
Psychological Testing on the Internet

New Problems, Old Issues

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The Internet has significantly changed the way people conduct business, communicate, and live. In this article, the authors' focus is on how the Internet influences the practice of psychology as it relates to testing and assessment. The report includes 5 broad sections: background and context, new problems yet old issues, issues for special populations, ethical and professional issues, and recommendations for the future. Special attention is paid to implications for people with disabling conditions and culturally and linguistically diverse persons. The authors conclude that ethical responsibilities of psychologists and current psychometric standards, particularly those regarding test reliability and validity, apply even though the way in which the tests are developed and used may be quite different.

At their spring and fall 2000 meetings, members of the Committee on Psychological Tests and Assessment (CPTA) discussed issues related to psychological testing and assessment on the Internet. They recognized that as psychological test instruments become more readily available via the Internet, issues arise concerning, for example, test reliability, validity, administration, item security, and test-taker confidentiality. Members of CPTA's parent boards—the Board of Scientific Affairs (BSA), the Board of Professional Affairs (BPA), the Board of Educational Affairs, and the Board for the Advancement of Psychology in the Public Interest—reviewed and endorsed the idea of creating a task force to examine these issues. Specifically, BSA and BPA members agreed that it was important for the American Psychological Association (APA) to be a leader in discussing new and emerging technologies in psychological testing, assessment, and research and in providing information about Internet-based testing and related issues. They noted that a jointly sponsored BSA–BPA task force on Internet-based testing would complement other APA groups focusing on related issues. The Task Force on Psychological Testing on the Internet was therefore formed, with a broad mission of reviewing current practices on Internet-based psychological testing and determining psychometric, ethical, legal, and practical implications of this approach to testing particularly for

individuals from culturally and linguistically diverse populations.

Task force members were chosen to reflect expertise across a broad range of testing areas (e.g., educational, school, employment, forensic, career–vocational, clinical, cross-cultural, neuropsychological), to be knowledgeable in Internet technology, and to represent the concerns of diverse groups that may be affected by testing. Their primary objective was to prepare a report, which informs the profession of psychology about emerging issues and problems in Internet testing and actions psychologists can take to protect the integrity of testing and the consumer. An accompanying objective was to devise mechanisms for informing and educating the public about potential problems with Internet testing.

This article is organized into the following five broad sections: (a) background and context, (b) new problems yet old issues, (c) issues for special populations, (d) ethical and professional issues, and (e) recommendations for the future. Throughout these subsections, both practical and scientific issues are discussed with careful consideration of the consequences of decisions based on information obtained from Internet tests. The goal was not to provide a thorough summary of all Internet testing practices, but rather to describe broadly the current state of practice. It will become obvious to the reader, as it did to the committee, that many issues about Internet testing practices are similar to those faced by the profession in the past. This report also contains recommendations for the profession's response to current developments in Internet-based psychological testing.

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Background and Context

Growth of the Internet

The past decade has witnessed a rapid expansion of the Internet. The foundations of the Internet began in the 1960s as part of the U.S. defense system development and the inception of new data-passing technologies. Since then it has grown from a university-based network to a worldwide network of interconnected computers accessible to people through many media in all civilized parts of the world (Abbate, 1999). The number of sites available on the Internet and the number of users grow larger each day. This relatively new and revolutionary communication network has significantly changed the way people conduct business, communicate with others, and live.

Over the past 10 years, the number of Internet sites and users has grown from hundreds to millions. As of July 2001, there were over 125 million Internet sites (Internet Software Consortium, 2001). Approximately 143 million, or about 54%, of all U.S. citizens have home access to the Internet (U.S. Department of Commerce, 2002). In fact, a recent report suggests that only 24% of Americans are truly offline, with no direct or indirect experience with the Internet (Pew Internet & American Life Project, 2003a). Although access varies worldwide by country, it is clear that similar percentages hold, on average, across the globe and that more than 500 million people around the world have access (Nielsen/NetRatings, 2001). Further, close to 40 million U.S. citizens have access to the Internet at work. At home, the average U.S. user spends about 26 hours a month on the Internet; while at work, the average user spends over 75 hours per month on the Internet (Nielsen/NetRatings, 2003). Clearly, the Internet is quickly becoming a medium as pervasive as radio and television, with the capacity for infinitely more two-way communication.

There is no doubt that the Internet is quickly becoming one of the most pervasive communication and commerce media in the world (Abbate, 1999). It is also quite clear that usage and access will continue to grow for years to come. For example, although ethnic minority members in this country were sometimes among the last to utilize the Internet, their usage has grown significantly over the last five years (U.S. Department of Commerce, 2002). Individuals with disabling conditions are also connecting in growing numbers (U.S. Department of Commerce, 2002). Further advances in technology, such as broadband, allowing quicker and larger transmissions of data, are likely to increase Internet activities. The impact of the Internet has been, and will continue to be, substantial for all people and organizations, including professional groups. The profession of psychology is among the groups that are beginning to explore opportunities and issues, both positive and negative, concerning the Internet (Barak, 1999). And so we should, as many individuals look to the Internet for psychological information. A recent report suggested that 23% of Americans with Internet access have looked for information about a mental health issue such as depression or anxiety (Pew Internet & American Life Project, 2003b).

Growth of Internet Testing

Why has Internet testing created so much interest? Internet advocates stress better, faster, and cheaper services and products, and Internet testing provides many good illustrations of this principle. For example, a new test with accompanying translations could be made available around the world almost instantly. Test publishers can download new tests to secure testing sites in a matter of moments, while other test developers can put tests on their Web sites and make them available to anyone with an Internet connection. Updating a test is also much easier. For example, revising a paper-and-pencil test requires printing and distributing new test forms and answer keys and printing new or revised test manuals, an expensive process that may take several months or years. Revisions of a test that appears on the Internet can be downloaded to testing sites around the world in a few minutes at virtually no cost.

In many paper-and-pencil testing and assessment programs, examinees typically receive their scores and interpretive reports a month or two after they take a test. Their answer sheets must first be mailed to the test publisher, where they are scanned and scored, and perhaps interpreted. Then reports are created, printed, and mailed back to the examinees. In an Internet setting, responses are recorded in computer files as examinees answer each item. Software that computes test scores and generates interpretive reports can be run as soon as the last item is answered, with examinees receiving feedback within a few seconds of completing the test.

