

Prospects and Limitations of Psychological Testing on the Internet

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SUMMARY. Internet-based psychological testing is a recent extension of computerized testing, a technology developed in the 1980s. The new procedure possesses the benefits and costs of computerized testing and introduces several new fascinating professional opportunities as well as new problems. Side by side with professional tests, numerous, mostly unmoderated, popular, quasi-psychological tests have been published on the Internet in different diagnostic areas: intelligence and special aptitudes, personality traits, emotional states, attitudes and attitude sets, interpersonal and social behavior dispositions, vocational interests and preferences, and more. Net surfers may take most tests for free and receive immediate feedback. Although there are great benefits to this new procedure, risks and problems exist, too. This article reviews representative Internet-based psychological tests and discusses their professional status. Cumulative research that tries to shed light on the possible utility of this testing procedure is surveyed. The prospects and advantages as well as the problems and limitations are discussed, as are proposals aimed at maximizing the former and minimizing the latter. A plea for in-

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tensive research, as well as additional and different types of measures, is voiced. [Article copies available for a fee from The Haworth Document Delivery Service: 1-800-HAWORTH. E-mail address: <getinfo@haworthpressinc.com> Website: <<http://www.HaworthPress.com>> © 2002 by The Haworth Press, Inc. All rights reserved.]

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The use of personal computers for psychological testing is not a new procedure. Although it is not entirely clear when the first attempt was made in this direction, publications on the procedure emerged almost two decades ago (Byers, 1981). With the development and sophistication of computer and communications technology and the training of professional users, computerized testing has become widespread. Personal computers—either as independent machines or as part of a local network—have been used successfully for testing purposes in organizations (Zickar, Overton, Taylor, & Harms, 1999), counseling and clinical agencies (Sampson, 1990), and schools (Kingsbury & Houser, 1999). Cumulative research clearly shows that computerized tests maintain the measurement reliability and validity of the original paper-and-pencil tests in different testing domains (Campbell et al., 1999; DiLalla, 1996; Neuman & Baydoun, 1998). In recent years, however, the introduction to psychology and the mental health professions of Internet communication and of advanced Internet technologies and software (Barak, 1999) has offered a new means of delivering psychological tests. This opportunity, in fact, has been exploited by many individuals and agencies alike through a great number of websites offering numerous psychological tests and questionnaires for diverse purposes: from mere entertainment to professional diagnostics to research data collection. The purposes of the current article are as follows: (a) to describe and discuss psychological testing procedures on the Internet; (b) to consider the pros and cons of Internet-based psychological testing; (c) to review the current available research on Internet-based psychological tests; (d) to discuss relevant legal and ethical issues; and (e) to propose directions for future research and development on this subject.

COMPUTERIZED TESTING: POTENTIAL BENEFITS AND PROBABLE COSTS

Internet-based testing includes all the advantages and disadvantages of personal (micro) computer-based testing, but introduces additional

factors, negative and positive. Therefore, a brief review of computerized psychological testing should precede the discussion and evaluation of Internet-based testing.

Two basic procedures exist for computerized testing: (a) simple conversion of paper-and-pencil tests into computerized form and (b) more advanced computerized adaptive testing. In the former case, test items and instructions are simply typed into a computer program. The program presents the instructions and trial or sample items to test-takers on a computer screen; respondents mark their responses through (usually) mouse clicks. Test-takers may move forward or backward along the items, change answers, and do anything they would have done on an equivalent paper-and-pencil test. The computer program also monitors the testing time of time-limited tests, and it may present additional tests if a test battery is used. Upon completion of the administration of the test, the program computes raw and standardized scores according to pre-programmed instructions. The usual options available are the following: supplying on-screen and/or printed test results to test-takers, providing test-takers with an overall evaluation, accumulating data to update test norms, and saving data for research purposes. In using the second procedure, Item Response Theory (see a recent review by Harvey & Hammer, 1999) is adopted to create adaptive testing. In this case, test-takers may respond, not to *all* test items, but to a minimum number of individually determined items that best predict the final test score/s. The number and nature of the items to be included in the test are either computer-determined (i.e., computerized adaptive testing) or self-determined (i.e., self-adaptive testing). In this procedure, the computer has the obvious advantage of mathematically estimating (according to a preset algorithm) optimal item collection to provide the most valid test scores (see Meijer & Nering, 1999).

Computerized tests present several clear advantages over standardized paper-and-pencil tests. First, disposable materials are saved. This advantage has implications for both short and long-range costs, for convenience of test administration, and for environmental protection. Second, because the tests are fully automated, they are more standardized in terms of test instructions and time-keeping. Third, precise scores can be calculated very rapidly, with unfortunate common human mistakes obviated and much time saved, especially in complicated-to-score tests and inventories. Fourth, scores may be automatically and easily added to a test's database to adjust norms and to be used for research. This advantage, too, may save considerable expense in terms of labor costs. In addition, the very availability of data sets may encourage research.

Fifth, test-takers have the advantage (in case this option is provided) of receiving immediate, objective, expert-based narrative feedback of their test findings. Moreover, if a complicated inventory or test battery is administered, a comprehensive, automated evaluation may be provided instantly, as well.

