

Comparing Paper-and-Pencil and Web-based Test Results: An Equating Study for AFCT Form 19G

Zannette A. Uriell

Navy Personnel Research, Studies, and Technology

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Zannette A. Uriell

Reviewed by
Paul Rosenfeld, Ph.D.
Institute for Organizational Assessment

Approved and Released by
David L. Alderton, Ph.D.
Director

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Navy Personnel Research, Studies, and Technology (NPRST/BUPERS-1)
Bureau of Naval Personnel
5720 Integrity Drive
Millington, TN 38055-1000
www.nprst.navy.mil

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Foreword

The Armed Services Vocational Aptitude Battery (ASVAB) is administered to all individuals interested in enlisting into military service. The test covers a range of topics, including automotive and shop knowledge, electronics information, mechanical reasoning, verbal and mathematical ability, and general science information. Scores are used to determine whether a person qualifies for service as well as the likelihood of successfully completing job-specific training, and, by extension, success on the job.

Once a person is in service, Sailors may retake the test to improve their test scores and qualify for a different Navy job. The in-service version of the ASVAB is referred to as the Armed Forces Classification Test (AFCT). It is a retired paper-and-pencil version of the ASVAB. Responses are recorded on “bubble” answer sheets, scored by hand using a stencil overlay. The scale scores are calculated by summing up the number of correct items for a subtest.

Several things occurred to make these procedures impractical. First, the Navy is actively reshaping the force structure, eliminating some jobs and growing others. As a result, many Sailors are being asked to change jobs, which has dramatically increased the number of AFCT administrations. This makes the long, slow, and error prone process of administering, timing, and hand-scoring tests impractical. Secondly, in July 2002, the Navy adopted a new normative reference population to compare test scores against. The new national normative data was collected in 1997 (the old data was from 1980). There are a number of differences between the two populations that substantially change what a score means. For example, a 50 on the 1980 Math Knowledge scale is actually a 52 on the 1997 scale; but a 50 on the 1980 Electronics Information scale is actually a 47 on the 1997 scale. Thus, the AFCT scores need to be on the current score scale. However, there is a further complication. The 1997 scores scales are all based on scoring algorithms using a 3-parameter logistic model from Item Response Theory. Practically speaking, this means that when someone is hand scoring a test, each correct item must be scored using three 5-decimal place numbers in an exponential function, then summed. This is nearly impossible to do correctly by hand for all 225 AFCT test items.

One solution to these problems would be to move the AFCT test onto a computer. A computer-based AFCT could accurately and consistently handle test administration (e.g., each of the 9 subtests are separately timed) and background algorithms could instantly and perfectly score items, estimate subtest scores, and place the summary scores on the 1997 scale. Moreover, the volume of test administrations would have no impact. However, past research has shown that “computerizing” a paper test can inadvertently alter test scores in both large and small ways and differently for demographic groups. This report outlines efforts to create a computer-based version of the AFCT and determine if there are scores differences between the paper and computer based versions.



DAVID L. ALDERTON, Ph.D.
Director

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Also key to the data collection effort were NPRST volunteer test proctors: Dr. Paul Rosenfeld, Dr. Rosemary Schultz, Ms. Terri Ferraro, Mr. Perry Pena, Mr. Geoff Patrissi, Ms. Carol Newell, Dr. Gerry Wilcove, Ms. Joyce Alexander, Ms. Olivia Puentes, and Mr. Rodney Myers. Programming of the test was done by Ms. Evangeline Clewis and the scoring algorithm was programmed in SAS by Dr. David Alderton. The author also thanks Dr. William Farmer for timely assistance in linear equating.

Summary

Problem

Increases in the number of in-service AFCT administrations, the shift to the 1997 score scale, and the necessity of using Item Response Theory scoring methods has made the current AFCT administrative procedures and hand-scoring methods impractical. Administering the AFCT across the Internet may shorten testing time and increase security of test items, and it will reduce scoring errors and produce scores based on the current score scale. This is also in line with Navy initiatives to move more training and testing to the Internet. However, the impact on test scores from moving from a paper-based test to computer-based administration is unknown.

Objective

The goal of this study is to create a web-based version of the AFCT, then administer both the paper- and web-based versions to personnel and determine if there are substantial differences between test scores across the two modes of administration.

Approach

Students at Naval Service Training Command, Great Lakes, were assigned to take either the paper- or web-based version based upon the last digit of their Social Security Number; those with even numbers were given the paper version and those with odd numbers were given the web version. Tests were scored and a scale score was created for each respondent. Scale scores were compared for both versions overall as well as by gender and ethnicity (majority vs. minority).

Findings

1. Web AFCT as programmed was stable; the only issue was related to lost connectivity to the server.
2. Paper-based scores tended to be slightly higher, especially for Paragraph Comprehension and Assembling Objects.
3. Larger differences between versions were seen for women than men, possibly due to the small number of women participants.
4. Both majority and minority groups showed differences in scores obtained from the two versions, and a similar pattern was shown in the overall findings.

Recommendations

1. AFCT can be administered across the web, but a concept of operations for Fleet-wide administration needs to be determined. For example:
 - a. Where should the test software be hosted?
 - b. How can a version of the test be made available to deployed ships and submarines?
2. Determine if small point differences between the two versions can be considered negligible.
3. Consider improvements to web-based layout, such as:
 - a. Increased font size and different fonts for Paragraph Comprehension display.
 - b. Find way to allow web-based respondents to “write” on the displayed graphics for Mechanical Comprehension and Assembling Objects subtests.
4. Replicate equating study with larger group.

Contents

Introduction	1
Problem and Background	1
Objective	2
Approach	2
Test Instruments.....	2
Testing Room Layout.....	4
Subjects	5
Procedure	6
Data Analyses.....	7
Results.....	8
General Science.....	8
Arithmetic Reasoning	11
Word Knowledge.....	13
Paragraph Comprehension.....	15
Verbal Composite.....	17
Mathematics Knowledge	19
Electronics Information.....	21
Automotive and Shop	23
Mechanical Comprehension	25
Assembling Objects.....	27
Armed Forces Qualification Test.....	29
Discussion.....	31
Findings	31
Testing Observations	31
Future Steps	33
References.....	35
Appendix A: Additional Analyses	A-0
Appendix B: Selected Portions of the Manual for Administration	
Armed Forces Classification Test (AFCT) Version 19G	B-0
Appendix C: Privacy Act Statement	C-0
Appendix D: Scoring	D-0
Appendix E: Web AFCT Equating Study	E-0
Appendix F: Detailed Results by Test Question	F-0

List of Figures

1. Web-based AFCT screen layout.	4
2. Room layout for web-based testing.	5
3. Linear equating for General Science.....	9
4. Linear equating for General Science by gender.	10
5. Linear equating for General Science by ethnicity.....	10
6. Linear equating for Arithmetic Reasoning.	11
7. Linear equating for Arithmetic Reasoning by gender.	12
8. Linear equating for Arithmetic Reasoning by ethnicity group.....	12
9. Linear equating for Word Knowledge.	13
10. Linear equating for Word Knowledge by gender.....	14
11. Linear equating for Word Knowledge by ethnicity group.	14
12. Linear equating for Paragraph Comprehension.....	15
13. Linear equating for Paragraph Comprehension by gender.	16
14. Linear equating for Paragraph Comprehension by ethnicity group.	16
15. Linear equating for Verbal composite.	17
16. Linear equating for Verbal composite by gender.	18
17. Linear equating for Verbal Composite by ethnicity group.	18
18. Linear equating for Mathematics Knowledge.....	19
19. Linear equating for Mathematics Knowledge by gender.	20
20. Linear equating for Mathematics Knowledge by ethnicity group.....	20
21. Linear equating for Electronics Information.	21
22. Linear equating for Electronics Information by gender.....	22
23. Linear equating for Electronics Information by ethnicity group.	22
24. Linear equating for Automotive and Shop.....	23
25. Linear equating for Automotive and Shop by gender.	24
26. Linear equating for Automotive and Shop by ethnicity group.....	24
27. Linear equating for Mechanical Comprehension.	25
28. Linear equating for Mechanical Comprehension by gender.....	26
29. Linear equating for Mechanical Comprehension by ethnicity group.	26
30. Linear equating for Assembling Objects.....	27
31. Linear equating for Assembling Objects by gender.	28
32. Linear equating for Assembling Objects by ethnicity group.	28
33. Linear equating for Armed Forces Qualification Test.....	29
34. Linear equating for Armed Forces Qualification Test by gender.	30
35. Linear equating for Armed Forces Qualification Test by ethnicity group.....	30

List of Tables

1. ASVAB Subtests	1
2. Overall number of AFCT subjects.....	6
3. Standard Score Ranges	8
4. One-way ANOVAs for General Science scale scores	11
5. One-way ANOVAs for Arithmetic Reasoning scale scores	13
6. One-way ANOVAs for Word Knowledge scale scores	15
7. One-way ANOVAs for Paragraph Comprehension scale scores.....	17
8. One-way ANOVAs for Verbal Composite scale scores.....	19
9. One-way ANOVAs for Mathematics Knowledge scale scores.....	21
10. One-way ANOVAs for Electronics Information scale scores.....	23
11. One-way ANOVAs for Automotive and Shop scale scores	25
12. One-way ANOVAs for Mechanical Comprehension scale scores.....	27
13. One-way ANOVAs for Assembling Objects scale scores.....	29
14. One-way ANOVAs for AFQT scores	31

Introduction

Problem and Background

Before entering the Navy, potential recruits complete the Armed Services Vocational Aptitude Battery (ASVAB). This test consists of nine subtests covering a wide variety of subjects as shown in Table 1. If not taking a computerized, adaptive version of the ASVAB, each subtest has a specific number of questions and a time limit, also indicated in Table 1.

Table 1
ASVAB Subtests

Subtest	Topics	Number of questions	Time Limit
General Science (GS)	Life science, earth and space science, and physical science	25	11
Arithmetic Reasoning (AR)	Arithmetic word problems	30	36
Word Knowledge (WK)	Synonyms	35	11
Paragraph Comprehension (PC)	Extracting information from paragraphs	15	13
Mathematics Knowledge (MK)	Mathematical concepts and applications	25	24
Electronics Information (EI)	Electrical current, circuits, devices, and electronic systems	20	9
Automotive and Shop Information (AS)	Automotive maintenance and repair, wood and metal shop practices	25	11
Mechanical Comprehension (MC)	Mechanical devices, structural support, and properties of materials	25	19
Assembling Objects (AO)	Spatial visualization	25	15

The military service branches may opt to include additional subtests. Previous tests have included Coding Speed (finding information in a table quickly) and Numerical Operations (rapidly computing simple mathematical calculations).

The ASVAB is administered at Military Entrance Processing Stations (MEPS) as part of the formal processing for acceptance into any enlisted military position. The test results will be used to intellectually qualify an applicant for service and then used by classifiers to determine an applicant's suitability for a specific job. Within the Navy, this classification to jobs—or Navy ratings—is based upon optimally formed composites of

ASVAB subtests and “cut-scores”¹ which have been found to predict success in job training schools. The ASVAB composites and cut-scores are periodically re-evaluated to ensure that the most optimal ASVAB standard is used for each school (see, e.g., Held & Monzon, 1991).

Once in the military, a version of the ASVAB called the Armed Forces Classification Test (AFCT) may be administered to personnel who are interested in changing their job, allowing personnel the opportunity to improve their scores to qualify for their desired job. The AFCT is a retired version of the ASVAB. At present, it is only available in paper format, which in normal operational settings means it must be hand scored. However, today’s ASVAB subtests are exclusively scored using a 3-parameter logistics (3PL) Item Research Theory (IRT) model which increases the precision of measurement. Practically speaking, this means that when someone is hand scoring a test, each correct item must be scored using three 5-decimal place numbers in an exponential function, then summed. This is nearly impossible to do correctly by hand for all 225 AFCT test items. (IRT scoring was used in this project for both the paper-based and computer-based versions.)

Objective

This report describes an effort undertaken to create a web-based AFCT and determine if there were differences in scores between the paper- and web-based versions. Of particular interest were comparisons of scores for males, females, majority-ethnicity personnel, and minority-ethnicity personnel.

Approach

Test Instruments

The paper AFCT booklet contains 4 to 10 questions per page, depending upon the subtest. Examinees mark their selected answer on a standard scantron (“bubble”) answer sheet. Examinees are not allowed to continue to subsequent subtests until time is up or until test administrators determined by a show of hands that all examinees had completed a subtest. All testing materials were collected before examinees were dismissed.

The web-based version was programmed using WebQuiz XP (SmartLite Software, Inc.). Each subtest was created individually. All questions were typed into WebQuiz XP and then verified by two individuals for accuracy. Some subtests (especially MC and AO) contained graphics; these graphics were scanned using a OneTouch 8900 scanner. Every graphic was cleaned in Photoshop 4 to remove any imperfections and then saved as a .png at 96 dpi. Their display sizes were the same as in the paper test booklets.

¹ Classification composites are simple summations of individual subtest scores. If, for example, a composite consists of AR+MC, and a person scored 52 on AR and 61 on MC, their composite score would be 113. If the “cut-score” for qualifying for a particular school is AR+MC = 111, then this person would “make the cut” and be deemed qualified for that school, based on that cut-score.

WebQuiz XP created .mdb files for the questions and the data, and additional .asp files for the actual display of the questions. Before viewing even the instructions for the first subtest, an administrative password was required to ensure that everyone started after the verbal instructions were given. At the bottom of the instructions of the first subtest, an SSN was required to continue to the first question. The .asp files for the succeeding subtests were modified so that this SSN was required to begin and propagated throughout each of the subtests. However, the SSN was “lost” once the next subtest had begun, ensuring that the respondent could not go back to the answers in the previous subtest without having to return to the beginning of the AFCT and reenter an SSN.

Each subtest of the web-based version included the same instructions and sample questions as in the paper condition with just minor wording changes (e.g., “Mark on your answer sheet” became “Click the answer”). The instructions were on-screen and read silently by each examinee, whereas they were read aloud by a proctor for the paper-based version. The instructions were not timed; the timer would start as soon as the first question appeared on screen, similar to the paper process when the timer did not start until turning to the first question.

Figure 1 shows the general screen layout of each question in the web-based version. The title of the subtest was displayed under the Internet Explorer toolbars, the question and answer choices located directly below that, and the timer was in the bottom left corner of the window. Only one question was presented at a time. Within each subtest, the examinee could move forward or backward through the subtest using the “Next” and “Previous” buttons (previous not available on question 1 of each subtest); moving to a different question would retain the person’s selected answer. Moving through questions did not impact the timer; it would continue counting down the remaining time.

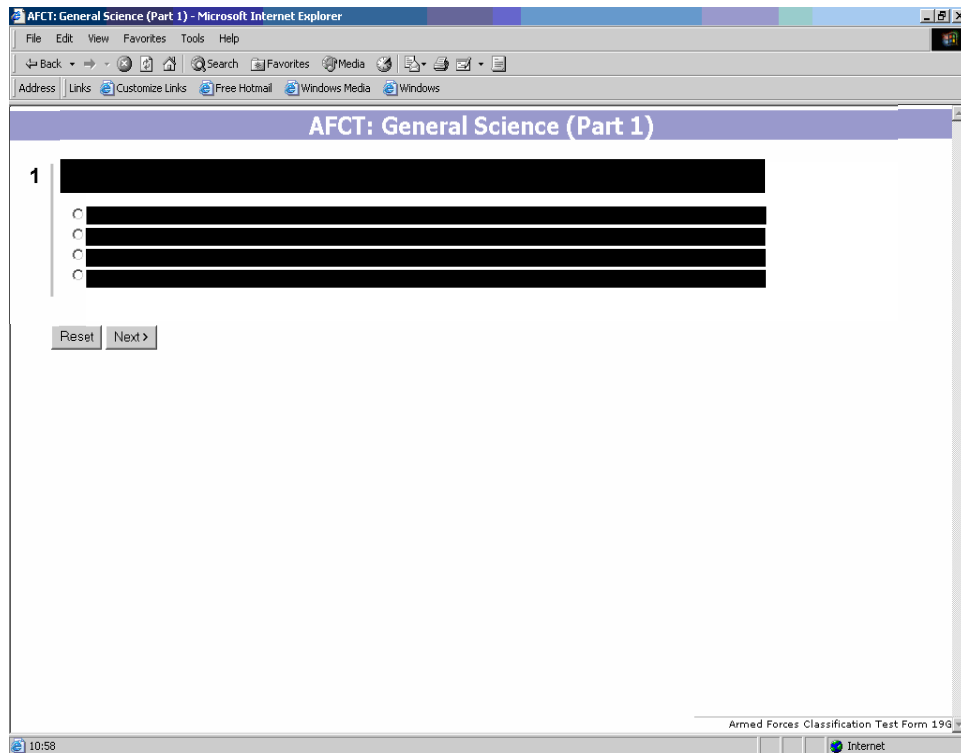


Figure 1. Web-based AFCT screen layout.

For the Paragraph Comprehension subtest, each paragraph relates to a few subsequent questions. In the web-based version, the paragraph was presented with the first question; succeeding questions were presented on separate pages but the examinee could go back to the paragraph using the “Previous” button.