Internet testing is more scalable than paper-and-pencil testing. In the language of the Internet, *scalable* means that adding volume results in very little additional cost. Therefore, over the course of a year, the number of times people who visit a Web site and respond to a test may increase, for example, from 5,000 per month to 10,000, but the test



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Photo by Harry Zanotti

publisher does not incur the costs associated with printing, distributing, and scoring 5,000 additional paper-based tests. Of course, eventually an additional server may be required, but additional test administrations are much lower in cost in an Internet setting compared with paper-and-pencil administration. Additionally, because of the minimal costs involved, tests and assessments could be made available at no cost to respondents. For example, researchers may put tests and assessments on their Web pages hoping that people will complete the assessment in order to receive a score report. In exchange, the researcher obtains the data provided by the respondents. Test publishers sometimes put free assessments on their Web sites as a means of attracting potential customers.

Goals of Testing

Internet tests and assessments can be classified into three broad categories according to their goals. First, many Internet tests, instruments, and surveys are designed for personal development and growth and may or may not be scientifically based. Measures such as these are usually designed for the layperson or public consumer. These instruments may be used to identify specific personality characteristics or traits (e.g., motivation for success; match-making), determine suitability for a particular type of job or trade, or facilitate psychotherapy (e.g., a personal rating of depression or anxiety). Second, many traditional psychodiagnostic measures like the Minnesota Multiphasic Personality Inventory (MMPI), the Minnesota Multiphasic Personality Inventory—2 (MMPI-2), and the Beck inventories now appear on the Internet. These instruments are typically used to make important diagnostic and treatment decisions regarding individuals. In addition, there are Web pages that are devoted to ways to respond so as to create a desired

result, especially in forensic settings where instruments like the MMPI-2 may be pivotal. Finally, cognitive ability tests, certification tests, and licensing exams can be administered via the Internet with the purpose of identifying the best candidates to be awarded some scarce resource (e.g., a job or admission to graduate school) or credential. Here the test or assessment is used to make an important decision about the examinee, usually related to access into a profession or area of study (e.g., medicine, psychology, etc.).

The goals of a test have important implications for how the measure should be administered. For example, a test that is designed for personal development or growth is less likely to be affected or contaminated by some response style. The person is likely to be candid and open, and not defensive or guarded. In these situations, there is little motivation for dissimulation on the part of the respondent. On the other hand, when a measure is used to make a decision about the examinee, the process is more likely to elicit a motivation to obtain a better score. If test takers are sophisticated, they will answer items in a way that they believe maximizes their positive results. For example, an individual may fake good on a personality inventory or cheat on a cognitive ability test. Much more care in test administration is needed in such situations.

Benefits of Internet Testing

The benefits of Internet testing are speed, cost, and convenience. Testing over the Internet provides rapid communication of findings to clients, patients, researchers, and the public. It also allows researchers to collect data rapidly, conveniently, and at lower costs than in face-to-face research settings. Internet testing is cheaper and more efficient; it saves valuable time and provides results more rapidly and easily compared with face-to-face testing. Benefits of Internet testing also include sensitization and familiarization of testing to potential clients and the presentation of test materials in a consistent, uniform manner. The more that potential clients become familiarized with these procedures, the more comfortable their approach to the tests can be, reducing spurious sensitization and situational effects.

Internet testing is also beneficial in that it allows patients in rural settings to be tested, where it would be difficult or impossible to travel to a testing center or to the office of a testing professional. Internet testing is of value to patients who lack transportation to such sites or to those who cannot travel because of physical limitations. In addition, tests may be presented in a precise manner or in interesting and novel ways, so that the client's attention to the testing task is enhanced, compared with face-to-face administration.

Differences Between Testing and Psychological Assessment

The important distinction between testing and psychological assessment (Matarazzo, 1990) is particularly important for Internet testing sites. Internet site developers as well as many others unfortunately use the terms *testing* and *psychological assessment* synonymously when actually these



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terms mean quite different things. *Testing* refers to the administration, scoring, and perhaps the interpretation of individual test scores by applying a descriptive meaning based on normative, nomothetic data. The focus here is on the individual test itself. Administering a test is typically a relatively simple process that can be conducted by psychologists and possibly testing technicians, sometimes with relatively little training, or even by a computer. Although more than one test may be given, the emphasis in each case is the comparison of each individual test score with the scores of an appropriate normative group.

Conversely, in *psychological assessment*, the emphasis is typically on the person being assessed and the referral question, rather than on specific test results. Typically, an array of tests is given with an emphasis on their integration, taking many factors other than normative findings into account. The results of the tests are integrated among themselves, in the context of additional available patient-client data, such as history, observations, referral source, and information from friends and/or relatives. The eventual goal of the assessment is to answer the referral question or questions. Tests are typically used in the psychological assessment process, but much more information and often much more complexity is involved. The integration and interpretation of data in the assessment process requires a high degree of skill, psychological sophistication, and education.

The distinction between testing and psychological assessment is important because most of what is available on the Internet is testing, not psychological assessment. Therefore, the issue of method variance is an important one; for example, the test results obtained on the Internet may be inaccurate because of the specific method used in the testing and because there is no psychologist available to

assist in interpretation. Although it is conceivable that assessment on the Internet may be possible someday, the requirements for appropriate psychological assessment exceed current Internet capabilities.

Psychometric Advantages

Computerized tests provide some psychometric advantages in comparison with paper-and-pencil assessments. In fact, considerable research has been conducted to document and demonstrate these advantages. A brief summary is provided here; more detail can be found in Sands, Waters, and McBride (1997) and Drasgow and Olson-Buchanan (1999).

An Internet test and assessment provides more accurate scoring compared with a traditional paper-and-pencil test. Optical scanning of paper test forms encounters difficulties with stray pencil marks, incomplete erasures, and insufficiently darkened answers. In computerized testing, an examinee enters a response, the response is displayed on the screen, and the examinee is provided an opportunity to change the answer. Suppose an examinee has selected "B" as his or her response. The computer monitor will then display a darkened circle next to option "B" and will allow the examinee to change the response or proceed to the next item. If the examinee goes to the next item, well-designed software will correctly record and score the "B" response. A significant source of errors is removed when optical scanning is not used.

