – 1 or 2 proctors + IT staff available
- **Results**
 - Successfully conducted a dozen sessions, tested several hundred candidates
 - Atlas provided immediate score results - enabled rapid scheduling of interviews & planning for training & recruitment -- “just in time, right- sized” test orders
- **Lessons Learned:**
 - Technology set-up & pretest is key – don't assume existing business systems will work “as is” for personnel testing

Web-Based Assessment: Issues and Applications

Example - Implementing WBT

Example #2 – Call Center Rep (CSR) Test Battery

- **Assessment: 1-hour timed test battery delivered on ATLAS:**
 - Basic Skills Tests – 4 short, “speeded” tests of verbal, reasoning & perceptual skills
 - ViewPoint – work & service attitudes, consistent with Big-5
- **Setting: National Telecommunications company**
 - Approx 40 testing locations
 - Call center training work stations used for testing
 - IT support readily available
- **Implementation:**
 - Staff training – “Webinar” training on test admin, reporting
 - System setup & pretest – scoring & reporting options; technology guidelines
- **Results**
 - Used successfully to test thousands of candidates
- **Lessons Learned**
 - Timed cognitive tests can be successfully implemented on WBT
 - Tech-oriented business/jobs are very well-suited for WBT

Web-Based Assessment: Issues and Applications Technology Considerations for Delivery

*What are some of the important technical considerations for WBT?
What issues should WBT systems address?*

- **4 key technical features of WBTs:**

- **Architecture** - ensure accurate and reliable delivery
- **Presentation** - *preserve* test content appearance, placement, and accessibility
- **Navigation** - enable examinees to answer questions and advance similar to paper-based tests
- **Security** – preserve the integrity of the assessment

Web-Based Assessment: Issues and Applications Technology Considerations for Delivery

Examples of essential delivery features to look for in a WBT system:

- Test-at-a-time download/upload ensures delivery is not affected by web traffic (no latencies or “screen paints”)
- Accurate, robust timer algorithm to support timed tests
- Display test questions & passages without scrolling – no hidden text
- Full-screen presentation (Kiosk mode) to standardize test presentation & navigation
- “Status bar” to determine test progress
- Test sequencing to standardize administration
- Examinee tutorial

Web-Based Assessment: Issues and Applications Technology Considerations for Security

Examples of essential security features to look for in a WBT system:

- Browser functions disabled (cut, paste, print)
- Key-based test session
- Encrypted data transmission (SSL)
- Passwords & file permissions restrict outside access
- On-line security agreements
- Proctored administration

Web-Based Assessment: Issues and Applications

Psychometric Considerations

What are important measurement-related issues that must be addressed?

- **Validity** – skills, abilities, and characteristics must not be affected by the delivery system
- **Reliability** – scores must be stable and consistent
- **Norms** – score distributions must exhibit desired characteristics (mean, dispersion, shape)
- **Equivalence** - mixed use of paper and web-based cognitive tests requires consideration of the *equivalence* of scores
- **Candidate acceptance** – the assessment must be well-accepted by candidates to ensure success of the program (consequential validity)

Web-Based Assessment: Issues and Applications

Psychometric Considerations

Validity - Research by PSI and others supports the cross-mode validity of cognitive and non-cognitive tests

- Computer & paper-based scores measure the same thing - adjusted r 's near unity

Test Type	Cross-mode r^*	No. R's	Study
Cognitive-Power	.97	123	<i>Mead & Drasgow (1993) - various tests</i>
Cognitive-Hybrid	.98	8	<i>Gibson & Weiner (1997) -BST</i>
	.97	7	<i>Chandler (2003) -BST & EAS</i>
	1.0	6	<i>Weiner, et al (2003a) -EAS</i>
	.95	10	<i>Weiner, et al (2003b) -BST</i>
Cognitive-Speeded	.72	36	<i>Mead & Drasgow (1993)</i>
	.86	4	<i>Gibson & Weiner (1997) -BST</i>
	.90	2	<i>Chandler (2003) -BST & EAS</i>
	.87	1	<i>Weiner, et al (2003a) -EAS</i>
	.85	2	<i>Weiner, et al (2003b) -BST</i>
Personality	.92 to 1.0	232	<i>Finger & Ones (1999) -MMPI</i>

*disattenuated cross-mode r

Web-Based Assessment: Psychometric Considerations

Equivalence: *Carefully constructed WBTs can be expected to have construct equivalence (validity).*