Unlike the paper-based version, the web-based AFCT was self-paced. If one subtest took only 10 minutes for a respondent to complete, they could then proceed to the next subtest when they were ready. If the respondent exceeded the total time on a subtest, the subtest would stop and indicate that it was now time to continue to the next subtest.

Testing Room Layout

Paper-based testing occurred in one of two locations. The first location was a classroom, with each examinee having an individual table/chair combination. To minimize concerns about cheating, each column of chairs was about 2 feet apart from the one next to it.

The second location for paper-based testing was a hangar bay. Large tables were available, with two chairs per table. Respondents were asked to sit in every other chair, to again minimize the potential for cheating.

Because of the electricity requirements for the web-based testing condition, testing only occurred in a classroom environment. The chairs were arranged as seen in Figure 2, with pairs of subjects facing each other. Each chair was 2 feet from other chairs to the left and right, and the laptop screens served as dividers between examinees.

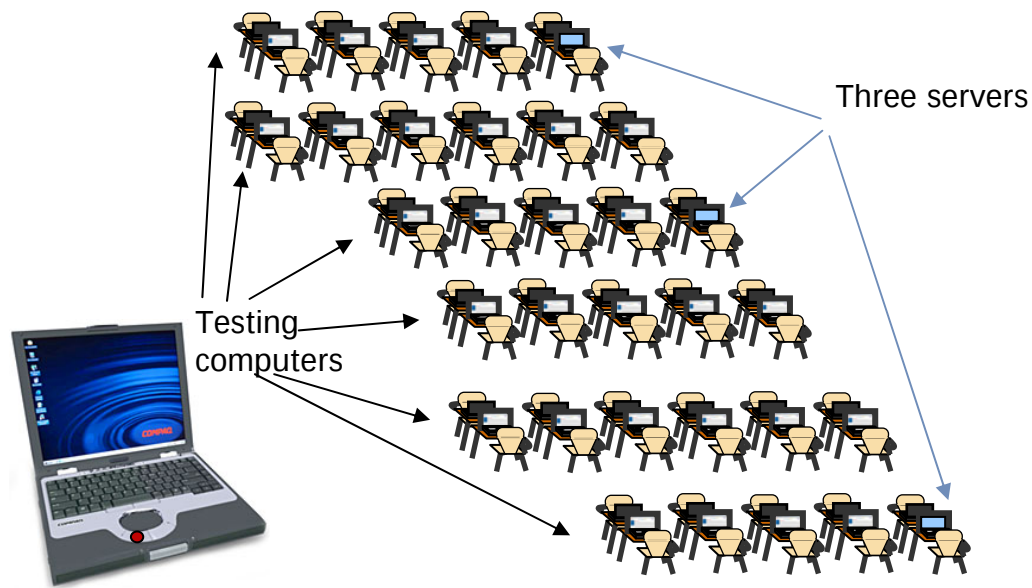


Figure 2. Room layout for web-based testing.

Testing computers were Compaq Evo N1020v laptops with Windows XP and IE 6.x loaded. Up to three servers (either Windows NT or 2003) were used at a time, with at most 23 testing laptops connected through CAT-5 cables to each server. The Windows 2003 server took longer to present succeeding pages, but the loading time did not count against the subtest time as there was no question displayed during the loading period.

In both conditions, at least two proctors monitored testing. In the classroom conditions, proctors wandered between each column of desks; in the web-based condition, proctors also wandered between each row of desks and were usually facing opposite directions to best monitor test-taking.

Subjects

Testing was conducted from 31 July to 13 September 2006. Participants were personnel assigned to NSTC Great Lakes during that time period. The majority were students in "A" School (who were selected by duty section) or in indoctrination sections prior to "A" School (generally after their last indoctrination class ended). A small portion was students not under instruction (NUI) and two were staff members (E-6).

Results from subjects who did not include a complete SSN on testing paperwork or who did not sign the Privacy Act Statement were not included in subsequent analyses. In addition, the two staff members were not included because of the potential that their additional Navy service could have changed their responses.

A few participants took the test multiple times, in the same or different format. Only the first set of answers was used for analyses. In one case, one format was complete and the second only had a few answers; the assumption was that the person realized they were doing it again and stopped, so only the complete set of answers was used. In

another case, both sets of answers were complete and it was unclear which occurred first; all data for that person was excluded. Table 2 contains the overall number of respondents for each of the analysis groups.

Table 2
Overall number of AFCT subjects

	Overall	Male	Female	Majority	Minority
Paper (p)	689	547	91	412	177
Web (w)	762	572	111	361	229

Some subjects seemingly chose to not take the test seriously and recorded some pattern (e.g., all As, ABCD repeated, AABBBCCDD repeated, etc.) in their answers. Because it is unclear what constitutes a pattern and what is a legitimate answer, and because this behavior likely occurred in both paper-based and web-based modes, all these answers are included.

Some of the subtests were partially blank. This may have occurred because they skipped questions, ran out of time, or had to leave the test early. Data were retained for those who had answered at least half of the questions in the subtest. The number of subjects varies by subtest; Ns are included where appropriate in the results section.

Procedure

As participants arrived, all were asked to sign in. The sign-in sheets included spaces for names, the last 4 digits of their Social Security Numbers, gender, ethnicity, and rating or school. Once signed in, participants generally were divided by the last digit of their SSN, with even SSNs receiving the paper AFCT and odd SSNs receiving the web-based AFCT. There were a few testing sessions where there was insufficient room for paper-based testing; in those cases, respondents were first escorted into the computer lab until all computers were filled, and then the overflow went to another room to receive the paper-based test. (See Appendix A for details of additional analyses conducted to ascertain if the two groups were similar based upon their pre-existing ASVAB scores.)

To minimize the impact of computer illiteracy on the web-based testing, examinees in the web-based condition were allowed to play games before the testing started using the koala-pad mouse on the laptop. A colored dot was affixed to each computer to indicate which button was the left mouse button to be used to select answers.

General AFCT Form 19G instructions were adapted for the experiment. Appendix B includes the modifications to the general instructions, with annotations provided to indicate where the additions occurred and for whom.

In both conditions, respondents were read instructions about the voluntary nature of the testing. In the course of the instructions, they were then asked to read and sign the Privacy Act statement (Appendix C). Normally, any AFCT score is recorded in personnel

files. Due to the uniqueness of the testing situation, examinees were informed that their scores would only be changed if they were higher than previous scores as indicated in the Privacy Act.

All examinees, regardless of condition, were given 2 pencils and 2 pieces of scratch paper, as indicated in normal AFCT instructions. Examinees could ask for additional pencils or paper at any time during the testing by raising their hand.

In the paper-based condition, the test administrators read instructions at the beginning of each subtest, including the sample problem(s), the number of questions in that subtest, and the time limit. Once all questions had been answered, the test administrators would start the subtest and then post the start and end time on a board at the front of the room. Those in the web-based condition were not read that information because of the asynchronous nature of the testing, but that information was available for them to read prior to starting the subtest.

Data Analyses

Tests were scored using the item response theory methodology laid out by Segall (2005), specifically the three parameter logistic model. Responses were recoded to be 1 if correct and 0 if incorrect or blank. Theta scores were computed from the given parameters using the bisection algorithm and then theta scores were translated to standard scores based on the 1997 ASVAB normative scale. Appendix D contains the SAS programming² used for scoring and converting the scores to standard scale scores.

Once scale scores were computed for all subjects, an equating study was conducted. Because of the relatively small number of cases, linear equating was chosen (Stoloff, 1986). In linear equating, lines are computed using the means (μ) and standard deviations (σ) of both tests as follows, where p = paper and w = web (Kolen & Brennan, 1995):

$$p = (\sigma_p/\sigma_w)*w + (\mu_p - ((\sigma_p/\sigma_w)*\mu_w))$$
$$w = (\sigma_w/\sigma_p)*p + (\mu_w - ((\sigma_w/\sigma_p)*\mu_p))$$

Using these formulae, scores were calculated for all possible scores between 20 and 80, and the two lines were graphed. Lines that are close together, especially at the scale mean of 50, indicate that the scores for the two tests are similar.

While standard scores should range from 20 to 80 and are graphed as such, scores for each subtest vary. Table 3 shows the actual range of standard scores by subtest; for the linear equating graphs that follow, all subtest scores are graphed assuming a range of 20 to 80. Since Form 19G was not constructed using Item Response Theory and it was not based on the 1997 normative population, the test score ranges are inconsistent. In particular, there are insufficient numbers of difficult items (all but one subtest has a maximum score below 80) and in several cases there are items that are so easy that (when missed) produce a minimum score lower than 20.

² The author would like to thank Dr. David Alderton for his SAS programming (Appendix D) to create scale scores.

Table 3
Standard Score Ranges

	Subject	With all wrong answers selected	With all correct answers selected
1	General Science (GS)	19	72
2	Arithmetic Reasoning (AR)	24	68
3	Word Knowledge (WK)	15	66
4	Paragraph Comprehension (PC)	25	62
5	Mathematics Knowledge (MK)	27	67
6	Electronics Information (EI)	23	80
7	Automotive and Shop (AS)	23	76
8	Mechanical Comprehension (MC)	28	75
9	Assembling Objects (AO)	27	66
	Verbal (VE) (Composite of PC and WK)	16	66

Results

Results are presented for the overall group, male and female, and majority and minority ethnicity. The results briefing is available in Appendix E, and detailed subtest information by question is available in Appendix F.³

General Science

Figure 3 shows the results for all examinees on the General Science (GS) subtest. To determine the equivalent paper-based score from the score obtained when taking the web version, the red diagonal line ($p = 1.06w - 2.41$) would be used since the paper score is the unknown. The red arrows show that a score of 75 on the web would be equivalent to a score of 77 on paper; paper-based scores are slightly higher than web-based scores at the higher end of the score range, although not significantly so.

³ After completion of all analyses, respondent scores were changed if they did better on all 9 subtests. Scores were changed for only 5 participants.

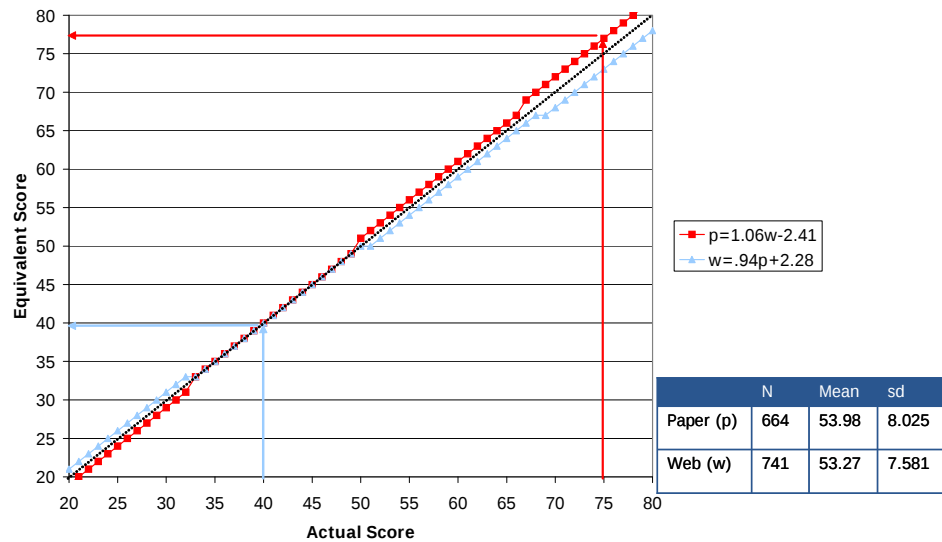


Figure 3. Linear equating for General Science.

To convert from a paper score to an equivalent web score, the blue diagonal line would be used. As indicated by the blue arrows, a paper score of 40 would be equivalent to a web score of 40. The dotted black line is the identity line, where the two versions would be considered equivalent; because the red line and blue line overlap with the identity line from 33 to 50, scores in that range are equivalent between the two versions of the subtest. Scores below 33 tended to be higher for the web-based subtest and scores over 50 higher for the paper-based subtest.

Figures 4 and 5 show the results for GS by gender and ethnicity. Scores for males are equivalent between the two subtests around the mean of 50 (from scores of 45 to scores of 55), but vary by 3 points at the extremes in the same direction as seen for all examinees above. Women tend to score significantly higher on the paper version of the subtest than the web version, especially when the score is low. However, the results for females are inherently unstable because of the small sample sizes, particularly for equating purposes.

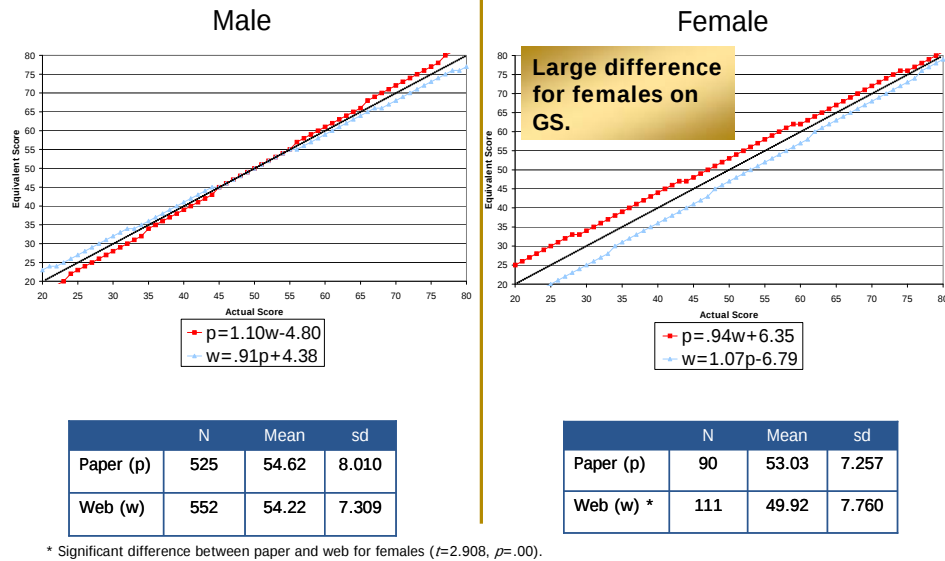


Figure 4. Linear equating for General Science by gender.

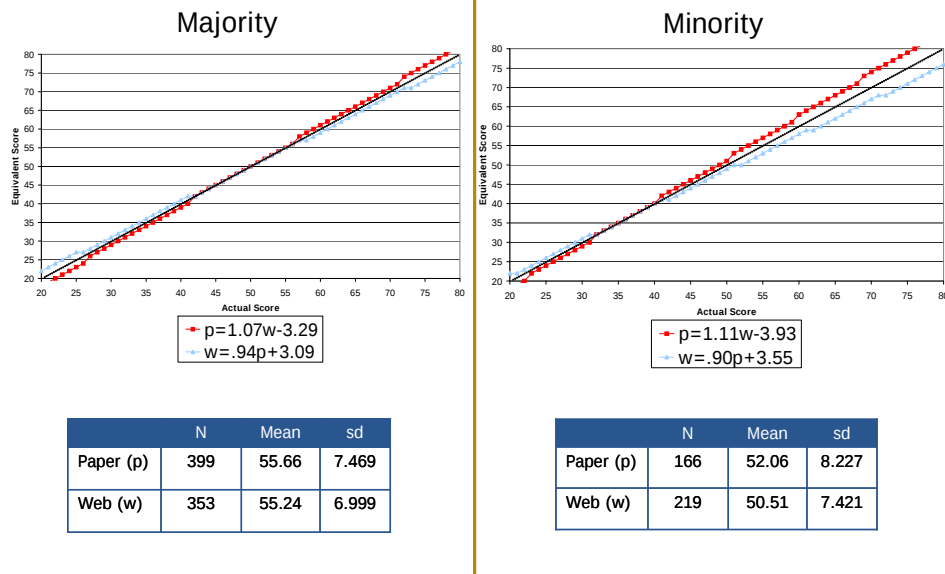


Figure 5. Linear equating for General Science by ethnicity.

The results for the majority ethnicity are similar to those found for the males, with scores being equivalent around the mean (between 42 and 56 inclusive), higher for paper for scores above the mean, and higher for web for scores below the mean. Scores for minority again are equivalent, but in a range below the mean (32 to 40). As with majority, paper-based scores tend to be higher than web-based scores for the high end of the score range, but the difference is slightly larger.

One-way Analyses of Variance (ANOVAs) were computed for the scale scores. Table 4 shows that the only significant difference in mean GS scores was for females.

Table 4
One-way ANOVAs for General Science scale scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	177.306	1	177.306	2.919	.088
Males	43.803	1	43.803	.747	.388
Females	482.083	1	482.083	8.481	.004
Majority	32.338	1	32.338	.615	.433
Minority	227.852	1	227.852	3.766	.053

Arithmetic Reasoning

Results for the Arithmetic Reasoning (AR) subtest for all respondents found the two versions of the subtest to be equivalent (Figure 6). Results for males show that the two subtests are generally equivalent, with a one point difference for scores below 35 (Figure 7), while the results for females as well as for both the majority and minority group (Figure 8) show more differentiation, especially for the female and minority groups. For females, paper-based scores tend to be at most four points higher (although equivalent for scores 69 and above). Results for majority are equivalent from 50–70 and at most 2 points different for low scores while the results for minority show that web-based scores are higher by 5 points at the lower end of the scale and paper-based scores are higher by 2 points at the higher end of the scale (equivalent between 56 and 65).