Internet testing and assessment is especially well suited for the use of item response theory (IRT; Hambleton & Swaminathan, 1985; Hulin, Drasgow, & Parsons, 1983; Lord, 1980). For example, computerized adaptive tests that tailor difficulty to the ability level of each examinee can be efficiently delivered through this medium. In this process, IRT technology would be used to select which items are given so that they are of appropriate difficulty for each examinee. Internet assessment can also offer the potential for assessing abilities and skills not easily assessed by paper-and-pencil methods. For example, Vispoel (1999) developed a computerized assessment of musical aptitude; Ackerman, Evans, Park, Tamassia, and Turner (1999) created a dermatological test that allows examinees to pan in and out as they examine color images of skin disorders; and Drasgow, Olson-Buchanan, and Moberg (1999) developed an assessment that uses video clips to assess respondents' conflict-resolution skills. These and many other needs can be effectively met using computerized technology that can be delivered via the Internet.

New Problems Yet Old Issues

Test-Client Integrity

In the same way that we do not allow clients to take tests at home, given that they might not take them privately, Internet testing encounters this old problem with a new twist. When the goals of the test taker differ from the goals of the test user, it is important to confirm the identity of the person answering items. The simplest and most effective method is to require test takers to go to a secure test site and show a government-issued photo ID such as a driver's



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license or passport. Of course, test administration at such sites is inconvenient and expensive. When a test or assessment is not administered at a secure test center, there are a number of ways to check a test taker's identity (e.g., "What is your mother's maiden name?"). Unfortunately, such methods can easily be circumvented; a more talented accomplice can sit with the supposed test taker and provide answers to items.

Segall (2001) suggested a clever means of confirming the validity of test takers' administered tests remotely via the Internet. He has proposed Internet administration of the lengthy Armed Services Vocational Aptitude Battery (ASVAB) enlistment test used by the U.S. military. Segall's idea is that individuals could take the ASVAB at their convenience in nonsecure locations. Individuals who obtain scores qualifying for enlistment would then travel to secure test centers, where they would be administered a much shorter confirmation test composed of highly discriminating items. A statistical procedure developed by Segall would then be used to check whether the test taker's original responses are consistent with the responses from the confirmation test. This method was found to be very effective at detecting cheating in a simulation study. A combination of informing examinees that a confirmation test will be administered as well as applying Segall's statistical analysis may also prove to be effective in discouraging cheating.

Test Security

Levels of security can range from highly secure and restrictive (e.g., high-stakes testing programs) to unsecured and permissive (low-stakes testing). As might be expected, the greater the level of security, the higher the cost for implementing and maintaining an application. The level of

security implemented for a given test or test site should be appropriately matched to the usage of the test. Secure test environments should use a three-tier server model. Within this model, the test system is actually made up of three independent servers: an Internet server, a test application server, and a database server. It is imperative that the application server is solely dedicated to the test application. In order to maximize the security of client data, a separate data server should be maintained behind a secure firewall. This configuration reduces the possibility of unauthorized intrusions into client test data. If scoring and reporting services are required, it is recommended that these applications be placed on yet a fourth server in the middle tier with the application server in order to minimize processing bottlenecks that may affect the test application or data access. Regular and frequent backups of all collected data should be conducted, and the provider should be able to give prospective customers a detailed disaster recovery plan. Redundancy allows a site to continue to operate even if one of its components completely fails. A reputable provider will have redundancy on all systems throughout its site including incoming and outgoing communications lines. As with any secure application, client and administrator password formats need to be robust (nontrivial) and actively maintained. Finally, server traffic should be actively and continuously monitored for intrusions.

On the client side, one of the most important security considerations is the prevention of unauthorized copying by the examinee or an observer and printing of test items. This can partially be achieved within a browser by disabling access to menu selections such as cut, copy, paste, export, save, save as, print, print screen, and so forth. Hot keys and right mouse context menu selections should also be disabled. However, it is only possible to partially secure items by controlling browser functions. Even with such controls in place, it is still possible for more technically knowledgeable examinees to make use of operating system features and other applications to capture items from the screen. Therefore, where full client-side security is required, it is necessary to install a test security agent on the client's desktop, which completely prohibits an examinee from dropping out of the test application while it is in operation. Such an application prevents users from launching screen recorders, word processors, e-mail applications, and any other unrelated application that may be used to compromise the security of test items.

Issues for Special Populations

The delivery of psychological tests through the Internet provides the opportunity to meet the needs of a wide variety of individuals, in particular, important special populations including people with disabling conditions and culturally and linguistically diverse persons.

People With Disabling Conditions

A critical issue in determining appropriate accommodations for a person with a disability is demonstrating the clear relationship between the individual's deficit and the

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nature of the accommodation. The challenge of determining the type of accommodations required for Internet-based assessment arises in part because little is known about the unique aspects of testing in this format. Although many of the accommodations developed for paper-and-pencil testing can be used for Internet assessments, new issues will likely arise. As psychologists begin to make recommendations to institutions on behalf of individuals with disabilities or on behalf of institutions attempting to design fair testing practices for groups of individuals with disabilities, it is important to consider new types of accommodations to address the unique problems inherent in Internet assessment.

Accommodations may be considered in terms of operating at the level of the individual or at the level of the group. At the individual level, adequate accommodations include alterations in the testing environment. Although this is standard practice with paper-and-pencil testing, unique challenges may be encountered with Internet assessments because the computer may be permanently affixed in one position. Adjusting the height and placement of the table on which the computer sits is critical for an individual in a wheelchair. For some disabilities, accommodations require alterations to test administration itself rather than alterations to the environment. For example, a reader is often recommended for individuals who are sight impaired or who have a specific reading disability (e.g., dyslexia). During Internet-based assessment, there is likely to be a new vocabulary to describe the spatial layout of the material and the actions taken by the reader (e.g., rather than stating, "I am filling in Answer A on the scantron sheet," the reader might say, "I am clicking Choice A on the answer screen"). These accommodations are not unique to testing over the Internet, but are unique to testing on a

computer platform, the frequency of which will likely increase as Internet technology advances.

At the group level, a lack of equal access to technology may result in poorer test performance for some groups. Households with lower incomes have reduced access to computers and therefore the Internet. Assessment over the Internet, therefore, may be confounded by the novelty of the format. For example, during cognitive testing, individuals who are less familiar with computers will have a greater cognitive load due to divided attention than individuals who are familiar with computers. Further, a lack of familiarity with the security and privacy features of the Internet may influence performance. In this sense, low access to computers may be viewed as a disability that requires accommodations to ensure fair testing.

Culturally and Linguistically Diverse Groups

Many culturally and linguistically diverse groups, including Latinos and African Americans, have been among the last to connect to the Internet because of economic and/or access issues. Yet, the number of people from these and other minority groups who have access to the Internet is increasing dramatically. For these groups, the Internet is proving to be a tool that connects them to their country of origin, resources in a particular language or dialect, and so forth.