Alongside these advantages, there are several disadvantages and limitations to computerized tests. First, for test administrators, this procedure necessitates at least a basic knowledge in computer operations and sometimes also in programming. Although the need for computer literacy seems to be obvious in recent years, this may be a limiting factor for older professionals. Second, for test-takers, there are indications that computer skills—at least typing speed—may be related to test achievement (Russell, 1999). It should be noted, however, that this factor was found to be related to performance in open-ended tests, not multiple-choice tests (Russell & Haney, 1997). Third, there is debate about the accuracy of the computer interpretation of test scores, a problem that may become paramount in cases when comprehensive test batteries, or series of tests, are administered. Fourth, computerized tests might be inappropriate for test-takers who suffer from computer anxiety, as a unique, irrelevant error-variance might be introduced into observed scores, thus impairing test-result validity. This point has also been mentioned in relation to gender differences, the argument being that women, because of their greater computer anxiety and less computer sophistication, benefit less than men from computerized testing (Lankford, Bell, & Elias, 1994). This argument, however, has yielded inconsistent empirical findings (Anderson, 1996; Chua, Chen, & Wong, 1999; Miles & King, 1998). Similarly, in regard to age differences (i.e., older people are more computer anxious, hence are at a disadvantage with computerized tests); these have become minimal, as well (Dyck, Gee, & Smither, 1999).

Although not yet widespread, computerized psychological tests are flourishing. Many psychological tests have both paper-and-pencil and computer versions, the type selected by test administrators and/or takers according to specific local considerations.

FROM PERSONAL COMPUTER TO INTERNET-BASED PSYCHOLOGICAL TESTING

The formation of the Internet and its exploitation by psychology (Barak, 1999; Sampson, Kolodinsky, & Greeno, 1997) created an un-

precedented opportunity that has enabled the general public to use various psychological tools and services from a remote system. In the context of testing, the Internet was first exploited to transfer test results quickly and even to deliver complicated psychodiagnostic information for immediate consultation by means of videoconferencing (Ball, Scott, McLaren, & Watson, 1993). More sophisticated, efficient use of the Net for psychological testing soon followed; a test could be uploaded into a server anywhere on the Net, and users could take it from a distance in a place and at a time of their choice. Moreover, the development of CGI scripts and Java applets introduced a wide range of testing possibilities from a distance. Early Internet-based tests and questionnaires were in a form that included only a list of items and scoring instructions; this procedure then changed to computerized scoring, sometimes accompanied by interpretations and recommendations. Although this procedure best fits a multiple-choice testing format and Likert-type questionnaire items, the use of fast Internet communication (i.e., e-mail) made open-ended, even essay format possible, as well.

Internet-based testing requires a remote access connection (such as a phone line) and standard Internet-browsing software. In contrast to personal computer (or local network)-based testing, Internet-based testing does not require test software; the software is installed on a remote server that uses a few, rather standard capabilities of a user's personal computer (e.g., a Web browser, Java-language software, multimedia devices). Access to a particular Internet-based test may be open to all or limited to selected users by means of a password or other mechanism. Test time can be predetermined (by use of Java), but most Internet-based psychological tests are practically unrestricted in terms of time. For most tests, users are instructed to click their responses on an HTML form and to submit it when done through the click of a "send" button. Results, in most cases, are provided in seconds. Internet-based psychological tests include tests of various types and foci: tests of intelligence and of specific scholastic abilities, perceptual tests, clerical tests, measures of a wide range of attitudes, personality inventories and specific personality traits, vocational interests and attitudes, and more. While some of the tests reflect a Web version of preexisting pencil-and-paper tests, others are original.

EXAMPLES OF INTERNET-BASED PSYCHOLOGICAL TESTS

Listed as follows are some representative examples of Internet-based psychological tests to illustrate what is being developed and what is cur-

rently available on the Web. These examples are not meant to be an exhaustive list, for there are literally scores from which to choose, and many are quite professional. The examples are intended to be representative, reflecting the variety of types of tests available on the Net. All of the psychological tests discussed here are interactive, Web-browser-based tests that give the test-taker immediate feedback on results.

Psychiatry Information for the General Public, hosted by the New York University Department of Psychiatry (at <http://www.med.nyu.edu/Psych/public.html>) offers screening tests for the public related to depression, anxiety, sexual disorders, attention deficit disorder (ADDC), and personality disorders. The website also includes quality informational references on many psychological disorders and links to relevant reading materials. All of the tests are 10-item inventories of symptoms, with 4- or 5-point Likert scales or checklists. All have a disclaimer on the test page and on the results page as well as links for referrals and more information about the condition being tested. For example, Online Screening for Anxiety (OSA) is a 10-item checklist of anxiety-related symptoms. It has a short disclaimer that states, "OSA is a preliminary screening test for anxiety symptoms that does not replace in any way a formal psychiatric evaluation. It is designed to give a preliminary idea about the presence of mild to moderate anxiety symptoms that indicate the need for an evaluation by a psychiatrist." Hitting the submit/results button leads to a Web page with a summary of the symptoms that were checked and a message, "The above answer(s) are anxiety symptoms that might be part of an Anxiety Disorder. It is advised to seek a psychiatric consultation," and links to referral information and information on anxiety from NIMH. The format is similar for the other tests. No psychometric information is provided.