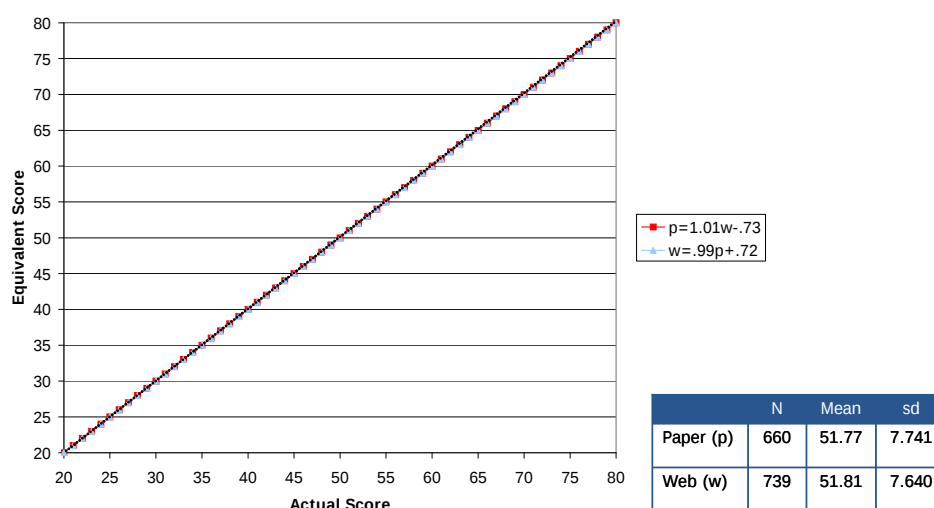


Figure 6. Linear equating for Arithmetic Reasoning.

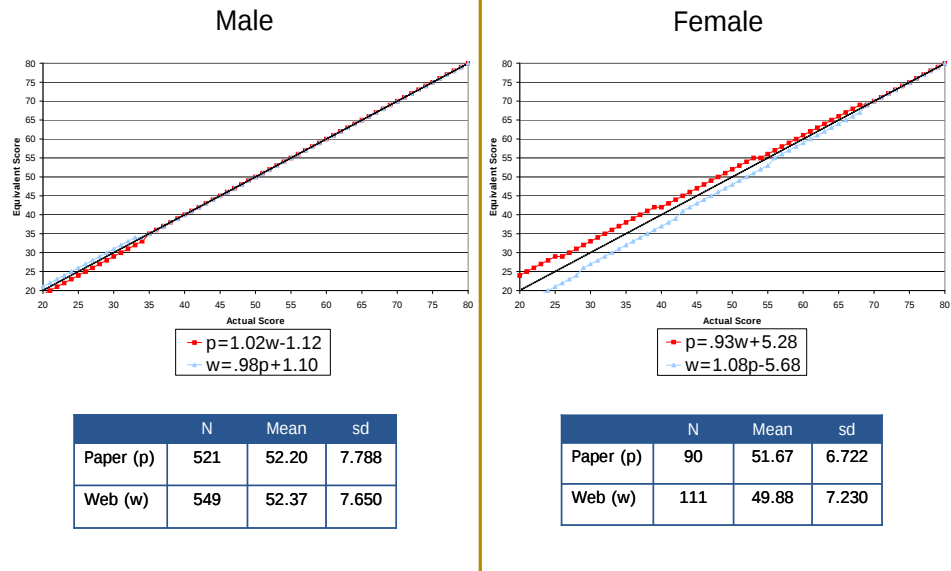


Figure 7. Linear equating for Arithmetic Reasoning by gender.

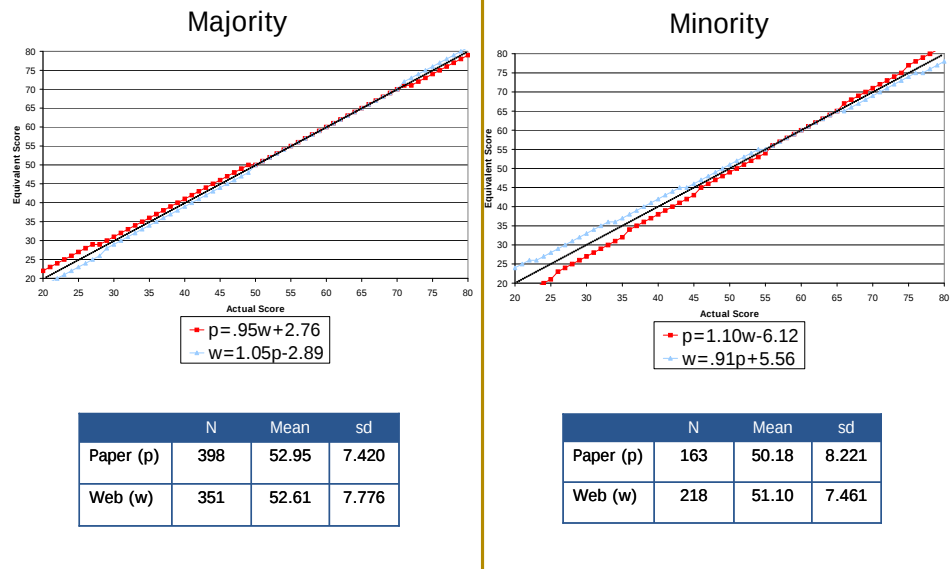


Figure 8. Linear equating for Arithmetic Reasoning by ethnicity group.

Table 5 shows the results of one-way ANOVAs; no significance was found for any group.

Table 5
One-way ANOVAs for Arithmetic Reasoning scale scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	.672	1	.672	.011	.915
Males	8.262	1	8.262	.139	.710
Females	158.144	1	158.144	3.221	.074
Majority	22.254	1	22.254	.386	.534
Minority	78.668	1	78.668	1.295	.256

Word Knowledge

The linear equating for Word Knowledge (WK) showed minimal variance. For all examinees, the two subtests were equivalent for scores from 40 to 54. For higher scores, the paper version of the text tended to be higher while the web version was higher when scores were below 40 (see Figure 9).

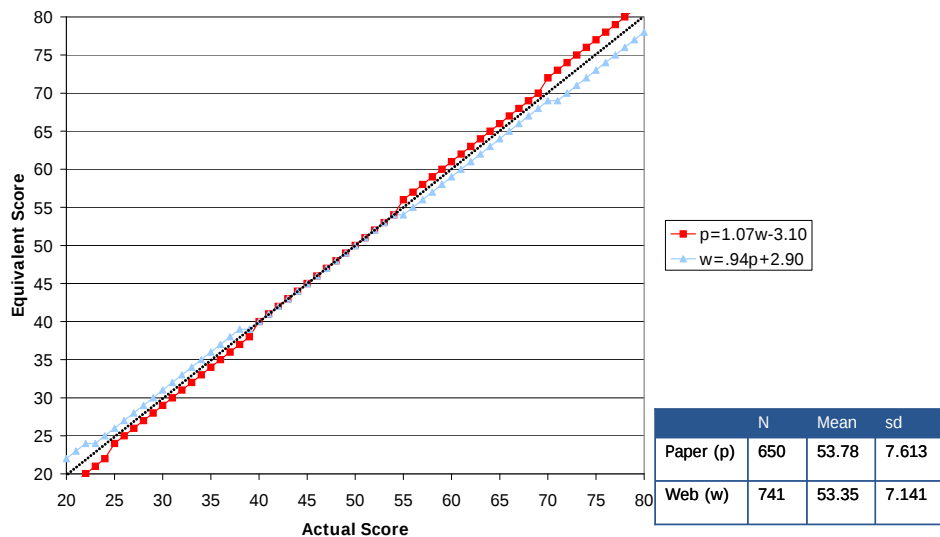


Figure 9. Linear equating for Word Knowledge.

Linear equating by subgroup again shows minimal variance for males but a larger difference for females (See Figure 10). While the lines for males cross and the scores are equivalent from 46 to 57, the scores for females are always higher in the paper version.

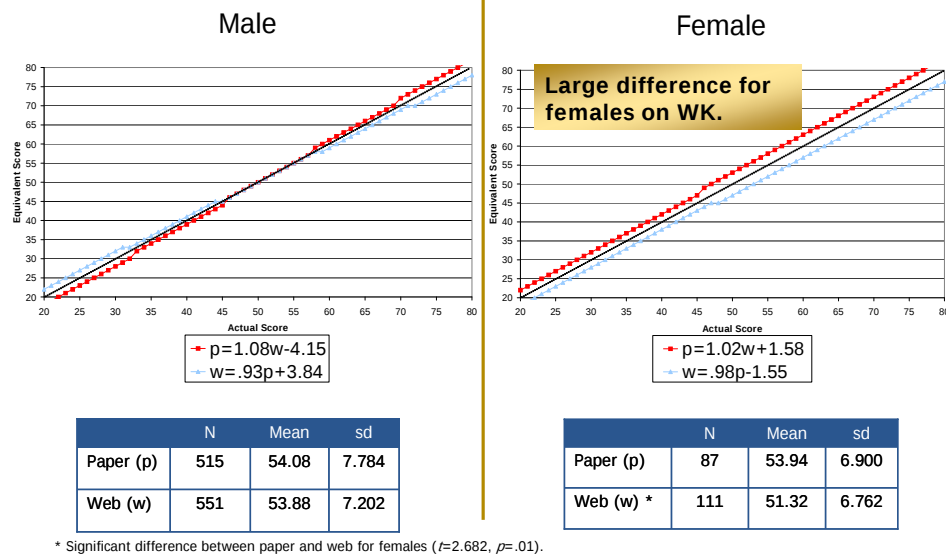


Figure 10. Linear equating for Word Knowledge by gender.

As with males, the majority subgroup shows that the lines again cross with the subtests being equivalent in the middle range of scores (51 to 57, see Figure 11). The scores for the minority show a small difference, with paper-based scores always being higher than web-based scores.

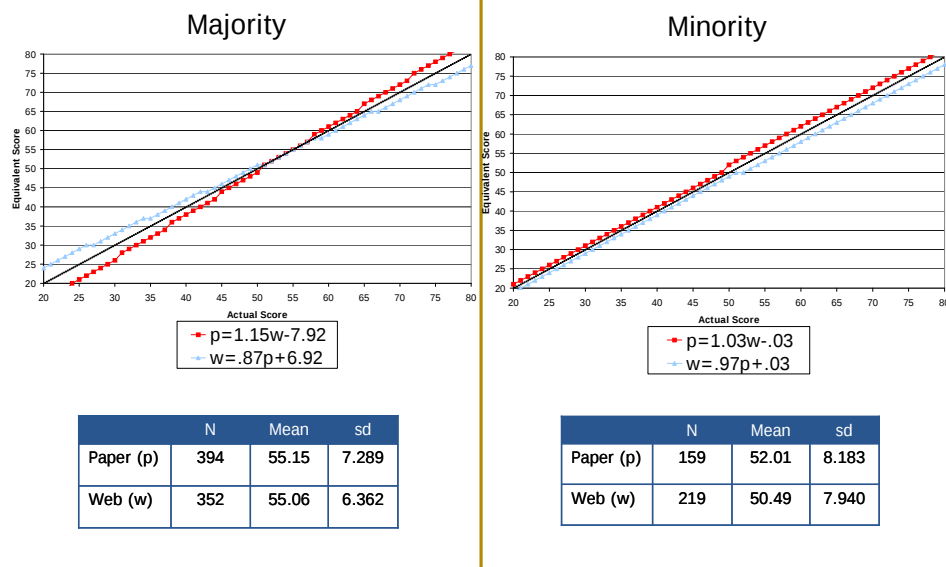


Figure 11. Linear equating for Word Knowledge by ethnicity group.

One-way ANOVAs were computed for all groups. Findings are significant for the female sub-group, as indicated in Table 6.

Table 6
One-way ANOVAs for Word Knowledge scale scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	65.548	1	65.548	1.208	.272
Males	11.197	1	11.197	.200	.655
Females	336.642	1	336.642	7.231	.008
Majority	1.694	1	1.694	.036	.850
Minority	212.190	1	212.190	3.280	.071

Paragraph Comprehension

Paragraph comprehension (PC) scores tend to be higher for the paper version than the web, although they are equivalent for scores of 72 and above (see Figure 12). Comparisons by subgroup show this same basic trend, with lines for the female subgroup showing the largest point difference (see Figures 13 and 14).

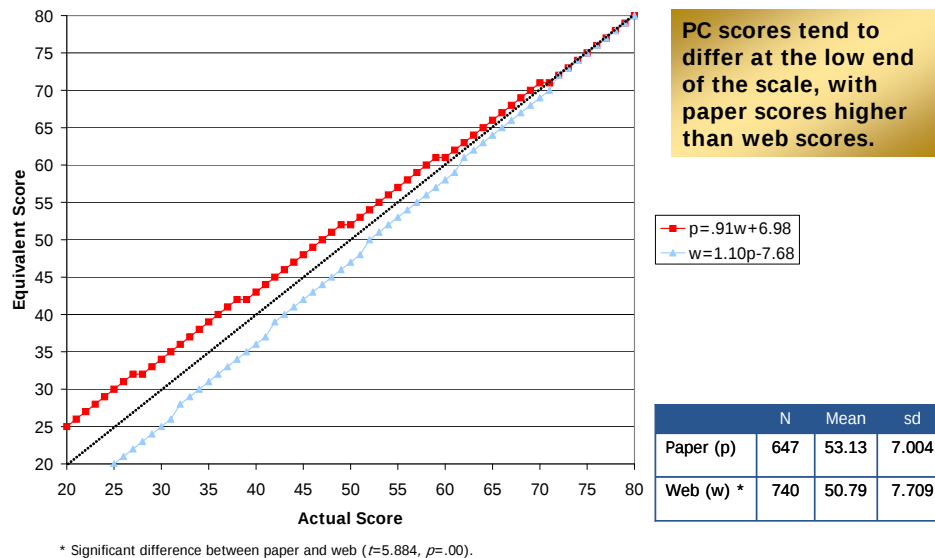


Figure 12. Linear equating for Paragraph Comprehension.

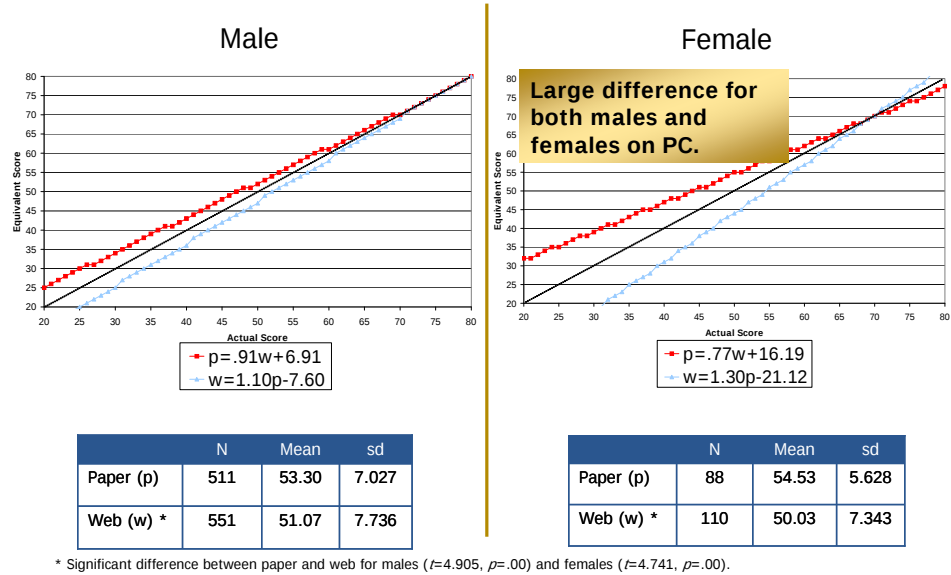


Figure 13. Linear equating for Paragraph Comprehension by gender.