Like the majority Euro-American population, members of these groups have also begun to access the Internet for information related to mental health and psychology. For example, it is not unusual for a Spanish-speaking Latino to seek out information about a particular mental condition or even a psychological test instrument through the Internet. The person is now likely to find information in Spanish, usually from an Internet site in Latin America. Similarly, the person may seek information about a particular test that he or she is about to take that will be administered by a psychologist (e.g., for employment screening or child custody purposes).

There remain many unanswered questions regarding the psychological testing and assessment of these groups via the Internet. In many ways, these issues are similar to concerns related to test use with culturally diverse or minority groups (e.g., fair assessment). For example, it is unclear if it is necessary to have separate norms, including norms for minorities, for an instrument that is administered via the Internet versus administered in the traditional manner. Also, a review of various Web pages indicated that many instruments are poorly translated, or have been modified for use with Latinos in the United States or Latin America, by Spanish-speaking professionals usually outside of the United States. Additionally, older measures, such as the MMPI, can still be found in Spanish despite the appearance of recent translations of the MMPI-2 that are superior to the translations of the older MMPI. People may use old and outdated instruments in a manner that is inappropriate or problematic, which may then result in negative consequences for clients and the public.

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Ethical and Professional Issues

Ethical issues abound for psychologists who use the Internet in their practice. Many of these issues are being addressed by specific APA committees (American Psychological Association, 1997). Although all of the ethical issues surrounding the use of the Internet in the practice of psychology are important, we confine our discussion to the issues specifically raised around Internet testing. Our discussion is framed by the current APA *Ethical Principles of Psychologists and Code of Conduct* (American Psychological Association, 2002), specifically Section 9, Assessment, which covers most of the issues surrounding Internet testing.

The first ethical issue to be considered is the professional context in which the Internet testing takes place. The associated ethical principle is as follows:

9.01 Bases for Assessment

(a) Psychologists base the opinions contained in their recommendations, reports, and diagnostic or evaluative statements, including forensic testimony, on information and techniques sufficient to substantiate their findings.

(b) Except as noted in 9.01c, psychologists provide opinions of the psychological characteristics of individuals only after they have conducted an examination of the individuals adequate to support their statements or conclusions. When, despite reasonable efforts, such an examination is not practical, psychologists document the efforts they made and the result of those efforts, clarify the probable impact of their limited information on the reliability and validity of their opinions, and appropriately limit the nature and extent of their conclusions or recommendations.

(c) When psychologists conduct a record review or provide consultation or supervision and an individual examination is not warranted or necessary for the opinion, psychologists explain this

and the sources of information on which they based their conclusions and recommendations. (American Psychological Association, 2002)

The issue raised by Internet testing is how testing is placed into a professional context when conducted on the Internet. Many tests on the Internet are accompanied by little other than some broad statements about the use of the test. Further, test takers may not read instructions or may ignore disclaimers more than in face-to-face situations (Barak & English, 2002). Under these principles, test materials that are posted for self-administration and interpretation on the Internet should be accompanied by a statement to the test taker that clearly defines the bounds and limitations of the professional relationship with the client that can be achieved through this medium. This may seem a bit counterintuitive given the impersonal nature of Internet communications. However, a potential client who is browsing the Internet for professional advice is seeking a trust relationship. Providing preliminary test materials for diagnostic or evaluative purposes therefore implies an offer to form this trust relationship. Thus, the limitations of the relationship that can be developed through an impersonal medium such as the Internet should be clearly described in an opening statement to the test taker. In addition, test providers may need to make available contact information (e.g., e-mail address, phone number) for those who do not completely understand directions or the purpose of the test. Finally, the limits of the feedback provided to the test taker following the test should be clearly described both before the test and preceding feedback. This description should clearly describe the potential limitations of conclusions and recommendations that can be made as a result of a very limited and potentially nonpersonal Internet approach.

The next area of ethical consideration involves the appropriate use of Internet testing and assessment. The ethical principle states the following:

9.02 Use of Assessments

(a) Psychologists administer, adapt, score, interpret, or use assessment techniques, interviews, tests, or instruments in a manner and for purposes that are appropriate in light of the research on or evidence of the usefulness and proper application of the techniques.

(b) Psychologists use assessment instruments whose validity and reliability have been established for use with members of the population tested. When such validity or reliability has not been established, psychologists describe the strengths and limitations of test results and interpretation.

(c) Psychologists use assessment methods that are appropriate to an individual's language preference and competence, unless the use of an alternative language is relevant to the assessment issues. (American Psychological Association, 2002)

Internet testing, in many cases, has been simply a process of putting paper-and-pencil or computerized tests onto a new medium. However, although research has explored the equivalence of some forms of computerized and paper-and-pencil tests (e.g., Mead & Drasgow, 1993), very little research has been conducted on the equivalence of Internet

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testing with these other formats. This may call into question the evidence for the usefulness of these tools. Further, tests that may have been developed and researched in a proctored setting are now often being used in an unproctored context that is facilitated by the Internet and its widening accessibility. This approach calls into question the proper application of the techniques. The effects of both the medium and the context require additional research to ensure appropriate use of tests and assessment on the Internet.

As noted earlier, an advantage to using the Internet to deliver tests is that it may provide greater accessibility and reach than an approach that requires an individual to be at a certain place, at a particular time. This advantage can also create a challenge. Wider access may cause a difference in the populations for which the test was developed versus the ultimate population that has access. For example, a preemployment test may be specifically developed and researched for a management population. Under more traditional conditions, applicants for these management positions may be required to test at a specific location where a significant effort and commitment is involved. However, the Internet may provide easy access to a different population where a nonqualified candidate could decide that he or she might just take the test on the off chance that he or she might gain entry to an otherwise inaccessible position.

Normative issues are also a related concern for Internet test delivery. With good intentions, a test may be placed on a Web site by a psychologist in the United States, but someone in China may have access to it and complete the test. Feedback may be based only on U.S. norms. An inadvertent, but inappropriate, use of norms is the result. This is clearly an area of great potential for the inappro-

priate use of tests and associated norms. Psychologists will need to make substantial efforts to collect demographic information prior to testing and to provide feedback only to individuals in groups for which normative data are available.