Queendom.com: Tests, tests, tests is a battery of original psychological tests (at <http://www.queendom.com/tests.html>) offered at no charge to the public. This site is geared toward self-help and personal growth. It includes a short description of what each instrument is intended to measure, clear instructions on how to take the test, and the amount of time each requires. The site offers inventories on anxiety, social anxiety, self-esteem, communication skills, coping skills, assertiveness, Type A personality, lifestyle, extraversion/introversion, sales personality, IQ, jealousy, relationship satisfaction, depression, emotional IQ, leadership, locus of control, burnout, optimism, relationship attachment, PMS, and arguing style. A disclaimer is clearly stated on the homepage: "While psychological tests may help you get to know yourself better, they cannot solve your problems and do not replace professional care."

Each test has a different format, whether Likert scales, multiple choice, checklists, or a combination of these techniques. Scoring is immediate, the results giving feedback on the number of responses, percentages, and percentiles. The Optimism test, for example, provides clear instructions on how to answer the questions, what will happen in the case of an omitted response, and the amount of time it takes to complete. The test has 18 multiple-choice questions and takes 10-20 minutes to complete. Once submitted, the results are reported immediately, giving the range of scores (0-100) and a short narrative of the results. The "Results" page also presents a link to yet another personality test. The site includes referrals to counselors and links to further psychological information. Although there are a number of advertising banners on each page, the layout of the site has a crisp, clean appearance, and it is easy to maneuver. Reliability and validity data are available for most scales. Copyright restrictions are clearly stated with exceptions made for non-commercial research for which the researcher registers to use. With the exception of licensing for research, scoring must be done online with the forms supplied by the website.

Self Discovery Workshop (at <http://www.iqtest.com/index.html>) is an IQ test provided to the public for free with the hope that takers of the test will purchase the site owners' Complete Personal Intelligence Profile. According to the history of the test, it was developed for the Institute for Self Improvement with the main goal of creating an accurate, quick, and entertaining test that could be marketed commercially to the general population. The site discusses the meaning of the IQ score in terms of academic potential; it cautions readers that scores do not guarantee happiness. The free test gives a complete page of instructions, and the opportunity to take three practice questions. During the actual test, 38 true/false questions are presented, to be answered in approximately 13 minutes. Scores are penalized or increased for completion in more or less than 13 minutes. The results, a general IQ score based on an average of 13 different abilities, are returned immediately. The site claims that the test's results are generally within five points of a professional test. A "Frequently Asked Questions" list is available to those who want more detailed information about how the test is evaluated.

Keirse Character and Temperament Sorter (at <http://keirse.com/index.html>) provides two typological-style personality scales, very similar to the Myers-Briggs Temperament Inventory (MBTI) on which they are based. The first test is a 38-item inventory with a combination of multiple-choice, 4-point Likert scales and two-dimensional checklist. The results, returned immediately, give a graphical representation

of one's temperament. The temperament descriptions can be read in detail from the site itself or from the author's book. The second test looks more like the original inventory from the book; it is a 70-item, two-dimensional checklist that gives a graphic display of temperament scores. The site is informational and interesting, but it is more of a promotion for the books than it is therapeutic. No psychometric information is provided.

What's Your Emotional Intelligence Quotient? (at <http://www.utne.com/azEQ.tmpl>) gives an Emotional Intelligence Quotient test based on Daniel Goleman's book. The site offers a 10-item, multiple-choice test, with immediate feedback detailing how each question is scored. It discusses the basics of emotional intelligence and explains where the score falls relative to an average score. No psychometric information is made available.

Organizational Diagnostics Online's Profiler test (at <http://od-online.com/webpage/intro.htm>) is described at the website as the "first personality test on the Internet that provides comprehensive feedback written by psychologists." It is a 50-item test that includes sections containing a Likert scale, a checklist inventory, and questions concerning one's position in the workplace. Interpretation provided by trained psychologists, offers a unique profile detailing one's strengths and weaknesses. Results are immediate. The Summary Report evaluating one's personality is free; it includes a description of degree of extroversion, agreeableness, thoroughness, openness to experience, and emotionality. For payment, additional information may be provided, such as on career match, work style, and interpersonal relationships. No psychometric information is made public on this website.

ADVANTAGES AND DISADVANTAGES OF INTERNET-BASED PSYCHOLOGICAL TESTING

Advantages

Electronically-created tests are easy to design, create, alter, and distribute (English, 1996). Almost any word processor or editor can be used to design the instrument; once created in a digital format, it can be converted into whatever form is needed for distribution, be it e-mail or Internet (using browser-based software tools). For the purpose of this article, emphasis is given to browser-based Web technology for testing,

and it is assumed that e-mail will be used predominantly to distribute the URL of a Web page containing a test.

One of the advantages directly related to research of using browser-based technology is that it can be used locally (on a personal computer) or remotely (via the Web) or in a combination of both, depending on the needs of the researcher and the situation. This flexibility can allow a researcher to take a laptop to a certain site, collect data, and later use a browser interface to upload the data to a single, centralized location where the data can be scored and archived.