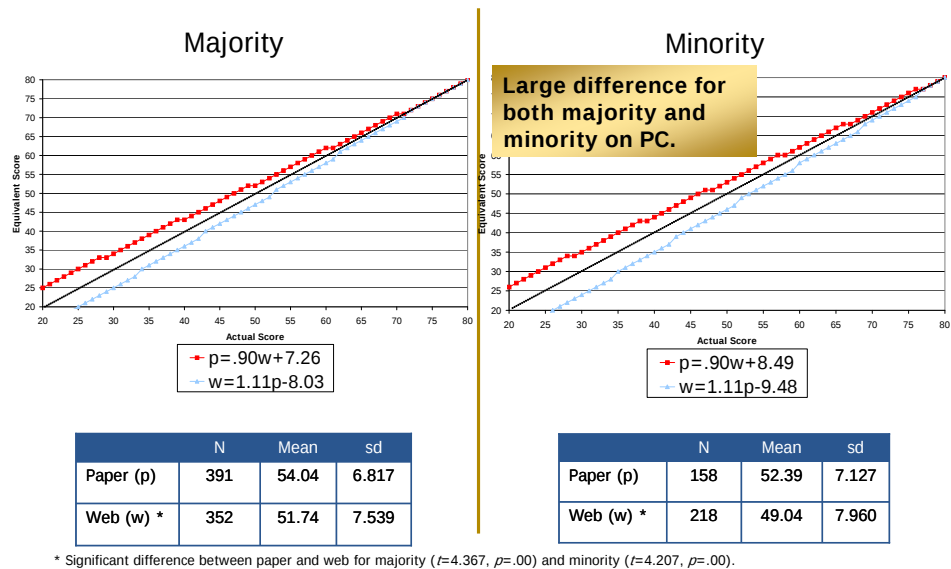


Figure 14. Linear equating for Paragraph Comprehension by ethnicity group.

Results for the one-way ANOVAs for the Paragraph Comprehension subtest are significant for all groups (see Table 7).

Table 7
One-way ANOVAs for Paragraph Comprehension scale scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	1886.799	1	1886.799	34.561	.000
Males	1316.648	1	1316.648	24.021	.000
Females	993.002	1	993.002	22.545	.000
Majority	979.919	1	979.919	19.073	.000
Minority	1028.741	1	1028.741	17.711	.000

Verbal Composite

The Verbal Composite (VE) is based on the scale scores of combined WK and PC scores. While there were large differences between lines for PC, the differences are somewhat tempered by the similarity of WK, so that the VE scores are very similar between the two administration modes. As seen in Figure 15, the lower range of scores (33 and below) are equivalent between the two subtests before the lines diverge and the scores on the paper version are slightly higher than on the web.

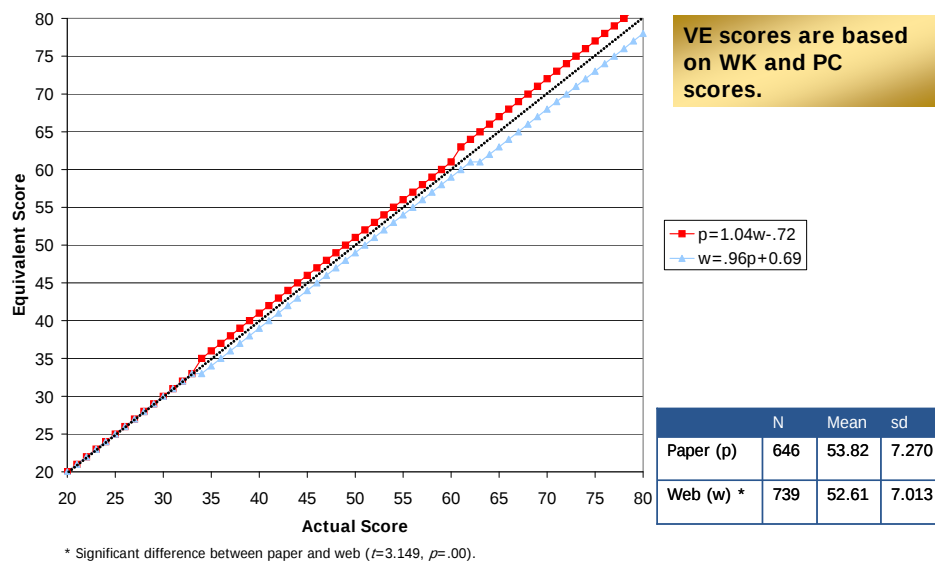


Figure 15. Linear equating for Verbal composite.

Lines for the male subgroup are similar to the overall findings, with equivalence at the lower end of the scale (between 24 and 43, inclusive) and the paper being higher than the web on the higher end of the scale (Figure 16). The scores for females are never equivalent, as seen in Figure 16; paper-based scores are always higher, and with a 6 point difference at the low end of the range of scores.

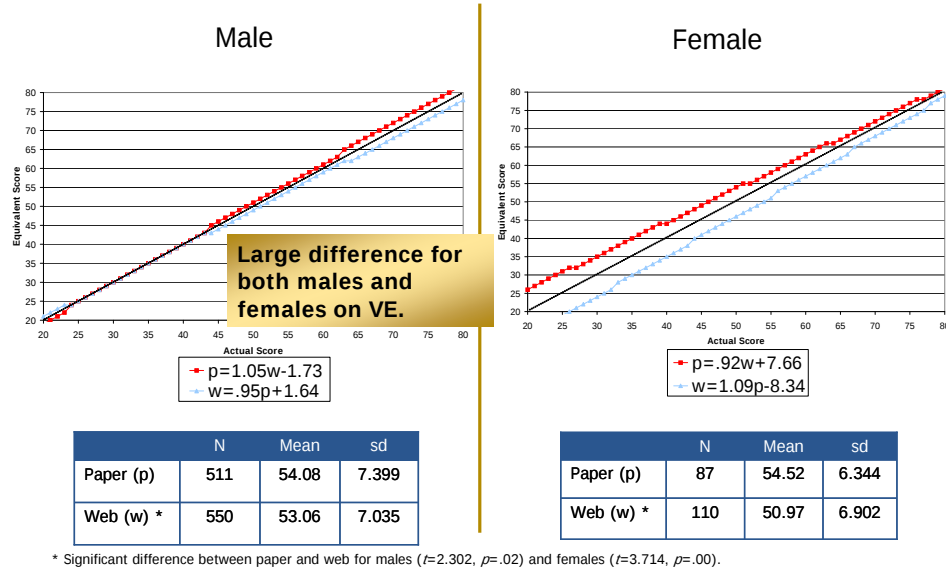


Figure 16. Linear equating for Verbal composite by gender.

The findings for the majority subgroup show equivalence around the mean (40–49). Lower than this, scores for web are slightly higher while the scores at the higher end of the range are higher for paper (see Figure 17). The findings for the minority subgroup are closer to those seen for females; paper-based scores are always higher, by as much as four points.

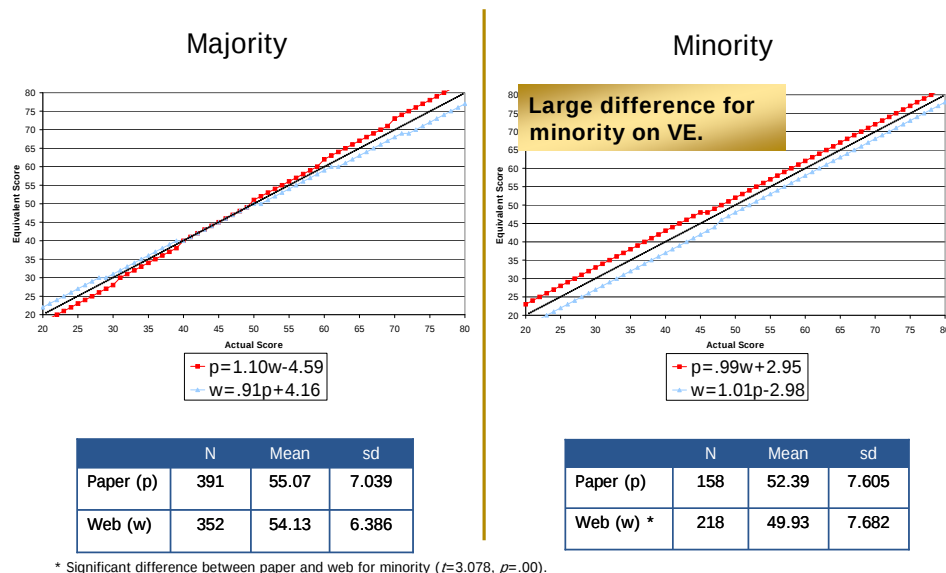


Figure 17. Linear equating for Verbal Composite by ethnicity group.

One-way ANOVAs show significance for all subgroups except Majority (Table 8).

Table 8
One-way ANOVAs for Verbal Composite scale scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	503.655	1	503.655	9.896	.002
Males	274.813	1	274.813	5.283	.022
Females	610.322	1	610.322	13.751	.000
Majority	166.885	1	166.885	3.677	.056
Minority	552.061	1	552.061	9.433	.002

Mathematics Knowledge

Linear equating of the Mathematics Knowledge (MK) scores shows that the two versions of the subtest are similar. The two are equivalent when the scores range from 35 to 51; web-based scores are higher below that range and paper-based scores are higher above that range (Figure 18). Results for males (Figure 19) and majority (Figure 20) show the same pattern, with scores of males being equivalent from 37 to 52 and scores for majority being equivalent from 26 to 47. Scores for females (Figure 19) also show the same pattern (equivalent from 31–40, inclusive), although the difference in scores between the two versions is larger than for males or overall. The minority subgroup (Figure 20) also shows the same general pattern, although the range of equivalency (44 to 52) is smaller than the overall results and the differences between scores at the extremes are larger.

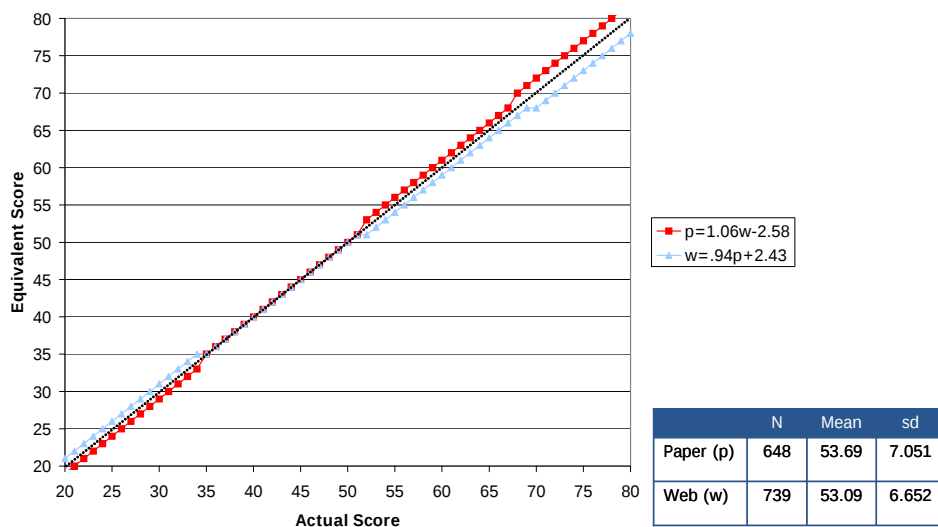


Figure 18. Linear equating for Mathematics Knowledge.

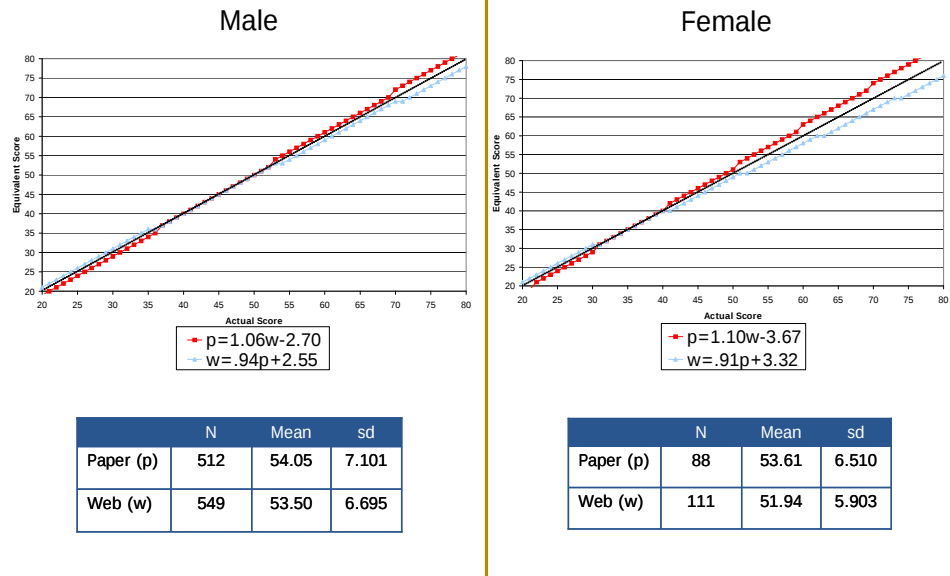


Figure 19. Linear equating for Mathematics Knowledge by gender.

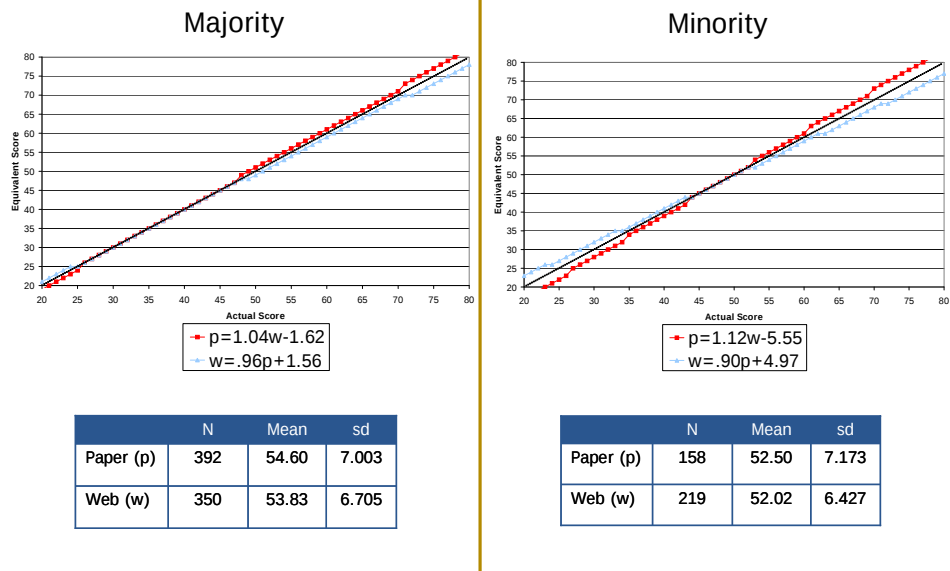


Figure 20. Linear equating for Mathematics Knowledge by ethnicity group.

One-way ANOVAs show no significant differences for the groups (Table 9).

Table 9
One-way ANOVAs for Mathematics Knowledge scale scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	128.131	1	128.131	2.737	.098
Males	79.007	1	79.007	1.662	.198
Females	137.995	1	137.995	3.615	.059
Majority	108.269	1	108.269	2.298	.130
Minority	21.300	1	21.300	.468	.495

Electronics Information

The scores for the Electronics Information (EI) subtest show similarity between the two groups; almost consistently through the range of scores there is a one point difference between the paper-based and web-based scores (Figure 21). Males (Figure 22) and the majority subgroup (Figure 23) show this same tendency, with males scoring exactly the same on the two versions except at the maximum (77 and above) and majority being exactly the same above a score of 47 and one point different below that.

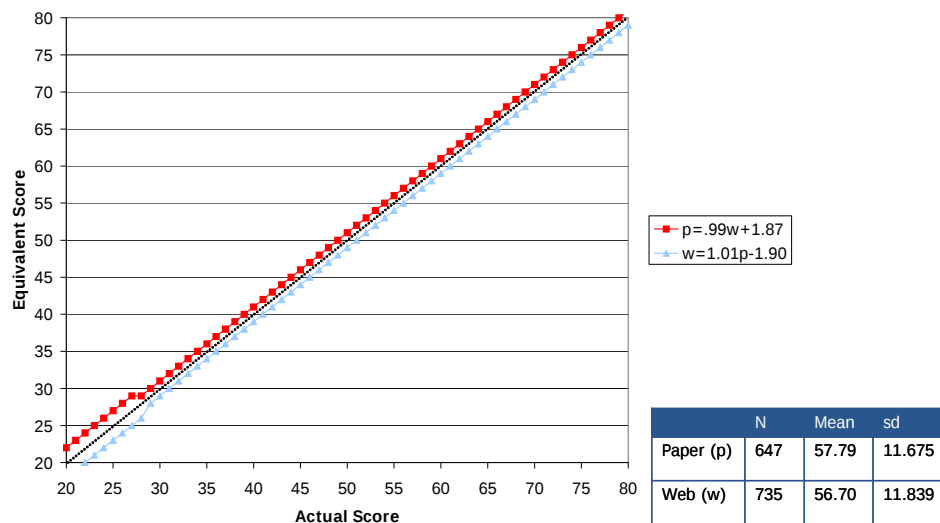


Figure 21. Linear equating for Electronics Information.

Noticeable differences were found for the scores of females (Figure 22) and minority (Figure 23). Scores on the web-based version are 5–7 points lower for females than on the paper-based version; the difference ranges from 3–4 points for minority.