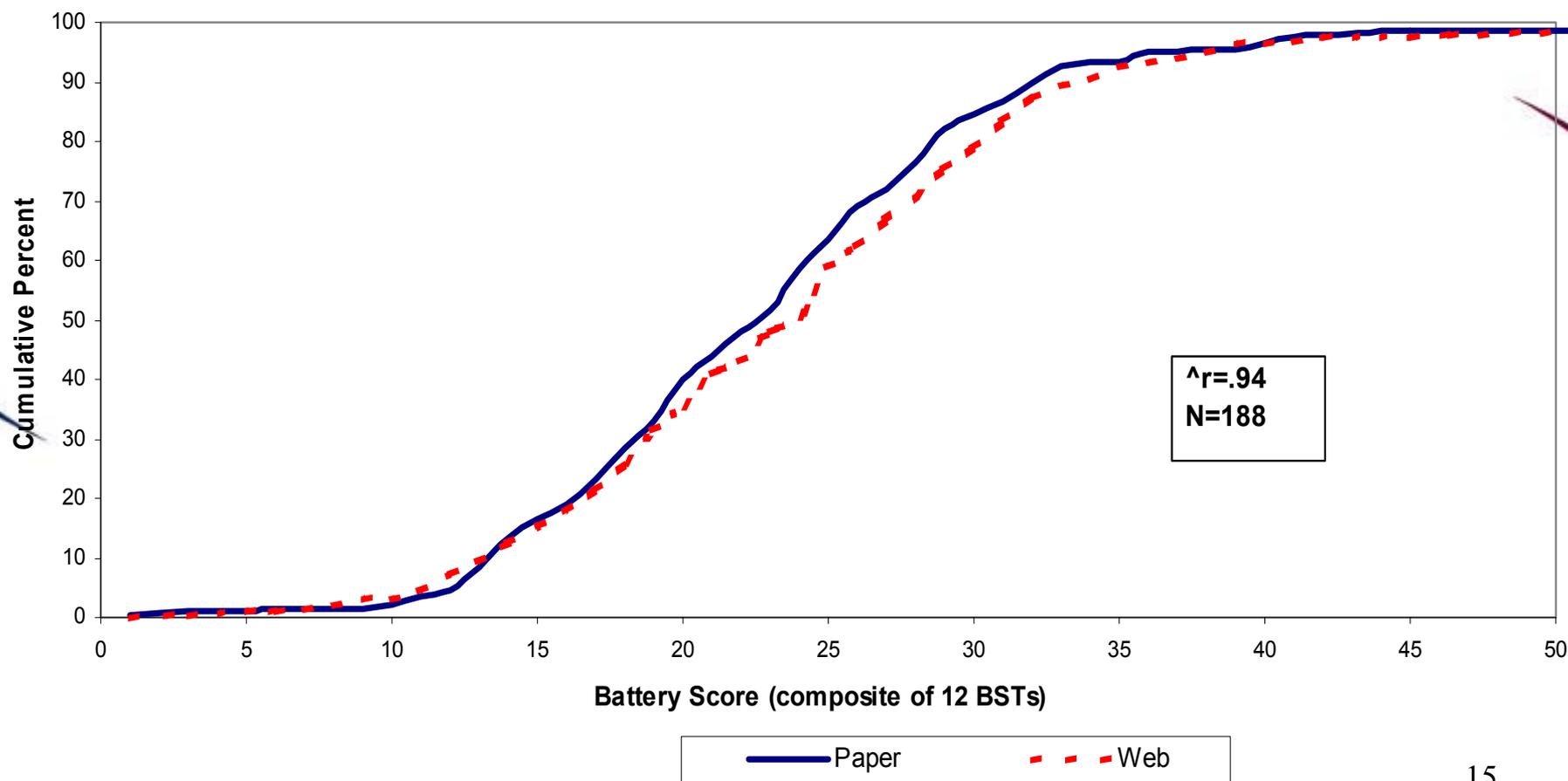
- *However, normative adjustments may be required for certain cognitive ability tests, particularly if they are time-restricted.*

Example - Recent PSI Study (Weiner, et al, 2003b)

- **Web-paper form equivalency study (N=424 paid volunteers)**
- **Timed cognitive ability tests – PSI’s Basic Skills Test series**
 - 12 tests of verbal, reasoning, numerical & perceptual skills
- **Design: Repeated measures, counter-balanced**
 - (1) WBT only, (2) paper forms only, (3) Both