Another advantage of using a browser interface for testing is that a researcher can easily solicit participants who are already on the Web to participate in a study and take a test via the Web (English, 1997). In this way, the participants can take the test at their leisure, in the privacy of their own surroundings, at any time during the day or night. Once the software is in place, the researcher can collect data automatically without having to administer the test personally to each participant. Because of the ease of distribution of Internet-based tests, large numbers of potential participants can be contacted (and can respond) in a relatively short amount of time (Buchanan & Smith, 1999). Depending on the nature of the study, a wide variety of types or a single focus group that might otherwise be difficult to locate can be contacted. The flexibility of a browser interface and Web technology allows a test to be distributed widely, with practically no political or geographical border. Yet, this procedure enables the data and scoring to remain in one central location (be it with the researcher, the publisher, or other copyright holder), which is a great advantage when standardizing new instruments.

Another advantage refers to test-takers' feedback. Depending on how the instrument is to be used, informational feedback can be given to the test-taker or more detailed, diagnostic feedback given to a counselor in a remote area for professional screening. The user may merely take the test or upload the responses and receive results without concern for scoring, which can be done automatically.

An additional advantage relates to the sensitive issue of illegal copying of tests. Depending on how an Internet-based test is laid out, it can be made more difficult to print or reproduce than a paper test. Without the ability to score them, however, the test questions are not very useful. A paper test can be taken to the nearest copying machine and reproduced until resources are exhausted. A Web-test program can be written in such a way that its reproduction would be tedious and difficult. For example, questions can be broken up to appear on different pages, mak-

ing printing a very lengthy process; or creative colors used to make printing more expensive and time-consuming. In any event, if someone is determined to copy a psychological test, it is generally easier, more convenient, and cheaper to obtain a paper copy of the instrument and have it mass produced than it is to print it off the Web.

There are a few other specific advantages that relate to the specifics of test designing. Data can be collected in a relatively secure way to protect privacy and insure confidentiality. The Web test pages can be constructed with mandatory fields to prevent oversights or omissions during testing. Participants can take a Web test anonymously, in private, and at their own pace, which encourages veracity in responses (Anderson, 1987; Turner, Ku, Rogers, Lindberg, Pleck, & Sonenstein, 1998; Wolford & Rosenberg, 1998). Often, participants feel more comfortable revealing sensitive data about themselves to a computer than to a human interviewer (Kobak, Geist, Jefferson, & Katzelnick, 1996; Turner et al., 1998; Wolford & Rosenberg, 1998). If follow-up is desired, an entry can be created for the participant to leave an e-mail address while the researcher can leave a contact e-mail address on the Web test for future questions. Participants who would like to follow the outcome of a particular study can be given a "results" Web page for further information (English, 1996). This simple procedure may encourage researchers to adhere to APA's (1992) Code of Ethics in regard to providing debriefing and making research results available to participants.

In summary, an Internet-based test is convenient to construct, revise, distribute, and standardize, and it offers a researcher the opportunity to gather a great deal of data in a relatively short amount of time. This type of test is also convenient to take, use, score, and receive informational feedback for the user. Despite the many advantages of browser-based Web tests, however, there are, as with any technology, disadvantages as well, including many of the same ones that hold true for paper testing, unless care is taken.

Disadvantages

One of the obvious disadvantages of Web technology is that a certain amount of Web expertise is needed for a researcher, psychologist, or test administrator or programmer they hire. Fortunately, many Internet software tools are now available on the market to allow a novice user to design and create relatively rapidly a prototype of what is needed for an Internet-based test. Once a prototype is created, a person with Internet programming skills (e.g., research assistant) can work with the re-

searcher or other professional to automate the final working version of the Web test. With adequate documentation in the final program, updates and revisions can be made without much difficulty. The need to have someone on the team who must be familiar with Web technology in order to create or maintain a browser-based test or questionnaire might, however, be considered a disadvantage.

A second disadvantage emanates from the previous one: considerable time must be invested in designing, creating, and testing an Internet-based test. Often, the social system or the organizational context in which the test developer is operating supports another medium (such as paper-and-pencil) and may not be open to innovative forms of testing.

Another drawback relates to possible limitations in technological capabilities and associated expenses. Obviously, having access to browser-based Web software tools becomes crucial at some point to make an Internet-based test feasible. The researcher developing a browser-based test needs both the resources and access to the Internet to keep data and scoring centralized. Participants and/or the person administering the test (if other than the researcher, as in a counseling center) would also need access to the Web in order to enter data and receive scoring results and feedback.

Another important issue is the matter of copyright, an unresolved difficulty in the emerging field of Internet publishing. A researcher who does not hold the copyright to the instrument that is to be converted to a Web form may be unable to obtain the copyright holder's consent to have it developed electronically. Generally, a copyright holder hopes to retain control of scoring and, if at all, may wish to develop electronic versions of instruments in-house. This issue, which can prove to be a huge obstacle to a researcher who wishes to develop a well-established instrument into an Internet-based version, may explain why only a limited number of well-established psychological tests have been converted to and used on the Internet.

Web testing, if done in the participant's home, would probably be unmonitored. As with unmonitored paper-and-pencil tests, cheating is possible. If a participant is motivated to take an Internet-based psychological test for education and guidance, however, the privacy factor may actually increase the veracity of responses concerning sensitive material, particularly if the test is taken anonymously (Kobak et al., 1996; Wolford & Rosenberg, 1998). On the other hand, Internet-based testing might not be applicable for involuntary, non-monitored situations, such as court ordered testing.