The next area of ethical consideration involves informed consent. The ethical principle states the following:

9.03 Informed Consent in Assessments

(a) Psychologists obtain informed consent for assessments, evaluations, or diagnostic services, as described in Standard 3.10, Informed Consent, except when (1) testing is mandated by law or governmental regulations; (2) informed consent is implied because testing is conducted as a routine educational, institutional, or organizational activity (e.g., when participants voluntarily agree to assessment when applying for a job); or (3) one purpose of the testing is to evaluate decisional capacity. Informed consent includes an explanation of the nature and purpose of the assessment, fees, involvement of third parties, and limits of confidentiality and sufficient opportunity for the client/patient to ask questions and receive answers.

(b) Psychologists inform persons with questionable capacity to consent or for whom testing is mandated by law or governmental regulations about the nature and purpose of the proposed assessment services, using language that is reasonably understandable to the person being assessed.

(c) Psychologists using the services of an interpreter obtain informed consent from the client/patient to use that interpreter, ensure that confidentiality of test results and test security are maintained, and include in their recommendations, reports, and diagnostic or evaluative statements, including forensic testimony, discussion of any limitations on the data obtained. (American Psychological Association, 2002)

Gaining true informed consent through electronic means is likely to create unique challenges for psychologists. As noted earlier, the impersonal and standardized nature of Internet testing programs are not likely to fit all individuals the same. In other words, it may be very difficult to provide true informed consent to all individuals completing tests through the Internet. In many cases, it will not be known whether the person completing the test is capable of giving informed consent or whether permission is required from a legally authorized person. Take, for examples, a preteen who poses as an individual over 18 years old or a patient under the legal guardianship of another who gives consent in order to gain access to testing. Psychologists who wish to use testing on the Internet, other than for excepted practices, will need to find ways to deal with this thorny problem of how to authenticate informed consent over the Internet.

The next area of ethical consideration involves the appropriate release of test data. The ethical principle states the following:

9.04 Release of Test Data

(a) The term *test data* refers to raw and scaled scores, client/patient responses to test questions or stimuli, and psychologists' notes and recordings concerning client/patient statements and behavior during an examination. Those portions of test materials that include client/patient responses are included in the definition

of test data. Pursuant to a client/patient release, psychologists provide test data to the client/patient or other persons identified in the release. Psychologists may refrain from releasing test data to protect a client/patient or others from substantial harm or misuse or misrepresentation of the data or the test, recognizing that in many instances release of confidential information under these circumstances is regulated by law. (See also Standard 9.11, Maintaining Test Security.)

(b) In the absence of a client/patient release, psychologists provide test data only as required by law or court order. (American Psychological Association, 2002)

Psychological test data reveal very personal details about human characteristics, behaviors, preferences, and capabilities. This type of data is not only valuable to psychologists, but is also valuable to sales, marketing, political, and other groups who may or may not have the individual's best interest in mind when deciding how to use these data. Therefore, it is imperative that measures be taken to provide secure sites for the collection of psychological test data on the Internet. Without secure sites, test data could be intercepted, corrupted, or changed by unscrupulous data thieves and hackers. There are three major principles of Internet security, and psychologists using the Internet for testing should take proactive steps in each of these areas to protect test takers (Howard, Paridaens, & Gramm, 2001). The first principle is confidentiality, which deals with keeping information from being viewed by unintended readers. Encryption technology is designed to provide confidentiality by scrambling data so that only the appropriate senders and receivers can read the data. The second principle is integrity, which is concerned with keeping information from being altered. Message digests are fingerprints that do not allow the changing of information or at least can detect when information has been changed. The final principle is authentication, which relates to identifying the origins of the data. Digital signatures can provide the authentication through a system of keys that are used both in the sending and receiving of messages to identify the sender as authentic. Given the value and highly sensitive nature of psychological test data, psychologists should use technologies in each of these areas to secure data.

The sharing of data and reports is infinitely easier as a result of Internet-based access to databases. People anywhere in the world can access databases anywhere else at the click of a button, given the correct security clearance. This ease of access provides more opportunity than in the past for both the intentional and the inadvertent release of data to unqualified individuals. Safeguards must be put in place by psychologists, in conjunction with information technologists, to avoid the release of data to those who are unqualified to use it. Although there are many technological safeguards available to protect data, the psychologist's responsibility goes further. It extends to building lines of communication, to the use of training materials, and to other means of safeguarding data that involve the human element that is more likely to result in security breaches compared with the failure of technology.

The next ethical issue of note in the use of tests on the Internet has to do with test development efforts. The ethical principle reads as follows:

9.05 Test Construction

Psychologists who develop tests and other assessment techniques use appropriate psychometric procedures and current scientific or professional knowledge for test design, standardization, validation, reduction or elimination of bias, and recommendations for use. (American Psychological Association, 2002)

Traditional test construction techniques are appropriate for administration over the Internet in proctored test environments. However, as noted earlier, tests developed in a paper-and-pencil format and researched in monitored and controlled situations cannot be assumed to provide equivalent measurement when administered over the Internet in unmonitored and uncontrolled situations. Therefore, additional studies of test equivalence and norming should be conducted over the Internet, with subjects completing the test under conditions that represent those that the intended target population will experience (Epstein, Klinkenberg, Wiley, & McKinley, 2001).

Advances in computer and Internet technologies have provided the medium for many new advances in testing. Video-based simulations, virtual reality, computer adaptive testing, and precision measurement of physiological responses are examples of technological advances that are shaping the new testing landscape (Olson-Buchanan, 2002). Integrated systems approaches are also beginning to appear. For example, in the area of preemployment testing, methods and tools such as job analysis, recruitment systems, prescreening tools (i.e., questionnaires, application blanks, etc.), selection tests, interviews, and hiring decisions are being integrated in a fully Internet-based or enterprise system that challenge the existing psychometric knowledge base (Drasgow & Olson-Buchanan, 1999; Funke & Schuler, 1998). Therefore, it is incumbent on psychologists to understand the bounds of current psychometric methods and to establish, research, and report on new methods that support emerging technological advances. It would be unethical to develop new measurement tools that cannot be held to existing psychometric standards (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999) without providing arguments and evidence for new or revised standards. Advances in testing spurred by the Internet should be encouraged, but associated advances in psychometric theory may be a mandatory part of this advancement (i.e., in cases where existing models are inappropriate).