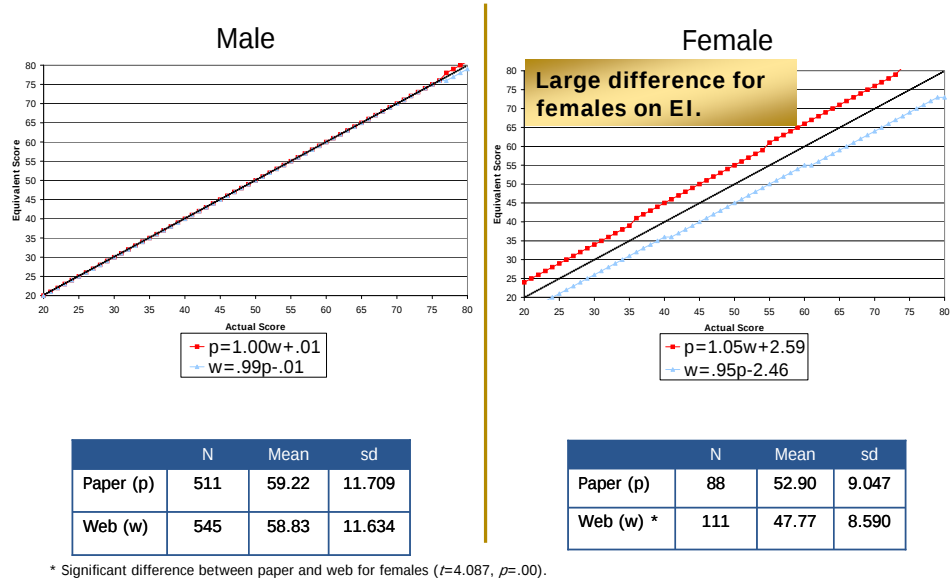


Figure 22. Linear equating for Electronics Information by gender.

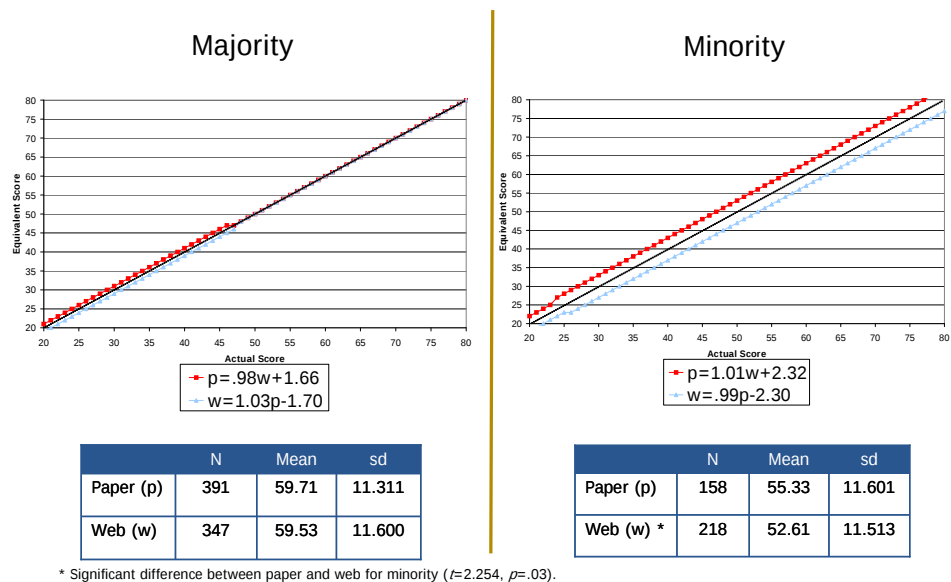


Figure 23. Linear equating for Electronics Information by ethnicity group.

One-way ANOVAs show a significant difference between paper and web for only the females (Table 10).

Table 10
One-way ANOVAs for Electronics Information scale scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	408.580	1	408.580	2.953	.086
Males	39.724	1	39.724	.292	.589
Females	1292.764	1	1292.764	16.715	.000
Majority	5.837	1	5.837	.045	.833
Minority	679.541	1	679.541	5.094	.025

Automotive and Shop

Linear equating for Automotive and Shop (AS) scores shows that paper versions of the subtest tend to score 1 or 2 points higher for those who score 61 or below (Figure 24). For those scores at the high end of the range, the two subtests are equivalent. This general pattern holds true for males (Figure 25), although the subtest is even more equivalent (from scores 29 and up).

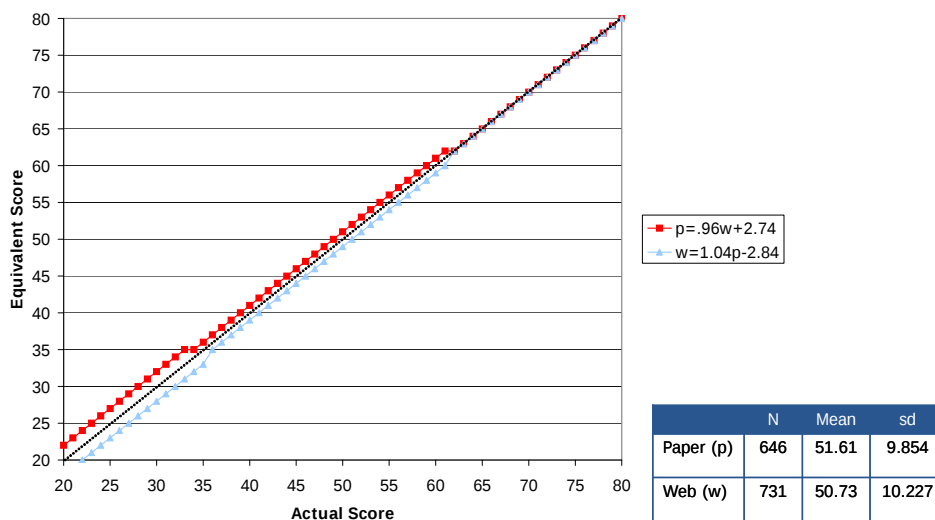


Figure 24. Linear equating for Automotive and Shop.

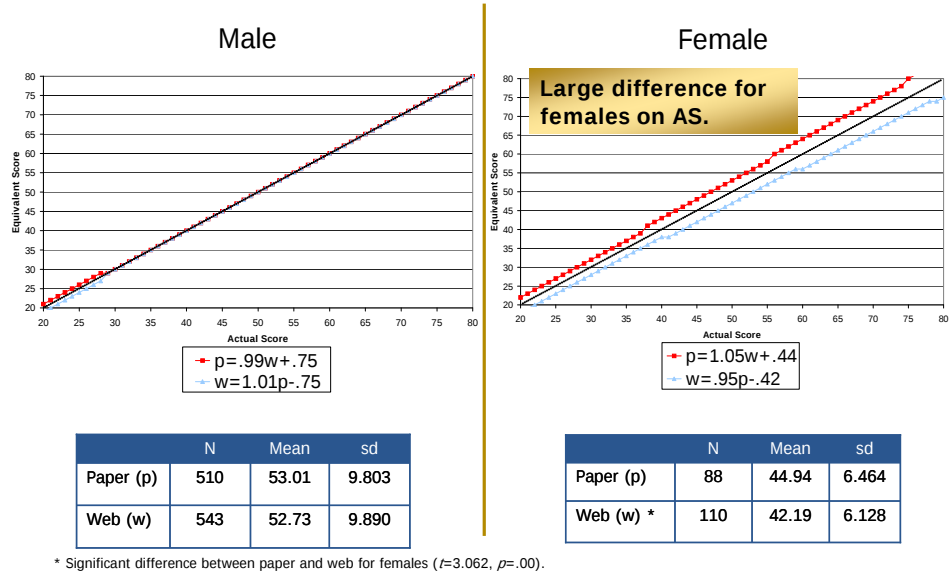


Figure 25. Linear equating for Automotive and Shop by gender.

Scores for females show divergence between paper-based and web-based, with paper-based scores tending to be four points higher or more (Figure 25). The difference between the subtests increases as the scores increase.

Graphs for both majority and minority show areas of equivalence (Figure 26). The subtests are generally equivalent for the majority subgroup, with a 1 point difference (paper higher) for those below 32 and a 1 point difference (web higher) for scores above 63. The reverse trend is true for minority; web-based scores are higher below 27 and paper-based scores are higher above 45.

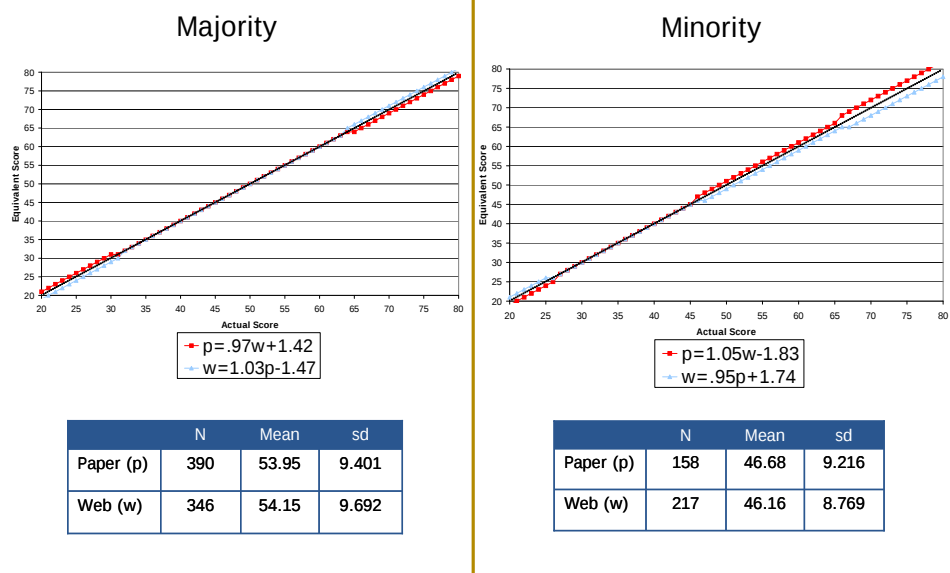


Figure 26. Linear equating for Automotive and Shop by ethnicity group.

One-way ANOVAs show the similarity between the two versions of the subtest for all groups except females, where the subtest mode causes significant differences in the scores (Table 11).

Table 11
One-way ANOVAs for Automotive and Shop scale scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	270.513	1	270.513	2.676	.102
Males	20.950	1	20.950	.216	.642
Females	370.334	1	370.334	9.393	.002
Majority	7.473	1	7.473	.082	.774
Minority	24.773	1	24.773	.309	.579

Mechanical Comprehension

Scores for the Mechanical Comprehension (MC) are consistently different; with paper-based scores being two points higher than web-based scores (see Figure 27). This trend is generally consistent for each of the subgroups at the higher end of the score range (see Figures 28 and 29). For lower scores, differences between the two subtests are smaller (equivalent for majority for scores 33 and lower).

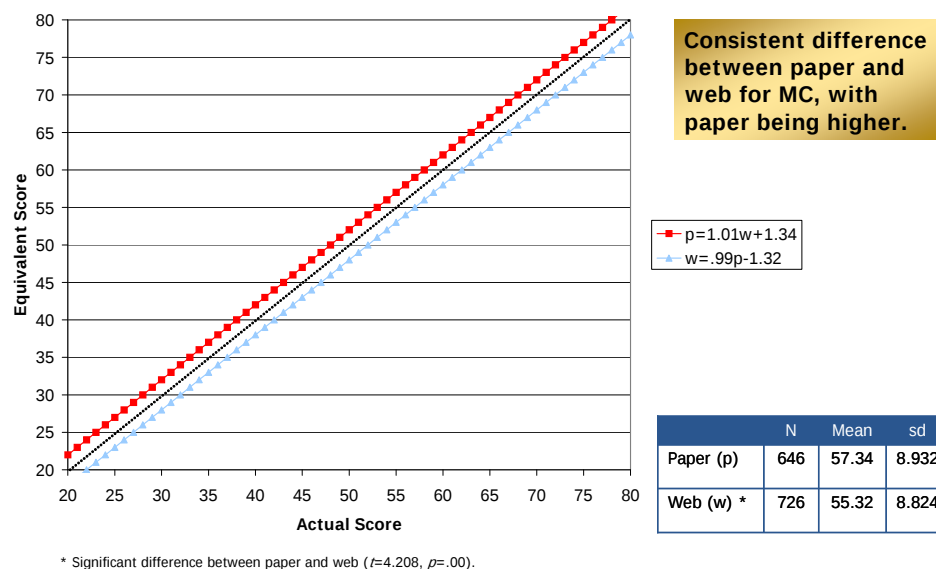


Figure 27. Linear equating for Mechanical Comprehension.

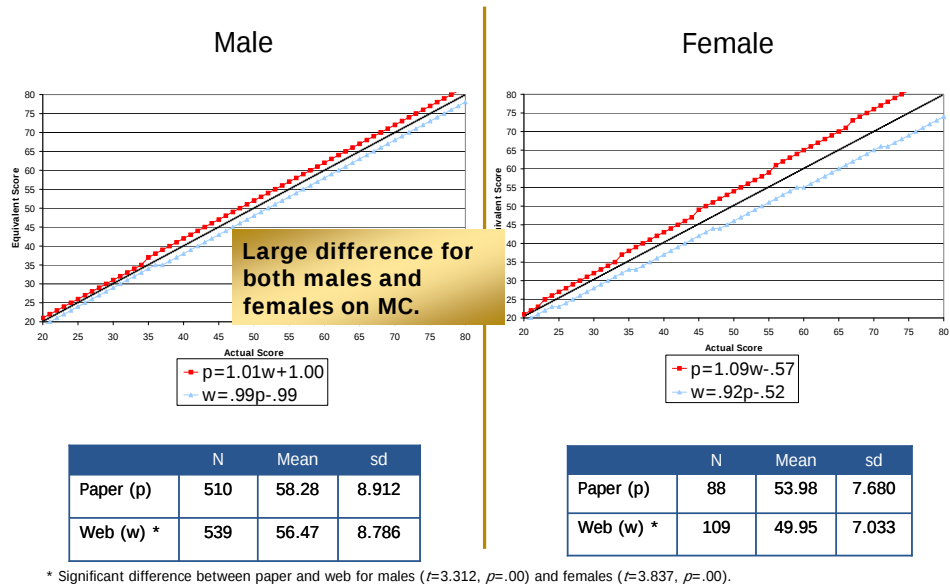


Figure 28. Linear equating for Mechanical Comprehension by gender.

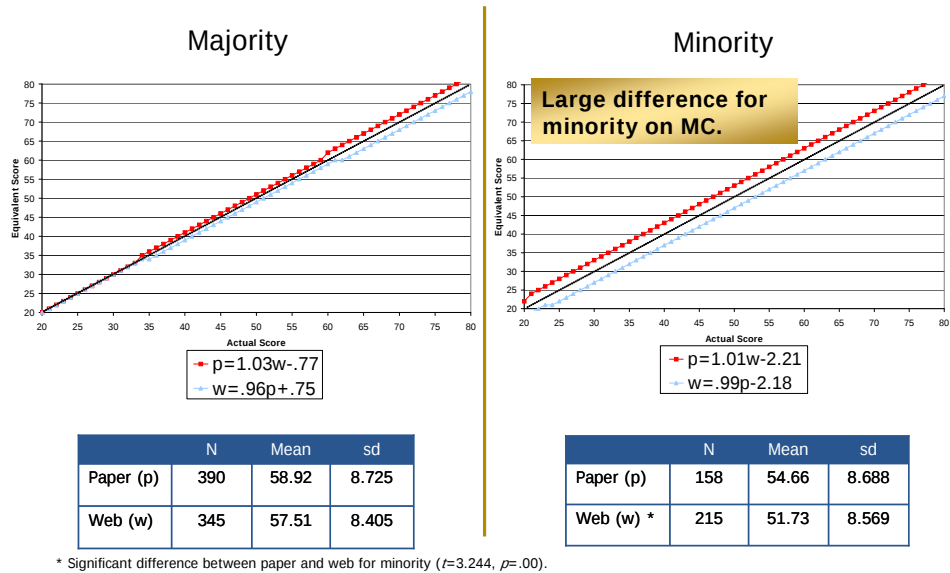


Figure 29. Linear equating for Mechanical Comprehension by ethnicity group.

As shown in Table 12, results of one-way ANOVAs indicate significant differences between the two subtests' means for all groups except majority.

Table 12
One-way ANOVAs for Mechanical Comprehension scale scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	1385.993	1	1385.993	17.597	.000
Males	859.454	1	859.454	10.979	.001
Females	788.087	1	788.087	14.671	.000
Majority	365.632	1	365.632	4.971	.026
Minority	781.673	1	781.673	10.521	.001

Assembling Objects

Large differences between the two versions of the subtest were found for all subgroups (see Figures 30, 31, and 32). Differences are largest for lower scores while overall, males, and majority analyses show scores only differ by one point for higher scores.