Although Web availability is growing every day, another disadvantage of using the Internet for research participants is that the numbers tested are likely to reflect the demographics of those populating the Web. On the other hand, if a researcher is studying a group with rare or special attributes, often these people can be located more easily on the Web through an e-mailing list, an Internet forum or chat group, where they can easily be contacted to administer a certain online test.

Along with a concern about research participants, there is always a possibility that test-takers may not read instructions properly or may ignore disclaimers, perhaps more frequently so than in monitored face-to-face situations. Also, participants may ignore, more than in a face-to-face testing situation, advice given to them to seek professional counseling. Monitoring a non-compliant subject can be difficult, even impossible, and needed support may be lacking in the case of a perceived failure or the existence of a psychological problem (these situations may also arise, though to a lesser degree, in face-to-face situations as well). This problem is associated with the fact that test-takers of Internet-based psychological tests are practically left alone in case of failure or what may be labeled as negative personality assessment. An extreme example might be of a person who gets results showing high suggestibility and suicide risk, who then goes on to commit suicide. This problem, obviously, does not exist when people are being tested in a clinical context.

Another problem has to do with the multiplicity of Internet-based psychological tests; it is often difficult to distinguish between legitimate, professional, measurement instruments and pop-culture "personality" quizzes, the latter being very common on the Internet. This leaves an open door for misuse if either test-taker or test administrator is unaware of the differences, especially if there is a service charge for use. It is important for a user taking an Internet-based psychological test do so from a reputable site and to be familiar with the instrument administered or, at least, be provided with full, relevant information on the psychometric quality of the test.

Another problem associated with online testing is related to one of the basic characteristics of the Internet, namely, borderless, global communication. Through the Internet, tests are easily available in many cultures other than the one where a test was developed and intended for. Test results may therefore not apply to test-takers outside the culture in which the test was standardized. While in the pre-Internet era this problem was relatively marginal, it has potentially become major at the present time.

Another drawback of using an Internet-based test has to do with still prevailing technological difficulties. Specifically, there is always the possibility that the client's browser, monitor, and/or video card may have other settings or an entirely different configuration than the designer intended, so that the layout of the questionnaire or test might look somewhat different from that envisioned. The user's software and hardware ultimately display the test or questionnaire, and the hosting Web server has no control over those versions, specifications, or settings. As a result, the designer of the test is best served by creating Web pages that are simple to display, using the most general, tried-and-true standards available so as to reach and serve as many varieties of client machines as possible. Related to this problem is the fact that Internet connection quality varies among users, depending on their own equipment as well as the equipment used by the service providers and other intersections along the information superhighway. A slow modem, a small screen, or a problematic phone line might significantly undermine online testing. This relates to a potential problem that arises when a test-taker has to restart a test, due to a technical failure, while there is no known way to control or adjust the test score for this abnormal test-taking procedure.

A major disadvantage of Internet-based testing relates to information security. A popular concern in the media is that data can be compromised through electronic "tapping" or hacking. Although this is possible, the expense and expertise needed to accomplish this task make it extremely unlikely that such tests and their results will be a target. To put this problem in perspective, this task would be akin to a government agency tapping one's phone, sitting outside one's building in a van or taking up residence in a nearby apartment with all sorts of expensive eavesdropping equipment, on the chance moment that there might be an opportunity to snag one's upload of an MBTI score. The data is actually no more at risk with Web technology than any data that resides on a computer. Moreover, there is no evidence that test data are more secure if paper-and-pencil tests are used and materials are archived in standard office cabinet files or drawers than on an Internet server. If normal security protocols concerning Web servers are used, there appears to be no greater risk for data collected on the Internet to be illegally obtained than any other electronic data or data saved on traditional paper materials. It should be noted, however, that only a negligible number of open testing websites use secured servers.

In summary, Internet-based testing and Web data collection have a number of advantages over paper-and-pencil testing. Many of the same

disadvantages and cautions needed for paper testing, however, are also needed for electronic testing. Internet-based testing can in many ways be more secure than paper testing, but taking normal precautions would apparently make the former no less secure than the latter.

RESEARCH ON INTERNET-BASED PSYCHOLOGICAL TESTING

The relative newness of Internet-based testing does not permit a comprehensive review of the research, for the simple reason that this research is only in its infancy. A thorough review of the Internet and relevant professional databases revealed that there are very few published studies on Internet-based tests to date. In addition, those empirical investigations published have added very little knowledge to the limited information on this subject that was available several years ago (Schmidt, 1997).

Several central research questions may be asked in relation to Internet-based psychological testing: Is this procedure as reliable and valid as pencil-and-paper testing in this domain? Is this true for *all types* of estimates of the reliability of measurement and *all forms* of test validity? Are there testing areas, or specific tests, that are more suitable for Internet testing than others? What are the boundaries and specific limitations of Internet testing in terms of reliability and validity of measurement? What is the estimated utility of using Internet-based tests insofar as types of tests, testing purposes, available infrastructure, and other relevant variables? What technological means and procedures may enhance both measurement quality and users' satisfaction? As mentioned, very few answers are now available to several of these questions. The following is an overall review of what is currently available.