Web-Based Assessment: Psychometric Considerations – Validity & Equivalence

Web & Paper BST Battery Score Distributions (Weiner, et al, 2003b)



Web-Based Assessment: Psychometric Considerations

Equivalence Research: Normative Adjustments

- Compare means & variance across modes

Problem Solving (BST5)	Difference			
	N	Mean	Variance	$r_{\text{paper-web}}$
	188	0.87	4.54**	.96

- **PSI 2003b**
- Derive linear equating formula for web-paper score conversion

$$Y' = A * (X) + B$$

- Assess fit of linear model
 - Conversion table; plot

Web-Based Assessment: Psychometric Considerations

Examinee acceptance of the web interface is important to ensure measurement quality.

- *Our experience is that examinees generally favor WBT*

Study of PSI's Employee Aptitude Test Series (2003a)

- *310 university students completed survey after taking tests*
- *Completed 14 web and/or paper forms of timed cognitive ability tests*
- *Repeated measures, counter-balanced design*

Web-Based Assessment: Psychometric Considerations

Examinee Acceptance Results

- *Computer-based test-taking experience is reasonable and acceptable*
78% agree / 5% Disagree / 18% In between
- *Preference for “high-stakes” testing purposes (e.g., job eligibility):*
51% computer; 34% paper
- *Tests perceived as fair*
web only: 65% agree paper only: 66% agree
- *Tests perceived as difficult:*
web only: 23% agree paper only: 29% agree
- *Computer proficiency (self rating) correlated with perceived ease of the test (.23)*
– **suggests need for tutorial and practice tests**

Web-Based Assessment: Practical and Technical Issues

Lessons Learned

WBT is used successfully in public and private sector personnel selection programs

- ***Characteristics of successful programs:***
 - Existing or planned technology infrastructure
 - Organizational commitment to utilize technology
 - provide appropriate technical support
 - Multiple leverage points
 - Speed, power, security, data management
 - Flexible, continuous testing schedule (vs. mass testing)

Web-Based Assessment: Practical and Technical Issues The Future

The future of WBT – what to look for:

- ***More integrated functionality***
 - *Recruitment, assessment, performance management*
- ***Seamless interchange between systems – HR XML standards***
 - *Easier use of multiple vended solutions*
- ***Innovative test formats***
 - *Simulations, multi-media, multitasking, tailored content, banking*
- ***Artificial intelligence – expert HR and assessment***
 - *“turbo test”*



Thank you

For further information, contact:

**John Weiner
Director, Product Development
PSI**

**(800) 367-1565
john@psionline.com
www.psionline.com**

References

- Donovan, M.A., Drasgow, F., & Probst, T.M.(2000). Does Computerizing paper-pencil job attitude scales make a difference? New IRT analysis offers insight. Journal of Applied Psychology, Vol. 85, No. 2, 305-313.
- Finger, M.S., & Ones, D.S. (1999). Psychometric equivalence of the computer and booklet forms of the MMPI: A meta-analysis. Psychological Assessment, Vol 11, No. 1, 58-66.
- Gibson, W.M., & Weiner, J.A. (1997). Equivalence of computer-based and paper-pencil cognitive ability tests. Paper presented at the twelfth annual conference of the Society for Industrial and Organizational Psychology, St. Louis.
- King & Miles (1995). A Quasi-Experimental Assessment of the Effects of Computerizing Non-cognitive paper-and-pencil measurements: A test of measurement equivalence: Journal of Applied Psychology, Vol. 80, No. 6, pp. 643-651.
- Mead, A., & Drasgow, F. (1993). Equivalence of Computerized and paper-pencil cognitive ability tests: A meta- analysis. Psychological Bulletin, Vol. 114, No. 3. 449-458.
- Chandler MacLeod (2002). Unpublished research: Equivalence of paper-pencil and web-based (C-M) versions of basic skills and aptitude tests.
- Richman, W.L., Kiesler, S., Weisban, S., & Drasgow, F. (1999) A meta- analytic study of social desirability distortion in computer-administered questionnaires, traditional questionnaires, and Interviews. Journal of Applied Psychology, Vol 84, No. 5, 754-775.
- Weiner, J.A. (2003). Equivalence of Computer-Based and Paper-Pencil Employee Aptitude Survey (EAS) Forms. Glendale, CA: PSI.
- Weiner, J.A. (2003). Equivalence of Computer-Based and Paper-Pencil Basic Skill Test (BST) Forms. Glendale, CA: PSI.