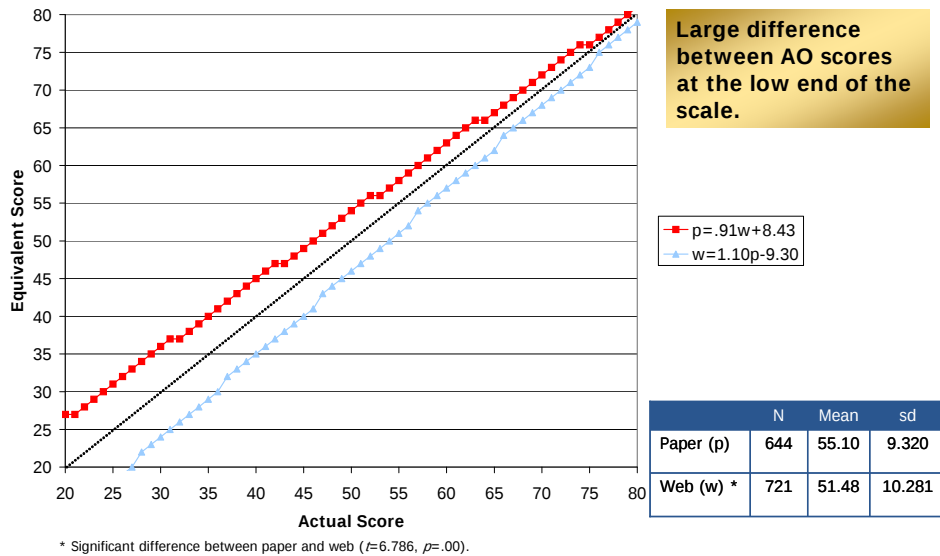


Figure 30. Linear equating for Assembling Objects.

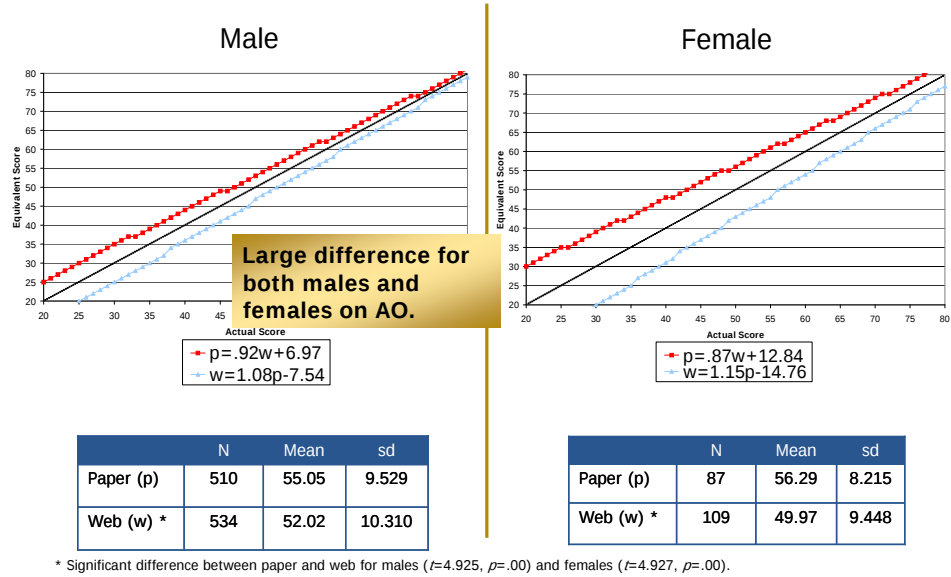


Figure 31. Linear equating for Assembling Objects by gender.

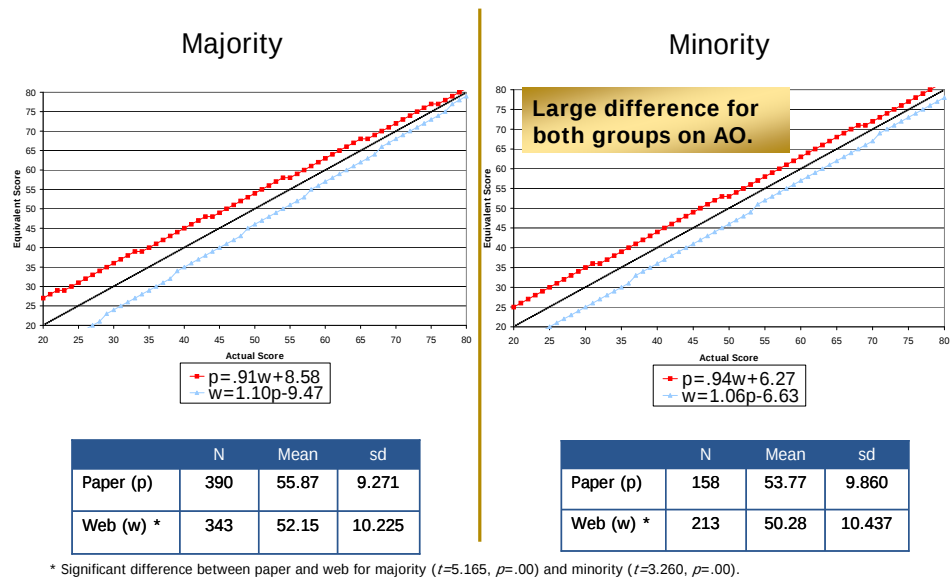


Figure 32. Linear equating for Assembling Objects by ethnicity group.

Differences between the two subtests' means are significant for all groups, as indicated in Table 13, with the paper version yielding higher scores than the web version.

Table 13
One-way ANOVAs for Assembling Objects scale scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	4452.975	1	4452.975	45.999	.000
Males	2398.373	1	2398.373	24.294	.000
Females	1929.389	1	1929.389	24.235	.000
Majority	2522.717	1	2522.717	26.651	.000
Minority	1101.164	1	1101.164	10.594	.001

Armed Forces Qualification Test

The Armed Forces Qualification Test (AFQT) is a composite of three scores from the ASVAB: AR, MK, and two times the VE score. Although not generally computed while in the service and therefore not a product of the AFCT, scores were computed following this test to further compare the two versions. As Figure 33 shows, the two versions yield similar scores (1 point difference at the lowest end, increasing to a 3 point difference for higher scores); paper-based scores tend to be slightly higher.

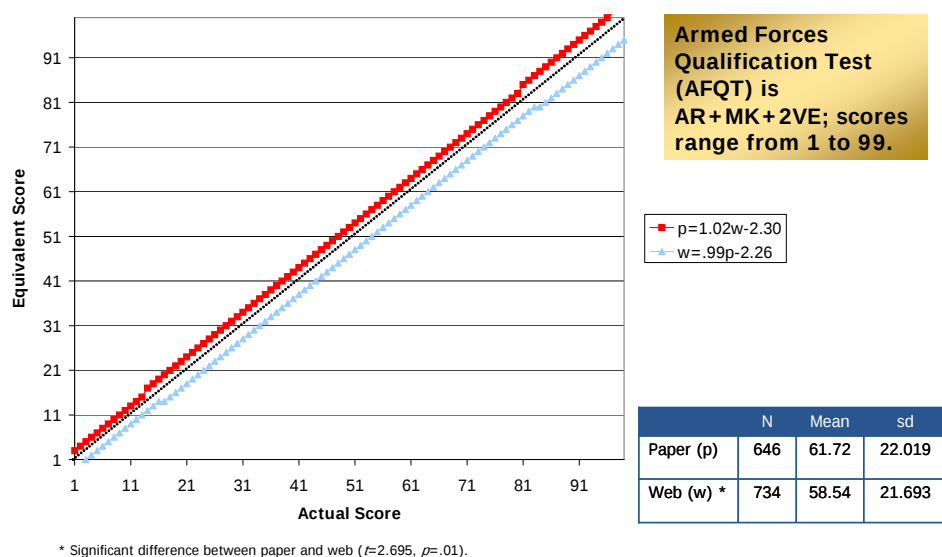


Figure 33. Linear equating for Armed Forces Qualification Test.

The differences for males are similar to the overall findings but differences for females are much larger (see Figure 34). Differences in female scores range from 15 at the lower end to 6 at the higher end.

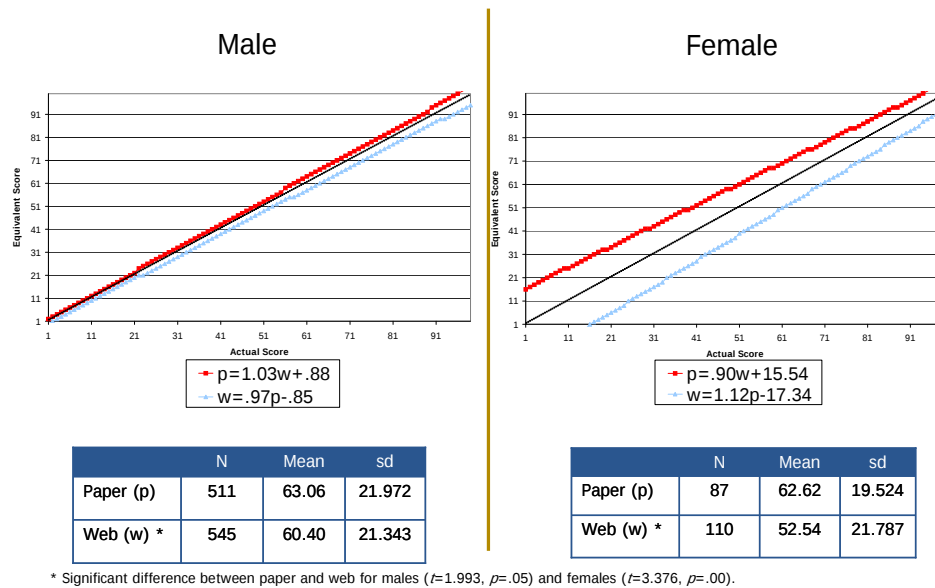


Figure 34. Linear equating for Armed Forces Qualification Test by gender.

Neither the majority nor the minority subgroup show differences as large as those found for females, but the two test versions are more dissimilar than was found for males (Figure 35). Differences for majority range from four points at the lower end of scores to three points at the higher end while differences for minority range from three points at the lower end to six points at the higher end.

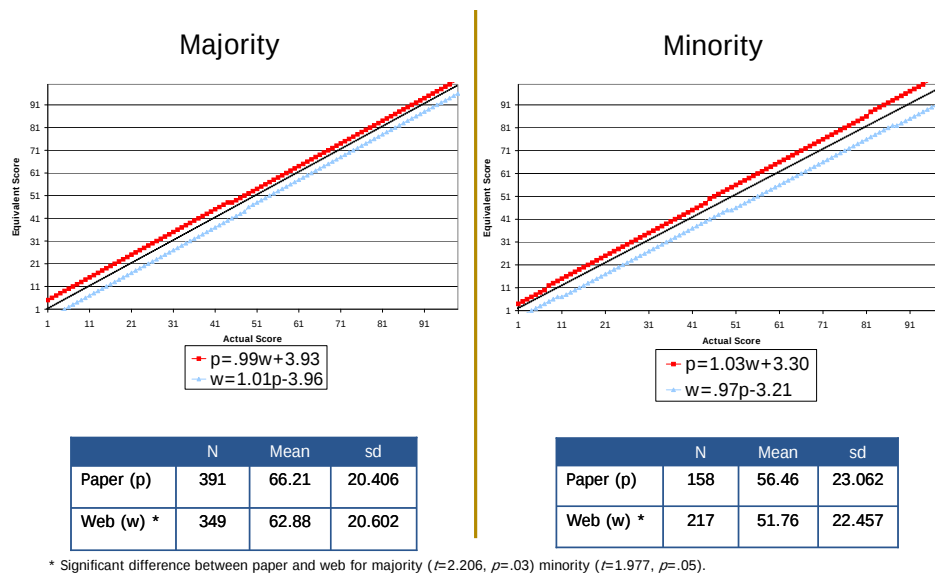


Figure 35. Linear equating for Armed Forces Qualification Test by ethnicity group.

Significant differences were found for all analysis groups, as indicated in Table 14.

Table 14
One-way ANOVAs for AFQT scores

Between Groups	Sum of Squares	df	Mean Square	F	Sig.
Overall	3465.925	1	3465.925	7.262	.007
Males	1861.638	1	1861.638	3.972	.047
Females	4940.142	1	4940.142	11.398	.001
Majority	2045.293	1	2045.293	4.867	.028
Minority	2015.660	1	2015.660	3.907	.049

Discussion

Findings

The equating study presented here shows that the version of the AFCT as programmed in WebQuiz XP was fully functional. The only issues that were encountered related to connectivity of the laptops; the room as configured had many cables that were occasionally and inadvertently pulled out of the laptops.

While there are key benefits to conducting the AFCT through the web, the results shown here indicate that there are differences between the paper and web versions that need to be accounted for before using a web version Navy-wide. Of key note, paper-based scores tend to be slightly higher, significantly for PC (5 points different for low scores) and AO (7 points different for low scores). This was true for the overall group, as well as males and both majority and minority ethnicity. The differences were even higher for females (about 10 points), although this likely is influenced by the low number of females who participated.

Testing Observations

While administering the test, there were both advantages and disadvantages observed by the test proctors. These advantages and disadvantages should be considered by Navy leadership in determining how to implement the web-based AFCT if they decide to do so.

The first overwhelming advantage was that the web-based AFCT was self-paced. Because of this, Sailors generally finished sooner than they would have on paper, where the pace is set by the slowest test-taker. Testing times for the individual subtests require a minimum of 2.5 hours for completion, plus additional time to read instructions. As seen in the web-based testing condition, some respondents finished within an hour, with at least half of the examinees done within two hours (consistent with CAT-ASVAB and results found when other tests have moved away from lock-step administration).

This shortened testing time then can return at least some Sailors to their duties, instead of spending their time waiting for fellow Sailors to complete the test.

Additionally, as designed here, there is less interaction with a test administrator, normally another Sailor. The test administrator is still needed to monitor the test-taking to ensure there is no cheating and to hand out additional paper and pencils as requested, but he or she does not have to give any additional instructions. Since the test is self-paced, this Sailor may also return to duty sooner than he/she would be able to with a paper-based test.

Because the examinee records their test answers as they take the test, there is no need for additional scanning or hand-entry of the answers, thereby reducing errors that may be associated with scanners (bubbles not aligned, incomplete fill of the bubble, 2 bubbles inadvertently marked with a succeeding question left empty, bubble not dark, etc.) or hand entry. The computer also makes immediate scoring and feedback of results a possibility.

If the test is on a computer which is password protected, or if the test continues to have an administrative password, the test requires less effort to ensure security. Multiple computers may access the same computer file of questions, instead of the need to have multiple copies of the test booklet available.

The web-based test as designed here made return to previously completed subtests nearly impossible since the examinee would have to restart the entire test. In the paper-based test, ensuring that examinees do not return to previous subtests requires close, constant vigilance by the test administrator.

The disadvantages of the web-based AFCT, as programmed, related to the inherent capabilities of a computer. All Windows-based computers have a calculator installed; the test administrators attempted to delete the calculator but it would return as a default. The calculator was removed from the Programs menu for these tests, making it more difficult to find, but the calculator program was still available and the test administrators were especially vigilant to ensure that it was not used on the test, as indicated in the paper-based instructions.

The web-based AFCT was administered through the standard version of Internet Explorer, which has several functions installed by default. One of these is the "Find" function; in the Paragraph Comprehension subtest, "Find" could be used to look for key words mentioned in the actual question.

A final disadvantage observed in the testing was the inability to draw on the test diagrams. While drawing in the test booklet is not allowed, it would still happen (the test booklets were scanned after each use to ensure there were no pencil marks; all pencil marks were erased or the booklet would no longer be used). The marks were usually either directional arrows, used by the respondent to figure out how something worked, or marks to help the examinee keep track of which answer choices were not possible. Web-based examinees could draw the diagrams on their scratch paper, however this would be an unwanted delay in a timed test; few examinees drew the diagrams on their scratch paper.

Future Steps

While there were significant differences found, some of these may be alleviated by modifications to the testing protocol. For AO in particular, allowing grease pencils on the monitor itself or on a transparency overlay of the monitor would allow respondents to make notations similar to what often happens in paper test booklets; grease pencil markings would be relatively easy to wipe clean, similar to using the eraser when marking in a test booklet.

Differences for the PC subtest may be more difficult to alleviate. Studies have shown reading speed may be equivalent between web and paper mediums but that skimming speed is slower on a computer monitor than on paper (Muter & Maurutto, 1991). In a test setting, it is possible that more are skimming than are reading; perhaps increasing the font size or changing the font type would increase skimming (and reading) speeds and these options should be considered.

Once another variation of the test is finalized—alleviating some of the potential causes of difference—this equating study would need to be replicated. This could also work to increase the dataset and provide additional data from females for analyses, potentially eliminating many of the large differences found for females.

It is possible that no modifications can be made to the web-based version of the test so that the scores match exactly what would have been received on the paper-based version. A decision then needs to be made at the Department of Defense level as to when to stop testing modifications so that a final version can be made available. Additionally, the DoD-level working group needs to determine how to handle both paper- and web-based scores concurrently in databases, since it is unlikely all tests will be administered in a single format for the next several years. If the assumption is that most people will be moved to a web-based version of the test, then it may be appropriate to create tables that easily convert all paper-based scores to web-based scores for recording into personnel databases.