Smith and Leigh (1997) compared the results of a sexual fantasies survey administered through paper-and-pencil to 56 introductory psychology students and to 72 Web surfers who volunteered to fill out Internet-based questionnaires. The researchers found no significant differences between the two data sets. Furthermore, differences between men and women in the two samples replicated the differences found in the original study in which the questionnaire was developed.

Bicanich, Slivinski, Hardwicke, and Kapes (1997) reported on a research project in which an Internet-based vocational test battery and a parallel paper-and-pencil test battery were administered to two samples of secondary and post-secondary vocational-education students. No in-

formation was provided as to the nature of the tests other than their purpose, which was to evaluate vocational-related diagnostic measures. Bicanich et al. did not provide a detailed description of the findings, but they reported that the test results from the two versions were very similar and did not yield a bias related to gender or special educational needs (e.g., disability). They also found that students preferred Internet delivery to paper-and-pencil versions by a three-to-one margin. Bicanich et al. reported, furthermore, that the test administrators told of a significant saving in time and effort from Internet test delivery. In regard to financial utility, the economic parameters of their project showed that cost savings could be expected to accrue after 375 test-takers. Obviously, this datum should be considered meaningful in the context of the conditions of this specific project.

As a general rule, no psychological testing Website or online psychological test is accompanied by empirical research information concerning its measurement quality. An exception is the *QueenDom.Com* Website. Jerabek ("Cyberia Shrink," 1999) provides much psychometric information on a series of online tests available on this site. The tests include those for intelligence, relationship, personality, career/job, emotional health, and general knowledge in a number of areas. Psychometric information, based on large samples of test-takers and published on 14 of the tests on this website, supplies descriptive statistics, reliability estimates (i.e., internal consistency coefficients), norm tables (percentiles), and some comparisons or correlations relating to basic variables (e.g., age, gender). The psychometric information is quite impressive: all tests are nearly normally distributed, split-half and alpha coefficients are in the .90s, and relationships to external variables generally support high construct validity (e.g., positive correlations between Emotional IQ and professional success).

Stanton (1998) compared identical psychological survey questionnaires administered to two equivalent groups of "employed professionals" in either paper-and-pencil ($n = 181$) or Internet-based ($n = 50$) versions. Twelve items in the questionnaire measured respondents' perceptions of fairness in their day-to-day interactions with their supervisors, and a few others referred to demographic information and the nature of supervisory relations. Stanton found very similar results in the two samples in terms of the magnitude and internal structure of the items. The items in the Internet version, however, showed greater variability. Another noteworthy finding in this study was that there were significantly fewer missing values in the Internet version than in the paper-and-pencil version.

Pasveer and Ellard (1998) compared the administration of a 20-item self-trust questionnaire through paper-and-pencil and the Internet to two standard (n 's of 760 and 148, respectively) and two Web-user (n 's of 429 and 1,657, respectively) samples. Findings revealed that (a) both forms were similarly internally consistent (Cronbach alpha coefficients were .84 and .86 in the two standard samples, and .86 and .88 in the two Internet samples); (b) the two versions had a similar four-factor structure; (c) item means were similar in the two versions. The only meaningful difference occurred in the variance of the item responses, which was slightly higher in the Web version of the scale (mean item standard deviations of .56 and .60, and of .63 and .73, for the standard and the Internet administrations, respectively). This difference could be attributed, however, to the more heterogeneous sample responding to the Internet-based questionnaire.

Buchanan and Smith (1999a) compared a traditional paper-and-pencil version of a self-monitoring scale consisting of 18 dichotomous items to its Internet version. They found that the Web version ($n = 963$) had a coefficient alpha of .75, compared with .73 for the traditional-version comparison group ($n = 224$), and with .70 reported by earlier studies. A similar three-factor structure, similarly loaded by items, was found in the two versions. In addition, the mean scale scores and standard deviations of the two forms were similar. In an additional two studies, Buchanan and Smith (1999b) were able to provide evidence for validity of Internet-based testing of self-monitoring, using either Newsgroup participant's anonymity condition (Study 1, $n = 415$), or self-reported behaviors (Study 2, $n = 218$).

Pettit (1999) explored the possibility of using the Internet to collect psychological information. He launched a computer-anxiety scale on a university website, advertised it through Web search engines and indices, and asked Web surfers to fill it out. Analyses of 839 completed surveys showed that the scale was as internally consistent as the original paper-and-pencil scale. In addition, an examination of correlations of the scale with several other variables (e.g., age, gender, computer usage) showed that it possessed high construct validity.

Joinson (1999), in a 2×2 factorial design, examined whether conditions of anonymity (anonymous versus non-anonymous) and testing mode (paper-and-pencil versus Internet) might affect social desirability, social anxiety, and self-esteem scores in a sample of university students. He found that respondents who filled out questionnaires on the Internet, showed lower social desirability, lower social anxiety, and marginally higher self-esteem than did those tested by paper-and-pencil

questionnaires. Similarly, the study participants scored lower on social desirability and social anxiety and higher on self-esteem in the anonymous than in the non-anonymous condition. As expected, the combination of anonymity and Internet-based testing resulted in the lowest social desirability scores. Joinson asserted that his research offered clear empirical support for the use of Internet-based self-reported psychological questionnaires, especially in an anonymous condition, as a better method to collect valid research data.