The interpretation of Internet test results poses some unique ethical considerations. The relevant ethical principle is as follows:

9.06 Interpreting Assessment Results

When interpreting assessment results, including automated interpretations, psychologists take into account the purpose of the assessment as well as the various test factors, test-taking abilities, and other characteristics of the person being assessed, such as

situational, personal, linguistic, and cultural differences, that might affect psychologists' judgments or reduce the accuracy of their interpretations. They indicate any significant limitations of their interpretations. (American Psychological Association, 2002)

Internet testing will often be conducted in unproctored and in variable environments. Test takers will likely be in unstandardized settings (e.g., home, library, school), and psychologists will have little or no way of knowing exactly what conditions might exist that could influence or limit interpretations. This problem may be alleviated to some extent by the use of instructions to test takers, but it is likely that this will only reduce a small amount of irrelevant variability in scores. Further, when tests are completed in unmonitored situations, there is currently no way to guarantee the true identity of the test taker (Schmit, 2001). Thus, psychologists will need to weigh carefully the importance they place on tests administered over the Internet. Confirmatory methods, administration of equivalent forms, or gathering of data through additional methods will almost always be necessary before making anything other than preliminary evaluations, diagnostic, or predictive decisions.

Gaining an understanding of the test-taking skills and specific personal characteristic of the test taker poses an even greater challenge, given the impersonal approach that characterizes most Internet-based testing and assessment. For example, in preemployment testing situations, a provider may have no way of knowing whether an applicant has a particular disability that might affect the test results and invalidate the possible interpretation of those results. Similarly, a test may be posted in English for use in counseling, but the test taker speaks English only as a second language. Unless the test taker is asked about this condition, the interpretation of results will likely be flawed. The point is that psychologists using Internet testing and assessment must make provisions for understanding the unique needs of test takers that may ultimately affect the interpretation of results.

In addition, test takers must be given information that clearly identifies the purpose of the test so that they can determine whether the test is appropriate for their situation. However, this may not be as easy as providing a purpose statement. The test taker will need help understanding whether the test is a fit for his or her situation. There will likely be a need for prescreening the test taker to help him or her understand whether the test or assessment is right for his or her situation.

The next set of ethical issues to be considered with regard to Internet testing involves the use of Internet tests by unqualified persons. The ethical principle states the following:

9.07 Assessment by Unqualified Persons

Psychologists do not promote the use of psychological assessment techniques by unqualified persons, except when such use is conducted for training purposes with appropriate supervision. (American Psychological Association, 2002)

The Internet has made it very easy for anyone to publish any kind of material in the public domain. This freedom has led many to assume that anything published on

the Internet is in the public domain and can be copied and used by anyone who chooses to do so. These and other Internet crimes are raising significant challenges for many professions (Reno, 2000). Whole tests, scales, and test items posted on the Internet can be copied and used by unqualified people. It is the responsibility of psychological test publishers and authors to keep their works under tight control and to report copyright violations. Most do this well with customers who use appropriate channels to gain access to the materials. However, publishers and authors must scan the Web for whole and partial elements of tests that require professional training for administration or interpretation. Partial tests are likely to be the most difficult to identify, yet they may be the most damaging, as the original psychometric properties are likely denigrated. Consistent with Principle 9.11 (cited below) publishers must also protect their copyrights on test materials. It is the duty of the psychology profession to protect the public from unscrupulous vendors who exploit the Internet with tests of others or, worse yet, with bad renditions of the original test.

Principle 9.07 is written in a way that may suggest that psychologists take reactive steps rather than proactive steps in the protection of the profession. However, others have taken more proactive measures to protect the public. For example, a mental health consumer advocacy and education program has stepped up a process for checking credentials of online counselors (Ainsworth, 2002). Online therapists can register with this organization and have their credentials (e.g., education, experience, background) checked. Therapists who pass this check are issued a special icon for posting on their Web site. Clients can go to the advocacy group's Web site to verify the authenticity of the therapist. A similar program could be established by a consortium of test publishers who have or plan to have their psychological test products administered on the Internet.

The next ethical principle to be considered deals with outdated test materials. It reads as follows:

9.08 Obsolete Tests and Outdated Test Results

(a) Psychologists do not base their assessment or intervention decisions or recommendations on data or test results that are outdated for the current purpose.

(b) Similarly, psychologists do not base such decisions or recommendations on tests and measures that are obsolete and not useful for the current purpose. (American Psychological Association, 2002)

The Internet is full of obsolete and outdated information. Consumers often have difficulty sorting out the current from the outdated pages available on the Internet. Consistent with the discussion of the previous principle, when partial or whole replication of test materials is made through uninformed or fraudulent acts, these tests materials are likely to become obsolete or outdated, because the original publisher updates the materials. Further, it is quite easy for Web publishers to forget about published pages on the Internet that may be updated in different places, yet the old materials remain available to the public. Finally, psychologists who do not closely watch the literature and other

materials from test publishers may inadvertently use outdated materials online. Others may resist change and intentionally use outdated materials. As previously noted, test publishers and authors must carefully monitor the Internet for obsolete and outdated materials and take both proactive and reactive steps to curb and eliminate these practices.

Third-party vendors of Internet tests and associated services also have a set of ethical issues to consider. The relevant ethical principle states the following:

9.09 Test Scoring and Interpretation Services

(a) Psychologists who offer assessment or scoring services to other professionals accurately describe the purpose, norms, validity, reliability, and applications of the procedures and any special qualifications applicable to their use.

(b) Psychologists select scoring and interpretation services (including automated services) on the basis of evidence of the validity of the program and procedures as well as on other appropriate considerations.

(c) Psychologists retain responsibility for the appropriate application, interpretation, and use of assessment instruments, whether they score and interpret such tests themselves or use automated or other services. (American Psychological Association, 2002)

The Internet is full of psychological, para-psychological, and pop-psychology tests, as described in earlier sections. Psychologists must find ways to differentiate themselves from the mass of alternatives that do not meet professional standards (American Educational Research Association et al., 1999). Providing the information described in this ethical principle is the first step in overcoming such confusion. Psychologists who provide tools to other trained professionals should go beyond the simple provision of providing basic psychometric information to potential users. Steps could be taken to show the equivalence of Internet testing with traditional forms of the measure (Epstein et al., 2001). Efforts should also be made to provide consultation and training to test users regarding the challenges faced in using tests on the Internet (Barak & English, 2002). The training should be specific to tests and populations that will take the tests. Professional vendors of psychological tests to be used on the Internet may be able to overcome some of the noise of Internet marketing by becoming professional Internet test consultants. Producers of pop-psychology tests should be made to issue more detailed disclaimers, or warnings, describing their tests as entertainment and not as true tests, just as tobacco manufacturers must issue store warnings on cigarette packages.