Once the decision is made to convert to a predominant web-based environment, each service will likely consider redoing their job analyses; the Navy may consider modifying cut-scores to better reflect the web-based version of the test. A concept of operations (CONOPS) also needs to be determined for the Navy that maintains test integrity while also including automated scoring with IRT and logging of scores. While a DOD version would be ideal (similar to CAT-ASVAB), this is at present not possible for ships and submarines, who may have limited or no internet connectivity. If the decision is to go completely web-based, each ship/submarine would need to have a version loaded on their servers that would populate scores into personnel files when connectivity became available.

While the web-based version of the test does seem attractive for a number of reasons including lack of printing costs, potential for increased security and accuracy, and reduced Sailor time (both administering and taking), these CONOPS issues are key to ensuring that testing continues to allow for accurate and fair gauging of rating success.

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Appendix A: Additional Analyses

Additional Analyses

When the Manpower Accession Policy Working Group (MAPWG) was formally briefed on the study in January of 2008, they expressed concern that the two testing groups (paper-based and web-based) were fundamentally different, which led to the significant differences between scores for the two versions. They requested that additional analyses be conducted using ASVAB scores of record, comparing the two groups for pre-existing data.

ASVAB record data was extracted for those personnel with useable scores. A few had record data scores of 0 (predominantly for the AO sub-test, which has only recently been approved as a Navy special test added to the ASVAB). Any sub-test score that was 0 was removed from comparisons for both the record scores as well as the testing data so that those scores (and Sailors) would not impact the computation of the means and standard deviations. T-tests of independent means were conducted, comparing scores of the web-based group to the paper-based group.

Overall results

Overall results show that there were a few significant differences between the groups prior to testing, particularly in the language areas (WK, PC, and VE), as well as in EI (see Table A-1).

Table A-1
Record data from all respondents

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	723	54.09	7.431	657	54.85	7.446	-1.896	.058
AR	722	54.76	6.303	654	54.90	6.485	-.406	.685
WK*	724	52.39	6.995	645	53.43	6.864	-2.770	.006
PC*	722	53.81	6.079	642	54.71	5.799	-2.789	.005
MK	722	55.93	5.396	644	56.26	5.586	-.922	.357
EI*	718	54.69	8.637	643	56.03	8.386	-2.897	.004
AS	714	51.88	9.115	642	52.99	8.511	-2.310	.021
MC	707	55.67	8.364	642	56.49	8.078	-1.828	.068
AO	629	57.17	6.974	584	57.63	7.318	-1.121	.263
VE*	722	53.09	6.295	641	54.11	6.103	-3.029	.003
AFQT	716	64.41	18.065	642	66.83	17.778	-2.483	.013

The testing data was also compared for those personnel with sufficient record data. As indicated in Table A-2, there continue to be significant differences in PC and VE, perhaps caused by the pre-existing differences discussed above. However, MC and AO now show significant differences; considering personnel were similar on MC and AO when they originally took the ASVAB, it is possible that the differences now shown are due to the mode of administration. Additionally, the pre-existing difference for EI has disappeared, again suggesting a change due to the mode of administration.

Table A-2
Testing data for all respondents

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	723	53.34	7.545	657	54.02	8.015	-1.623	.105
AR	722	51.88	7.629	654	51.79	7.739	.217	.828
WK	724	53.42	7.155	645	53.77	7.627	-.876	.381
PC*	722	50.87	7.679	642	53.13	7.026	-5.646	.000
MK	722	55.93	5.396	644	56.26	5.586	-1.513	.130
EI	718	56.74	11.868	643	57.77	11.644	-1.613	.107
AS	714	50.81	10.231	642	51.58	9.861	-1.407	.160
MC*	707	55.37	8.854	642	57.34	8.939	-4.063	.000
AO*	629	51.86	10.202	584	55.17	9.233	-5.090	.000
VE*	722	52.69	7.008	641	53.82	7.290	-2.915	.000
AFQT	716	58.85	21.628	642	61.76	22.011	-2.454	.014

Gender

Record data for males in the two administration groups show no significant differences, indicating that they were reasonably similar prior to the equating study (see Table A-3). Findings for females show three differences; WK and VE are significantly different between the two groups (similar to overall) as well as MC (see Table A-4).

Table A-3
Record data for males

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	548	55.12	6.945	521	55.81	7.034	-1.614	.107
AR	547	55.48	6.201	517	55.37	6.354	.286	.775
WK	549	52.93	7.005	511	53.80	6.703	-2.063	.039
PC	548	54.07	6.121	508	54.89	5.872	-2.218	.027
MK	547	56.00	5.494	509	54.46	5.735	-1.331	.183
EI	543	56.16	8.334	508	57.28	8.078	-2.210	.027
AS	541	53.67	8.693	507	54.35	8.172	-1.303	.193
MC	535	57.18	7.936	507	57.64	7.912	-.937	.349
AO	473	57.63	6.853	462	57.92	7.420	-.633	.527
VE	548	53.54	6.292	508	54.44	5.996	-2.376	.018
AFQT	542	65.99	18.013	508	68.02	17.645	-1.843	.066

Table A-4
Record data for females

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	110	49.99	7.933	90	52.10	7.801	-1.885	.061
AR	110	52.27	5.809	90	53.12	7.166	-.927	.355
WK*	110	50.25	6.664	87	53.15	7.313	-2.905	.004
PC	109	52.53	5.690	88	54.61	5.621	-2.565	.011
MK	110	55.75	5.087	88	55.20	4.797	-.634	.527
EI	110	48.81	6.798	88	50.02	7.171	-1.215	.226
AS	109	43.80	5.434	88	46.06	6.970	-2.557	.011
MC*	108	48.83	5.783	88	51.42	6.612	-2.924	.004
AO	100	55.56	6.450	79	57.11	6.528	-1.588	.114
VE*	109	51.07	6.901	87	54.52	6.344	-2.971	.003
AFQT	109	58.57	16.727	87	64.95	18.197	-2.551	.012

The data obtained through the testing shows three significant differences for males; results for PC, MC, and AO show significant differences between administration modes where none had existed prior to our testing (see Table A-5).

Table A-5
Testing data for males

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	548	54.26	7.298	524	54.64	8.015	-.811	.417
AR	547	52.38	7.660	517	52.20	7.786	.380	.704
WK	549	53.89	7.213	511	54.06	7.796	-.369	.712
PC*	548	54.10	7.742	508	53.31	7.042	-4.840	.000
MK	547	53.51	6.702	509	54.07	7.086	-1.320	.187
EI	543	58.84	11.653	508	59.19	11.669	-.486	.627
AS	541	52.70	9.896	507	54.35	8.172	-.476	.634
MC*	535	56.51	8.789	507	58.29	8.912	-3.245	.001
AO*	743	52.39	10.246	462	55.18	9.394	-4.337	.000
VE	548	53.07	7.045	508	54.08	7.411	-2.270	.023
AFQT	542	60.45	21.384	508	63.09	21.944	-1.974	.049

There are a number of significant differences between the two groups of women when viewing the testing data for the females. As mentioned before, the two groups were significantly different for MC and VE scores prior to our testing, and these differences continue to exist (see table A-6) and the differences in WK scores are almost significantly different. In addition, GS, PC, EI, AS, and AO, as well as the AFQT score now are significantly different, possibly indicating a difference based on the mode of testing, although also likely impacted by the small number of women.

Table A-6
Testing data for females

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS*	110	50.00	7.748	90	53.03	7.257	-2.831	.005
AR	110	49.96	7.212	90	51.67	6.722	-1.720	.087
WK	110	51.38	6.757	87	53.94	6.900	-2.616	.010
PC*	109	50.06	7.366	88	54.53	5.628	-4.693	.000
MK	110	51.95	5.927	88	53.61	6.510	-1.874	.062
EI*	110	47.84	8.596	88	52.90	9.047	-4.021	.000
AS*	109	42.22	6.148	88	44.94	6.464	-3.017	.003
MC*	108	49.98	7.060	88	53.98	7.680	-3.792	.000
AO*	100	49.99	9.615	79	56.37	8.426	-4.652	.000
VE*	109	51.04	6.901	87	54.52	6.344	-3.635	.000
AFQT*	109	52.77	21.748	87	62.62	19.524	-3.295	.001

Ethnicity

As with males, no significant differences were found for record data of the majority group; the web-based majority and the paper-based majority had similar scores prior to our testing (see Table A-7). The two groups of minority personnel were significantly different on WK, PC, MK, and VE prior to testing (see Table A-8).

Table A-7
Record data for majority

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	352	56.03	6.361	395	56.65	6.269	-1.340	.181
AR	350	55.92	6.019	394	55.90	6.358	.044	.965
WK	351	54.20	6.358	390	54.58	6.573	-.798	.425
PC	351	54.92	5.829	388	55.34	5.579	-1.000	.317
MK	349	56.13	5.733	389	56.56	5.590	-1.031	.303
EI	346	56.64	7.879	388	57.68	7.605	-1.818	.069
AS	345	55.23	8.288	387	55.21	7.806	.034	.973
MC	344	58.16	7.566	387	58.26	7.713	-.177	.860
AO	308	57.92	6.768	356	58.42	7.182	-.919	.359
VE	351	54.71	5.716	388	55.10	5.836	-.916	.361
AFQT	348	68.94	16.985	388	70.00	16.544	-.857	.392

Table A-8
Record data for minority

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	216	51.00	7.623	166	52.57	7.720	-1.984	.048
AR	217	53.52	6.317	163	53.34	6.757	.267	.790
WK*	218	49.61	6.875	159	52.21	6.842	-3.962	.000
PC*	216	52.06	6.084	158	54.10	6.011	-3.219	.001
MK*	218	55.82	4.997	158	56.28	5.746	6.864	.000
EI	217	51.99	8.319	158	53.27	8.979	-1.423	.156
AS	216	47.27	7.944	158	48.74	8.161	-1.747	.081
MC	212	52.06	7.930	158	53.50	7.685	-1.751	.081
AO	188	55.88	6.986	141	56.66	7.294	-.983	.326
VE*	217	50.57	6.231	158	53.12	6.134	-3.939	.000
AFQT	215	58.01	17.647	158	63.32	19.258	-2.762	.006

The testing found significant differences for majority personnel in two subtests: PC and AO (see Table A-9). There were no significant differences in the two groups prior to our testing, so a possible source of this difference in our tests is due to the different administration modes.

Table A-9
Testing data for majority

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	352	55.23	7.004	395	55.70	7.465	-.884	.377
AR	350	52.61	7.788	394	52.97	7.412	-.646	.519
WK	351	55.07	6.369	390	55.14	7.304	-.138	.890
PC*	351	51.74	7.549	388	54.05	6.833	-4.366	.000
MK	349	53.83	6.714	389	54.63	6.980	-1.583	.114
EI	346	59.53	11.616	388	59.66	11.256	-.154	.878
AS	345	54.12	9.691	387	53.94	9.411	.255	.799
MC	344	57.51	8.418	387	58.93	8.721	-2.233	.026
AO*	308	52.63	10.134	356	56.08	9.085	-4.625	.000
VE	351	4.13	6.394	388	55.09	7.052	-1.931	.054
AFQT	348	62.88	20.632	388	66.28	20.346	-2.248	.025

Four tests show significant differences between the two minority groups, two of which were not pre-existing. Significant differences were found for PC and VE, as was seen in the record data, but the differences in WK and MK no longer exist (see Table A-10). In addition, scores for MC and AO are significantly different, possibly indicating a difference between modes.

Table A-10
Testing data for minority

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	216	50.61	7.420	166	52.06	8.227	-1.806	.072
AR	217	51.14	7.447	163	50.18	8.221	1.189	.235
WK	218	50.52	7.946	159	52.01	8.183	-1.943	.053
PC*	216	49.09	7.976	158	52.39	7.127	-4.132	.000
MK	218	52.03	6.441	158	52.50	7.173	-.623	.534
EI	217	52.66	11.507	158	55.33	11.601	-2.211	.028
AS	216	46.19	8.776	158	46.68	9.216	-.522	.602
MC*	212	51.78	8.580	158	54.66	8.688	-3.177	.002
AO*	188	50.15	10.448	141	53.71	9.854	-3.133	.002
VE*	217	49.96	7.689	158	52.39	7.605	-3.036	.003
AFQT	215	51.86	22.497	158	56.46	23.062	-1.931	.054

Summary

The two groups that participated in this equating study were slightly different prior to their participation. As the tables above show, male and majority personnel were equivalent, but overall examinees as well as females and minority primarily tended to differ on the verbal tests (WK and PC, as well as the composite VE).

The results of the equating study show new statistically significant differences, especially in MC and AO. Because these differences did not exist between the groups prior to testing, it is feasible that these differences are due to the mode of administration of the test.

Appendix B:
Selected Portions of the Manual for Administration
Armed Forces Classification Test (AFCT)
Version 19G

5. Testing Materials.

Testing materials required for each examinee are:

- a. Computer
- b. Privacy Act Statement
- c. Scratch paper – 2 sheets
- d. Two number 2 pencils (with eraser)

Materials required for the Test Administrator are:

- a. This manual
- b. Sufficient computers
- c. Sufficient copies of the Privacy Act Statement
- d. Sufficient number 2 pencils with erasers
- e. Sufficient scratch paper

7. Preparation of computers prior to testing.

Computers should already be set up prior to testing, but below are key steps if they aren't:

1. Screen saver should be off
2. Sound should be off
3. In Internet Explorer, no toolbars (Standard Buttons, Address Bar, Links) should be on, ONLY THE STATUS BAR should be showing (bottom of the screen). Be sure IE window is the full screen.

Computers need to be networked with the server hosting the test prior to continuing:

1. Turn the server on. You don't have to log into the machine, just turn it on.
2. Turn the computers on. Just hit enter to login.
3. Open Internet Explorer. It should default to the test home page, which says AFCT and asks for a password.
4. Minimize Internet Explorer.

Section II, part 2 for paper:

This is a research project on the AFCT, the version of the ASVAB administered while in the Navy. As this is a research project, you may choose to not do the test or stop doing the test during your time here, and there will be no penalty to you. However, if you do the test and you score better than your previous ASVAB scores, your personnel record will be updated to reflect the higher scores. If your scores are worse, your current scores will remain in your personnel file. The goal of this research is to improve the AFCT, so please do your best on the test.

If you choose to take the test, you are required to disclose your Social Security Number (SSN). Your SSN will be used to verify that the scores you make are correctly transcribed to a scoring worksheet. Any data you provide is For Official Use Only and will be maintained and used in strict confidence in accordance with Federal Laws and Regulations.

Now look at the sheet entitled Privacy Act Statement. Read the Privacy Act statement silently as I read it out loud:

Privacy Act Statement

AUTHORITY: 10 USC 133 and 3013; E.O. 9397

PRINCIPAL PURPOSE: To collect and measure an individual's aptitude for re-enlistment, re-classification, or training as a commissioned or warrant officer for assignments to various military positions.

ROUTINE USES: The scores an individual makes (if higher than their previous ASVAB scores) will be transcribed onto the appropriate military personnel records and furnished to evaluation boards and officials.

DISCLOSURE: If you choose to participate, completing this form is mandatory. Your social security number is used to verify that the score you make is correctly transcribed on your military personnel record.

I certify that I am physically and mentally fit and that I have neither given nor received unauthorized assistance in conjunction with this test.

Now read the final statement.

For PAPER ONLY:

In the upper center portion of the answer sheet there is a black printed sequence number. Write that number on the Privacy Act Statement in the blank for Sequence/Computer Number.

Print your last name and Social Security Number in the blanks and sign in the space provided.

Section II, part 2 for WEB:

Since this test is computer-based, we'll take the first few minutes so that you can get used to the mouse on the laptop in front of you. The large area below the letter keys is the mouse pad and your finger is the mouse. When you touch that area, moving your finger causes the arrow on the screen to move.

In this test you'll need to select answers by left clicking. To do this, use the left button just below the "mouse pad". Do not use the grey circle with arrows.

There are three games showing on the desktop – solitaire, spider solitaire, and minesweeper. Spend the next few minutes playing the games so you can get better acquainted with how to use the mouse. I'm going to walk around and make sure everyone understands how to use the mouse before we begin the test. If you need to take a head break, now would be the time to do it. The test may take 2-3 hours.

Walk around the room, checking on each person to be sure they can use the mouse.

I am (give your name), your Test Administrator today. I will be administering the Armed Forces Classification Test (AFCT).

This is a research project on the AFCT, the version of the ASVAB administered while in the Navy. As this is a research project, you may choose to not do the test or stop doing the test during your time here, and there will be no penalty to you. However, if you do the test and you score better than your previous ASVAB scores, your personnel record will be updated to reflect the higher scores. If your scores are worse, your current scores will remain in your personnel file. The goal of this research is to improve the AFCT, so please do your best on the test.

If you choose to take the test, you are required to disclose your Social Security Number (SSN). Your SSN will be used to verify that the scores you make are correctly transcribed to a scoring worksheet. Any data you provide is For Official Use Only and will be maintained and used in strict confidence in accordance with Federal Laws and Regulations.

Please clear your desk of everything but the laptop. Each of you will receive scratch paper and 2 pencils. Do not begin the test until you are told to do so.