USES OF INTERNET-BASED PSYCHOLOGICAL TESTING

The numerous professional opportunities made available by Internet-based psychological tests almost guarantee that they will flourish with time as the Net becomes an everyday, routine tool for professionals and laymen alike. The combination of advantages enumerated above, together with convenience of usage and very positive feedback from empirical research, gives this new development great encouragement. It seems likely that Internet-based psychological tests will be used for various specific reasons and needs as professionals take advantage of growing computer capabilities, high-speed computer communications and related technologies, and the enormously growing prevalence of Internet users.

Internet-based psychological testing may be adopted in a number of ways and for a number of functions. First, being relatively simple and efficient to use, it is a tool of quality in *research data collection*. That is, researchers may use Internet-based tests—of their own or by linking to certain Web pages—in combination with other research variables (e.g., nature of participants employed, testing condition, differential instructions). Similarly, researchers may validly use Internet-based tests and questionnaires for survey research as has been shown in various investigations: Cooper, Scherer, Boies, and Gordon (1999) in a survey of Internet-sexuality-related behaviors through a questionnaire posted on ABC's website; Kaye and Johnson (1999) for a political survey published on an independent website; and Greenfield's (1999) *MSNBC* survey on Internet addiction. Indeed, a growing number of ongoing psychological investigations are conducted online, using various kinds of Internet-based psychological tests and questionnaires. Examples of current projects: an anger-disorders survey (<http://www.liii.com/~fantine/consent.html>), an assessment of psychology investigation (<http://www.unibw-hamburg.de/PWEB/psypae/eng.html>), a study of marital relationships

(<http://www.unc.edu/~schaefer/mariint.htm>), and research of social attributions (<http://www.geocities.com/CollegePark/Campus/3101/prism.htm>). Joinson's (1999) findings, as mentioned above, support this method, based on a combination of Internet and anonymity, as a superior method for valid research data collection.

Second, Internet-based psychological tests may be used broadly for the sake of "mere" *self-knowledge, awareness, and insight*. That is, test-takers may complete different types of psychological tests or surveys and receive computerized numerical and narrative feedback that might provide a wide range of objective information about themselves. As discussed for the *QueenDom.com* website and related psychometric information (Jerabek, 1999), this procedure—at least from a psychometric perspective—may be very useful. One should not overlook, however, the great impact of test-takers' integrity, motivation, and obedience in determining the validity of an unmonitored, online test result. Nonetheless, Internet-based psychological assessment and testing may be of great service for individuals who prefer self-help resources to cope with personal concerns or debate specific questions (Tucker-Ladd, 1999, Ch. 15). Availability of and access to psychological tests made possible by the Internet—otherwise practically unavailable and/or inaccessible to non-professional people—may mark a new development for human services. A recent review by Oliver and Zack (1999) of 24 websites that offer career assessment tests, however, showed that most of them were rated mediocre in terms of professional quality. As the two researchers suggested, much work still remains to be done in order to improve the quality of these important services.

Third, Internet-based psychological tests may also provide efficient service to professionals—psychologists of different specialties, psychiatrists, clinical social workers, guidance counselors—who may *refer clients to a test readily available* on the Net as an integral component of the counseling or psychotherapeutic process. Such a psychological test or questionnaire may be completed at a place and time of the client's convenience, independent of and in addition to clinic time. For professionals, this option creates an opportunity to introduce a great variety of relevant tests into the counseling process, as well as to save costly clinic time and expense. For example, as noted by Gore and Leuwerke (2000), Davies, Turcotte, Hess, and Smithson (1997), Sampson (1999), and Stevens and Lundberg (1998), Internet-based self-assessments in career guidance can easily be integrated with career counseling services to complement other relevant Internet services, such as career information. Likewise, clinicians may take advantage of Internet-based psycho-

logical tests to make comprehensive, yet individually subscribed, diagnoses by using tests that are available on the Net, without having to keep updates of a large number of test forms. In this context, it should be mentioned that computerized clinical psychological tests have been found to be of much psychometric as well as practical value in clinical practice (Kobak et al., 1996).

A fourth possible use of Internet-based tests is for *candidate selection* (Bartram, 1997, 1999). Obviously, this option necessitates monitoring test-takers in order to prevent cheating and other forms of dishonest conduct. Nevertheless, allowing candidates to take tests through the Internet (under personal surveillance) has special advantages, like those of the aforementioned computerized tests, especially in regard to fast and accurate scoring. In addition, as the tests are centrally located and maintained, a testing agency does not have to worry about updated test versions and norms. Also, a testing agency may “own” a very broad spectrum of tests and scales from which to choose for a particular purpose (i.e., job or study program); the ones selected can then be administered to a group of relevant candidates. A step toward this direction was recently introduced by the Civil Service of the State of California (Coffee, Pearce, & Nishimura, 1999), which successfully delivered to candidates an application procedure together with a testing process through the Internet.

A fifth possible use of Internet-based psychological testing is for very *special assessment purposes* or for procedures that do not ordinarily exist in test libraries but may be found on and used through the Internet, such as testing variables relating to virtual reality and three-dimensional perception. Special computerized tests developed for this purpose and available on the Internet (Riva, 1998) can easily be of service. Again, a test taken from a remote location—for which, if desired, payment could also be collected online—saves the bother of using the regular mail, having to install a program on a local personal computer, or mastering administration and scoring procedures.