The advent of technological breakthroughs and the ease of conducting a professional practice that results from these innovations can occasionally blind adaptors to the fundamental qualities that comprise quality tools. Psychologists must learn to discriminate among efficient delivery tools, flashy format, face-valid content, and psychometric quality. All of these qualities may be important to a psychologist in choosing a vendor, but the foundations of psychometrics are still necessary conditions that should be the first hurdle in a multihurdle decision process. Technology advances should not be considered in a vacuum when choosing an Internet test.

Perhaps one of the greatest challenges of Internet testing will involve the explanation of results to test takers. The ethical principle dealing with this issue is as follows:

9.10 Explaining Assessment Results

Regardless of whether the scoring and interpretation are done by psychologists, by employees or assistants, or by automated or other outside services, psychologists take reasonable steps to ensure that explanations of results are given to the individual or designated representative unless the nature of the relationship precludes provision of an explanation of results (such as in some organizational consulting, preemployment or security screenings, and forensic evaluations), and this fact has been clearly explained to the person being assessed in advance. (American Psychological Association, 2002)

Providing feedback to test takers over the Internet is a topic of concern to many psychologists. There are at least three major ethical issues to consider. First, there are limited ways to understand the conditions under which the test taker completed the test. Did the individual complete the test or did someone else help or do it for him or her? Under what environmental conditions was the test taken? These and many other questions should be answered in order to provide accurate feedback. Second, it is very difficult to provide feedback, particularly negative feedback, to a test taker without knowing the person's emotional and mental state. The wrong type of feedback could exacerbate the individual's condition. Third, it is difficult to provide test takers with immediate emotional support in cases where the feedback has traumatic effects on an individual. It is also difficult to know the extent of these reactions in the first place. Given these severe limitations and many other possibilities, psychologists should rarely provide feedback over the Internet. When they do provide feedback, processes for resolving these ethical issues either in "real time" or within a reasonable time period should be established. Feedback should generally be limited and should include directions for seeking additional information and help through other means. Ultimately, feedback should rely on multiple methods of evaluation to provide assessment results consistent with professional best practice.

Another rather charged area of ethical concern is the maintenance of test security when tests are delivered over the Internet. The ethical principle covering this set of issues is as follows:

9.11. Maintaining Test Security

The term *test materials* refers to manuals, instruments, protocols, and test questions or stimuli and does not include test data as defined in Standard 9.04, Release of Test Data. Psychologists make reasonable efforts to maintain the integrity and security of test materials and other assessment techniques consistent with law and contractual obligations, and in a manner that permits adherence to this Ethics Code. (American Psychological Association, 2002)

As the music industry can attest, the ease of posting material on the Internet has led to widespread violations of copyright laws. Many psychological tests and assessments are copyrighted because much effort was expended in their

development. These instruments constitute much of test publishers' intellectual capital and must be safeguarded. It is unethical and illegal for unauthorized parties to distribute or use such copyrighted materials. In fact, a quick search of www.ebay.com on any given day will produce quick access to many copyrighted and sensitive test materials. For example, a quick search on June 18, 2003, produced the opportunity to bid on an *MMPI Manual for Administration and Scoring* together with unused testing materials as well as the opportunity to purchase Rorschach Psychodiagnostic Plates.

In this section, we have made an attempt to raise issues, offer guidance, and delineate some of the ethical issues surrounding Internet testing. Although we have touched on many issues, this is certainly not a comprehensive list. We have shown, however, that the current APA *Ethical Principles of Psychologists and Code of Conduct* (American Psychological Association, 2002) provide strong guidance for Internet testing. We believe most issues can be resolved by studying these principles and making conservative interpretations that protect both clients and the general public.

Recommendations for the Future

This examination of the issue of testing on the Internet leads to several conclusions. First, and perhaps most important, is that the current psychometric standards, including test reliability and validity, apply even though the way in which the tests are developed and delivered may be quite different. Unfortunately, because there are many more tests that are now available via the Internet, there is much variability in the quality of these tests. The extent to which there is documented evidence of the reliability and validity of these tests is also quite variable because many Internet tests do not seem to meet standards established by the profession. This puts consumers in the unfortunate position of having the responsibility of evaluating the quality of the information they receive, often with little knowledge and skill to do so. One conclusion is obvious: Internet testing should be subjected to the same defensible standards for assessment tools (American Educational Research Association et al., 1999) as paper-and-pencil tests when their results are used to make important decisions. Still, new methods and combinations of methods that are made possible by emerging technologies will push the boundaries of existing psychometric theory, and it is up to psychologists to test and expand the limits of psychometrics to keep pace with these innovations.

The Internet provides a tremendous opportunity for testing, and with that opportunity comes a corresponding need for the ethical and professional use of these tests and a responsibility to expand our science to test the usefulness of these interventions. Despite the flash and sparkle of Internet testing, critical questions of the validity of the inferences made from test scores must be demonstrated. This is a fundamental issue of test validity that must be weighed in relation to the ease of availability, cost, and convenience of Internet testing. All of these advantages become irrelevant if scores are used in ways that are not

supported by evidence of validity. The *Standards for Educational and Psychological Testing* (American Educational Research Association et al., 1999) provides extensive information about what is needed to justify a particular use of a test. Internet test developers and test users should carefully read the *Standards* and ensure that their tests are used in appropriate ways.

Although the Internet has considerable potential as a means of testing, assessment will require the integration of information obtained via this medium with other relevant information. For this reason, what is typically available on the Internet is testing in contrast to psychological assessment. The test results obtained on the Internet may be inaccurate for a variety of reasons and therefore there must be a professional available to verify the validity of the information and assist in interpretation. Although it is conceivable that future Internet testing methods may approach a psychological assessment, the requirements for appropriate psychological assessment exceed current Internet capabilities. Practitioners must, therefore, be mindful of this distinction and utilize the Internet for its strength and augment it with their assessment skills.

Tests can be placed on the Internet in a manner that suggests authority and conveys confidence, although many of these tests may have little to no documentation of reliability and validity, test takers often ignore disclaimers that might appear, and self-administered tests can yield inaccurate interpretations. What is needed is considerably more accountability of the Internet site authors so that the user receives the same kind of protections obtained in traditional assessment sessions. Similarly, test developers and publishing companies that enter into Internet testing programs should ensure that Internet tests are held to the same psychometric standards as traditional tests. This would include, for example, documentation summarizing standardization samples, reliability, and validity as well as additional evidence, such as equivalence of tests delivered on Internet and paper, uniformity of stimulus quality on different displays, and so forth, to ensure high quality test administration.