ETHICAL AND LEGAL CONSIDERATIONS

The Internet, as discussed by King (1999), is a typical form of anarchy. Hence, without enforced order and regulated operations, sensitive materials may easily be misused at the expense of innocent Web users. The nature of Internet-based psychological tests and testing procedures makes them quite fragile in terms of ethical standards. In fact, most ethi-

cal principles laid down by the American Psychological Association (1992) and its standards for psychological testing (1985) may easily be violated when psychological tests are offered online. Among obvious ethical problems is the lack of a clear context of "defined professional relationship"; the absence of ways to substantiate test findings and interpretations; the use of tests or test information by unqualified persons; the possibility of using tests that have not been strictly developed under appropriate scientific procedures; the lack (or partial lack) of information on reliability, validation, and other related information on tests; the limited ability to take appropriate information into account in interpreting test results and making professional judgments; the existence of tests that have been developed and/or are offered by unqualified persons; the use of outdated or obsolete tests; the possible limited ability to explain assessment results to test-takers; the problem of maintaining test security; the possible use of test results without obtaining test-takers' permission; and, not least the major problem, of assuring the secrecy of an individual's test results. On top of all of these ethical issues, there is the paramount issue of copyright. It is quite common to find psychological tests that were entirely or partially copied from copyrighted materials and published on Internet sites without permission or without even mentioning this point. Issues of copyright related to the Internet are complicated and are still undergoing legal construction. It seems, however, that the ease of publishing and distributing attractive testing materials through the Internet, while maintaining anonymity, presents a legal and law-enforcement challenge.

Numerous scholars have addressed concerns relating to the provision of psychological services over the Internet and have proposed various ways to deal with them (e.g., Bloom, 1998; Sampson, Kolodinsky, & Greeno, 1997; Tait, 1999). Direct reference to and analysis of issues related to testing and assessment, however, have yet to be proposed (Oliver & Zack, 1999). The Internet-related ethical guidelines available today from both the American Psychological Association (1999) and the National Board for Certified Counselors (1997), as two representative professional organizations, fail to *specifically* address this subject. In addition to the necessity for developing an appropriate ethical code, it is important to invest in educating professionals in relevant considerations (McMinn, Buchanan, Ellens, & Ryan, 1999). Also, there is a great need to expand our knowledge in all aspects of this area, such as computerized test interpretation (McMinn, Ellens, & Soref, 1999), in order to enable better professional and ethical judgments.

RECOMMENDATIONS FOR INTERNET-BASED PSYCHOLOGICAL TESTING

A huge number of psychological tests and scales, as mentioned, are published on the Internet. Many of these are open to the general public; that is, Internet users may test themselves (or suggest it to others; for instance, their children) and receive what is supposed to be professional feedback. This evolving technology in the service of the behavioral sciences has, as indicated above, special benefits. It eases the use of psychological measurement tools in social research; it provides a convenient vehicle for an individual's self-knowledge; it provides easy access to professionals who may need specific diagnostic tests for their work with certain clients; it allows efficient use of testing procedures in the assessment of job or education candidates (under certain conditions); and it enables the measurement of special human characteristics. These special benefits call for professional support and encouragement of the further development of Internet-based tests and testing procedures, on the one hand, and inviting and educating people to use these tests, on the other.

Yet, the lack of professional test-takers' monitoring of any kind makes this new reality problematic and, in extreme cases, even dangerous. As with other potentially problematic Internet services and functions and their related risks to users, multi-perspective solutions seem to be needed. Accordingly, it is necessary that relevant professional organizations and institutions develop a code of ethics and make it obligatory for their members. Although this solution would be applicable only to professionals (that is, non-professionals would be "free" to pursue their unethical testing on the Net), such a code could significantly reduce problematic Internet testing and enhance the quality of testing procedures. Another step—one that may increase the use of professional rather than non-professional testing sites—would be to adopt Ainsworth and Grohol's (1997) procedure for semi-licensing of Web counselors. These authors initiated a procedure in which Web counselors who meet certain criteria receive a logo—as a visible sign of their accreditation—which may appear on their websites. A similar device should be developed and offered for psychological testing sites that meet certain minimal standards.

Certainly, a massive effort should be made to examine the psychometric properties of Internet-based psychological tests. Test reliability and validity cannot be assumed to remain similar when converting a paper-and-pencil or even a personal computer test to an Internet version,

as too many testing features are changed. This means that research and development should be a high priority. The intensive work of Jerabek (1999) on the many tests in the *QueenDom.Com* website should be commended, praised, and adopted.

Of no less importance, Web users ought to be educated on the actual usage of tests, from the very selection of an appropriate website, to examining a test's properties, and to understanding a test's limited results. This examination can be done through Internet portals, indices, and online guidance, and even embedded in general Internet training in schools. It would be helpful if professionals devoted time to publishing explanatory and educational articles on this issue in the general media, too.

The combination of these steps may further the quality of Internet-based psychological tests as well as foster their wiser use by Web surfers. Maximizing the benefits of Internet-based tests while minimizing their risks may prove a significant step forward for the behavioral sciences and indeed for humanity.

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