There are tremendous opportunities provided by Internet testing. This article has described many of them, and other innovations await discovery. The importance of this new method of testing and assessment is clear, as is the need for formal guidelines for Internet-based tests and the many ways in which psychologists may use this environment for a variety of applications. We encourage psychologists to think creatively about how their research and practice can be improved by Internet testing. Times have changed as the Internet has brought testing out of the secure environment controlled by a licensed professional psychologist or psychometrician. As testing becomes more accessible, it is important to realize that the principles of good testing still apply and the ethical standards for psychologists are still fundamental. Balancing widespread accessibility with good practice presents a critical challenge to psychologists for the new millennium. There are many issues that await resolution. Over the years to come, much research and critical thinking will be required to address

these issues. We believe that psychologists should look forward to this work with excitement and enthusiasm.

REFERENCES

- Abbate, J. (1999). *Inventing the Internet*. Cambridge, MA: MIT Press.
- Ackerman, T. A., Evans, J., Park, K. S., Tamassia, C., & Turner, R. (1999). Computer assessment using visual stimuli: A test of dermatological skin disorders. In F. Drasgow & J. B. Olson-Buchanan (Eds.), *Innovations in computerized assessment* (pp. 137–150). Mahwah, NJ: Erlbaum.
- Ainsworth, M. (2002). *Credentials check*. Retrieved January 11, 2002, from <http://www.metanoia.org/imhs/identity.htm>
- American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (1999). *Standards for educational and psychological testing*. Washington, DC: Author.
- American Psychological Association. (1997). *Services by telephone, teleconferencing, and Internet: A statement by the Ethics Committee of the American Psychological Association*. Retrieved January 11, 2002, from <http://www.apa.org/ethics/stmnt01.html>
- American Psychological Association. (2002). Ethical principles of psychologists and code of conduct. *American Psychologist*, *47*, 1597–1611. Available from the APA Web site: <http://www.apa.org/ethics/code1992.html>
- Barak, A. (1999). Psychological applications on the Internet: A discipline on the threshold of a new millennium. *Applied & Preventive Psychology*, *8*, 231–246.
- Barak, A., & English, N. (2002). Prospects and limitations of psychological testing on the Internet. *Journal of Technology in Human Services*, *19*, 65–89.
- Drasgow, F., & Olson-Buchanan J. B. (Eds.). (1999). *Innovations in computerized assessment*. Mahwah, NJ: Erlbaum.
- Drasgow, F., Olson-Buchanan, J. B., & Moberg, P. J. (1999). Development of an interactive video assessment: Trials and tribulations. In F. Drasgow & J. B. Olson-Buchanan (Eds.), *Innovations in computerized assessment* (pp. 177–196). Mahwah, NJ: Erlbaum.
- Epstein, J., Klinkenberg, W. D., Wiley, D., & McKinley, L. (2001). Insuring sample equivalence across Internet and paper-and-pencil assessments. *Computers in Human Behavior*, *17*, 339–346.
- Funke, U., & Schuler, H. (1998). Validity of stimulus and response components in a video test of social competence. *International Journal of Selection & Assessment*, *6*, 115–123.
- Hambleton, R. K., & Swaminathan, H. (1985). *Item response theory: Principles and applications*. Boston: Kluwer Academic.
- Howard, B., Paridaens, O., & Gramm, B. (2001, 2nd Quarter). Information security: Threats and protection mechanisms. *Alcatel Telecommunications Review*, 117–121.
- Hulin, C. L., Drasgow, F., & Parsons, C. K. (1983). *Item response theory: Application to psychological measurement*. Homewood, IL: Irwin.
- Internet Software Consortium. (2001, July). *Internet domain survey*. Retrieved January 11, 2002, from <http://www.isc.org/ds/WWW-200107/index.html>
- Lord, F. M. (1980). *Applications of item response theory to practical testing problems*. Hillsdale, NJ: Erlbaum.
- Matarazzo, J. D. (1990). Psychological assessment versus psychology testing: Validation from Binet to the school, clinic, and courtroom. *American Psychologist*, *45*, 999–1017.
- Mead, A. D., & Drasgow, F. (1993). Equivalence of computerized and paper-and-pencil cognitive ability tests: A meta-analysis. *Psychological Bulletin*, *114*, 449–458.
- Nielsen//NetRatings. (2001). *Hot off the net*. Retrieved January 11, 2002, from http://www.nielsen-netratings.com/hot_off_the_net.jsp
- Nielsen//NetRatings. (2003). *Monthly usage statistics*. Retrieved May 1, 2003, from http://www.nielsen-netratings.com/news.jsp?section=dat_to
- Olson-Buchanan, J. B. (2002). Computer-based advances in assessment. In F. Drasgow & N. Schmitt (Eds.), *Measuring and analyzing behavior in organizations* (pp. 44–87). San Francisco: Jossey-Bass.
- Pew Internet & American Life Project. (2003a). *The ever-shifting internet population*. Washington DC: Author.
- Pew Internet & American Life Project. (2003b). *Internet activities*. Retrieved May 1, 2003, from http://www.pewinternet.org/reports/chart.asp?img=Internet_A8.htm
- Reno, J. (2000, September). *Statement by the Attorney General. Symposium of the Americas: Protecting intellectual property in the digital age*. Retrieved January 11, 2002, from <http://www.usdoj.gov/archive/ag/speeches/2000/91200agintellectualprop.htm>
- Sands, W. A., Waters, B. K., & McBride, J. R. (Eds.). (1997). *Computerized adaptive testing: From inquiry to operation*. Washington, DC: American Psychological Association.
- Segall, D. O. (2001). *ASVAB testing via the Internet*. Unpublished manuscript.
- Schmit, M. J. (2001, September). Use of psychological measures for online recruitment and pre-employment selection. In L. Frumkin (Chair), *Internet-based assessment: State of the art in testing*. Symposium conducted at the 109th Annual Conference of the American Psychological Association, San Francisco, CA.
- U.S. Department of Commerce. (2002). *A nation online: How Americans are expanding their use of the Internet*. Washington, DC: Author.
- Vispoel, W. P. (1999). Creating computerized adaptive tests of music aptitude: Problems, solutions, and future directions. In F. Drasgow & J. B. Olson-Buchanan (Eds.), *Innovations in computerized assessment* (pp. 151–176). Mahwah, NJ: Erlbaum.