Distribute 2 sheets of scratch paper, 2 pencils, and the Privacy Act Statement to each examinee, then say:

On these tests YOU SHOULD WORK AS RAPIDLY AND ACCURATELY AS YOU CAN. DO YOUR OWN WORK AND LISTEN CAREFULLY TO INSTRUCTIONS WHEN THEY ARE GIVEN. Please work quietly out of consideration for others who are also being tested.

Now look at the sheet entitled Privacy Act Statement. Read the Privacy Act statement silently as I read it out loud:

Privacy Act Statement

AUTHORITY: 10 USC 133 and 3013; E.O. 9397

PRINCIPAL PURPOSE: To collect and measure an individual's aptitude for re-enlistment, re-classification, or training as a commissioned or warrant officer for assignments to various military positions.

ROUTINE USES: The scores an individual makes (if higher than their previous ASVAB scores) will be transcribed onto the appropriate military personnel records and furnished to evaluation boards and officials.

DISCLOSURE: If you choose to participate, completing this form is mandatory. Your social security number is used to verify that the score you make is correctly transcribed on your military personnel record.

I certify that I am physically and mentally fit and that I have neither given nor received unauthorized assistance in conjunction with this test.

On the back of the laptop screen is a number written on a yellow square. Write that number on the Privacy Act Statement in the blank for Sequence/Computer Number.

Print your last name and Social Security Number in the blanks and sign in the space provided.

You will be selecting answers on the laptop in front of you. Use the scratch paper which was given to you for any figuring you need to do. Return this scratch paper with your other materials when you finish the test. Calculators of ANY kind are not allowed on the test.

The AFCT contains 9 tests. Each test has its own instructions and time limit, which you will see before each test. When you finish a test you may check your work in that test ONLY. Once you are completely done with a test, you may continue on to the next test.

For each question, be sure to pick the BEST ONE of the possible answers listed. When you have decided which one of the choices given is the best answer to a question, select that answer by clicking in the circle in front of that choice.

Answer as many questions as possible. Do not spend too much time on any one question. Work QUICKLY, but work ACCURATELY.

Each test is timed, and the time remaining will be shown in the bottom left corner of the screen. If you need additional scratch paper or pencils at any time during the test, please raise your hand and I will bring them to you.

Are there any questions?

Now, maximize Internet Explorer and log into the test using the password nprst2006. Each test begins with instructions that are not timed. Read through each set of instructions before beginning the test. Read through the instructions for part 1 now, and then enter your SSN in the box at the bottom before clicking the Begin button to start the test.

Examinees will raise their hands when they are done. Press the power button (machine will hibernate), collect all materials, and then quietly dismiss the individual.

AFCT Q&A

Q: What if I suspect someone is cheating?

A: Hover around. If you definitely notice someone is cheating, at the end of the section, ask them to pack up their materials, take back the Privacy Act, and note the incident on the form.

Q: What if someone decides that they don't want to continue the test?

A: Take their materials and thank them for their time. Note the incident on their Privacy Act.

Q: What if someone has a question about one of their test questions?

A: We're not allowed to answer any questions concerning the test.

Q: In the computer administration of the test, what if someone inadvertently gets out of the test (closes Internet Explorer) or can't continue?

A: Go back into Internet Explorer and have them start from the beginning. After entering in their SSN and clicking Next through the first test (stopping after pressing the SUBMIT button), go to View – Toolbars – Address Bar. After the <http://164.94.7.>, type in the filename of the section they should be going to:

Part 2 – afct2.asp

Part 3 – afct3.asp

Part 4 – afct4.asp

Etc

Close the Address Bar again (View – Toolbars – de-check Address Bar). Make note of their SSN and what happened.

Q: For computer administration of the test, what if one of the computers just dies?

A: Each room should have backups (they will have a yellow sticky that says B_) that should be “plug and play”. Close the inoperative computer, disconnect the power and the network cable from the back of the inoperative computer, and plug the cables into the backup machine. Turn the machine on, open Internet Explorer, and continue on as listed in the FAQ above. Make note of what happened, including what computer became inoperative and what backup you used, as well as noting who it was and what section they went to.

Q: How do we find out our scores?

A: Since this is part of a research project, the tests until we have all our data (likely a few months). If you haven't heard anything before December, contact Zannette.uriell@navy.mil.

Q: What if I don't want to be reclassified?

A: Respondents are not automatically reclassified based upon the test scores.

Appendix C: Privacy Act Statement

Privacy Act Statement

AUTHORITY: 10 USC 133 and 3013; E.O. 9397

PRINCIPAL PURPOSE: To collect and measure an individual's aptitude for re-enlistment, re-classification, or training as a commissioned or warrant officer for assignments to various military positions.

ROUTINE USES: The scores an individual makes (if higher than their previous ASVAB scores) will be transcribed onto the appropriate military personnel records and furnished to evaluation boards and officials.

DISCLOSURE: If you choose to participate, completing this form is mandatory. Your social security number is used to verify that the score you make is correctly transcribed on your military personnel record.

I certify that I am physically and mentally fit and that I have neither given nor received unauthorized assistance in conjunction with this test.

Sequence/Computer Number

Last Name

Social Security No.

SIGNATURE

Appendix D: Scoring

AFCT Scoring in SAS

```

options center pageno=1 nodate ls=124 ps=66; /*for PDF ls=129, ps=71*/
data _null_; call symput('cdate', put(date(), weekdate17.)); run;
data _null_; call symput('ctime', put(time(), time8.)); run;
footnote1 'Source: Navy Personnel Research, Studies & Technology, NPRST/PERS-
1';
footnote2 "David L. Alderton, Ph.D. 901/874-4633; run &cdate. at &ctime. ";
/*****
*****/
/*This will perform the IRT scoring of the subtests... but does not include
version differences */
/*This also computes the standards scores from thetas and the AFQT from
standard scores. */
/*I used several numerical examples to test, including those given by Dan and
some others. */
/*There are no controls in here for missing, incomplete or messy data which
needs to be watched.*/
/*****
*****/

libname afct "Z:\ASVAB06\SCORING"; /*lib name for my computer...*/
/*****
*****/
/*isolate parms, rename them, and merge them together...*/
/*I just cut and pasted this from the Excel file. I only*/
/*have the version 1 data (top of file) but it would be */
/*easy to modify for both. */
/*****
*****/
data afct.parms;
  input subtest $2. inum a b c;
  cards;
GS    1      0.91436      -0.78555      0.14865
GS    2      0.47381      -2.64284      0.18462
GS    3      0.62907      -2.93499      0.20101
GS    4      0.72723      -1.24738      0.2784
GS    5      0.58742      -1.47272      0.27789
GS    6      0.88309      -0.99238      0.20458
GS    7      0.39527      -2.65297      0.25698
GS    8      0.62042      -0.94736      0.17202
GS    9      0.62517      0.01806      0.37433
GS   10      0.79165      -0.3915      0.25134
GS   11      1.018 -0.29386      0.32875
GS   12      0.73272      -0.90835      0.1738
GS   13      0.65149      -0.01085      0.06584
GS   14      0.94343      0.1288      0.21421
GS   15      0.71347      0.69584      0.14951
GS   16      0.67643      0.24637      0.18816
GS   17      0.49969      0.06832      0.21698
GS   18      0.66381      0.42804      0.14121
GS   19      0.75412      1.27854      0.38795
GS   20      0.51658      0.72605      0.31128
GS   21      0.40946      0.60364      0.14844
GS   22      0.95975      1.56912      0.0843
GS   23      1.085 1.86188      0.23835

```

GS	24	0.62037	2.28963	0.08836
GS	25	0.8328	1.44953	0.11436
AR	1	0.69161	-2.37083	0.17583
AR	2	0.53495	-2.80441	0.15007
AR	3	1.06292	-1.60186	0.07038
AR	4	0.69981	-0.8137	0.10938
AR	5	0.83974	-1.00857	0.08162
AR	6	1.4909	-0.17713	0.15836
AR	7	0.9524	-0.72321	0.14032
AR	8	0.93455	-0.89134	0.16704
AR	9	0.97787	-0.44061	0.02216
AR	10	1.26494	-0.27203	0.19634
AR	11	0.97071	-0.89672	0.05369
AR	12	0.81582	-0.53374	0.1798
AR	13	1.05432	-0.09479	0.13462
AR	14	1.187	-0.14862	0.16084
AR	15	1.09468	1.412	0.42045
AR	16	0.51542	-0.06039	0.12794
AR	17	1.07013	-0.05964	0.24954
AR	18	1.18848	0.78574	0.19108
AR	19	0.92195	0.81313	0.37857
AR	20	1.10426	0.79569	0.21308
AR	21	1.25263	0.66573	0.26127
AR	22	1.22938	1.06802	0.20573
AR	23	0.87833	-0.19689	0.18008
AR	24	1.91382	1.07465	0.28383
AR	25	1.18448	1.12197	0.1856
AR	26	1.12751	1.13302	0.32535
AR	27	2.02064	1.2274	0.2139
AR	28	1.10695	1.12523	0.26605
AR	29	1.23125	1.50646	0.25046
AR	30	2.05102	1.33308	0.14229
WK	1	0.94623	-1.99913	0.06185
WK	2	1.02139	-2.42811	0.16112
WK	3	0.95334	-2.70973	0.14682
WK	4	0.93721	-2.08811	0.07391
WK	5	1.10676	-1.81998	0.12403
WK	6	1.09404	-1.4362	0.14317
WK	7	0.77163	-2.42383	0.11548
WK	8	1.53072	-1.22798	0.23881
WK	9	0.88658	-1.60389	0.06828
WK	10	1.19039	-1.60244	0.19522
WK	11	1.24316	-2.0244	0.13798
WK	12	1.29483	-1.53161	0.27972
WK	13	1.02709	-0.66848	0.13248
WK	14	1.00874	-0.49049	0.154
WK	15	1.39306	-1.26894	0.22801
WK	16	1.2093	-0.99866	0.25079
WK	17	0.85414	-1.50791	0.09912
WK	18	0.71445	-1.07432	0.21296
WK	19	1.3733	-0.31955	0.23958
WK	20	0.85212	-0.60071	0.35207
WK	21	1.12563	-0.08497	0.5
WK	22	1.58637	-0.23732	0.29288
WK	23	1.38671	-0.03478	0.41813
WK	24	1.62807	0.40636	0.17273
WK	25	0.55365	-0.18213	0.13315

WK	26	1.59244	0.44838	0.31194
WK	27	1.68835	0.14143	0.36996
WK	28	1.03606	-0.35464	0.25983
WK	29	0.91295	1.07383	0.22502
WK	30	1.16759	0.85341	0.31975
WK	31	1.58561	0.88667	0.36568
WK	32	1.10822	0.7892	0.11174
WK	33	0.84336	1.74273	0.16347
WK	34	0.7019	0.80273	0.36277
WK	35	0.70198	0.7401	0.18915
PC	1	0.93677	-1.30059	0.18034
PC	2	0.68608	-1.13724	0.14735
PC	3	0.9056	-1.33379	0.1188
PC	4	1.31657	-0.6578	0.11826
PC	5	0.65822	-1.42087	0.07882
PC	6	0.47424	-1.77563	0.07943
PC	7	0.71842	-1.18292	0.10859
PC	8	1.0989	-0.57203	0.11593
PC	9	0.52058	-0.76966	0.14157
PC	10	1.03986	-1.86214	0.12344
PC	11	0.57626	-0.93273	0.13629
PC	12	0.75584	0.31241	0.1931
PC	13	1.16951	0.64189	0.15481
PC	14	1.53557	0.15254	0.17975
PC	15	1.52707	0.27197	0.20495
MK	1	0.48608	-2.27829	0.22232
MK	2	0.75602	-1.65131	0.15721
MK	3	0.7061	-2.51714	0.15603
MK	4	0.83788	-0.20459	0.21893
MK	5	1.03099	-0.54983	0.18116
MK	6	0.91807	-0.85209	0.12924
MK	7	1.11046	0.09746	0.40807
MK	8	1.37977	-0.14145	0.19052
MK	9	1.15755	0.09751	0.04072
MK	10	1.00277	-0.12153	0.26868
MK	11	1.07472	-0.31053	0.12026
MK	12	0.76672	0.39425	0.04302
MK	13	1.39979	0.47199	0.27006
MK	14	1.14591	0.49367	0.30219
MK	15	0.71741	0.08486	0.07646
MK	16	0.83677	1.07672	0.20505
MK	17	1.39926	0.72736	0.48806
MK	18	0.8545	0.33316	0.14661
MK	19	1.07006	0.6619	0.08507
MK	20	1.03234	0.66915	0.17034
MK	21	1.28953	0.25302	0.08505
MK	22	1.17254	1.1191	0.14822
MK	23	0.90738	0.85672	0.08214
MK	24	1.8991	1.15848	0.21171
MK	25	1.55167	1.29933	0.22083
EI	1	0.54128	-1.40113	0.09168
EI	2	0.44512	-2.19275	0.16594
EI	3	0.7749	-0.30943	0.19301
EI	4	1.08727	0.49554	0.39446
EI	5	0.57896	-0.3041	0.06633
EI	6	0.63905	0.12713	0.31333
EI	7	0.61368	-0.13805	0.20155

EI	8	0.43312	-2.16243	0.0974
EI	9	0.63808	-0.6724	0.10262
EI	10	0.59113	0.23785	0.16543
EI	11	0.40447	-1.44321	0.10542
EI	12	1.13622	0.93676	0.18266
EI	13	0.74173	1.10333	0.10825
EI	14	1.36233	0.97357	0.26708
EI	15	0.61123	0.75783	0.11334
EI	16	1.22852	1.10599	0.21568
EI	17	3.39299	2.54553	0.23674
EI	18	1.35882	1.49817	0.17364
EI	19	1.40809	1.92177	0.28898
EI	20	1.65236	2.0484	0.14688
AS	1	0.72604	-0.81937	0.18747
AS	2	0.94108	-1.23619	0.22178
AS	3	1.02158	-1.08821	0.1033
AS	4	0.88189	-0.31706	0.16216
AS	5	0.41232	-0.52765	0.08818
AS	6	0.96361	0.0404	0.11989
AS	7	2.04821	0.56323	0.4015
AS	8	0.52229	-0.11796	0.14273
AS	9	1.32283	0.76135	0.32233
AS	10	0.78761	0.96572	0.48112
AS	11	0.79827	0.01639	0.11234
AS	12	2.01073	1.09202	0.49381
AS	13	0.64198	0.39584	0.03703
AS	14	0.67502	1.10998	0.5
AS	15	0.35589	-0.11162	0.07506
AS	16	0.83379	0.91499	0.07623
AS	17	0.96923	0.57023	0.17139
AS	18	2.05555	0.68303	0.26783
AS	19	0.44447	0.43339	0.07009
AS	20	1.31577	1.02899	0.18656
AS	21	1.12678	1.3408	0.21803
AS	22	0.95009	1.36492	0.16984
AS	23	1.07364	1.67572	0.15328
AS	24	1.86967	1.08781	0.22078
AS	25	1.69923	1.27657	0.1821
MC	1	0.74279	0.18245	0.16946
MC	2	0.80909	-0.48081	0.24885
MC	3	0.97807	-1.08137	0.09415
MC	4	0.58193	-0.5386	0.07614
MC	5	0.5678	0.45434	0.11108
MC	6	1.06938	0.08375	0.11457
MC	7	0.55806	-0.91499	0.29483
MC	8	0.84652	0.20709	0.08688
MC	9	0.86135	0.6525	0.33261
MC	10	0.81386	0.89453	0.26505
MC	11	0.72131	0.40877	0.12841
MC	12	1.15143	0.78216	0.39641
MC	13	0.60165	-0.0506	0.17606
MC	14	0.86743	0.29763	0.04723
MC	15	0.99059	1.75212	0.18112
MC	16	0.55576	0.23291	0.11014
MC	17	0.77001	0.53024	0.09702
MC	18	1.08954	1.74088	0.34716
MC	19	0.71698	0.33447	0.22632

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MC    20    0.79906    1.12321    0.20126
MC    21    0.56447    0.69682    0.03684
MC    22    1.39813    0.84086    0.25107
MC    23    0.8079    1.34906    0.1776
MC    24    0.87742    1.83394    0.18349
MC    25    0.79277    1.02826    0.22463
AO    1    0.92604    0.27877    0.41604
AO    2    1.63548    -0.40704    0.37784
AO    3    1.3188    -0.44956    0.39579
AO    4    0.98753    -0.42992    0.30135
AO    5    1.25043    -0.19651    0.33863
AO    6    0.92736    -0.26473    0.4227
AO    7    0.9625    -0.26908    0.42695
AO    8    1.43875    0.02796    0.29233
AO    9    1.25061    0.14978    0.27594
AO   10    1.0184    0.32411    0.25874
AO   11    0.55062    1.26054    0.27527
AO   12    0.72643    -0.15407    0.29664
AO   13    1.57116    -1.49674    0.18803
AO   14    0.93175    -1.19936    0.08545
AO   15    1.34623    -1.28518    0.02998
AO   16    0.88941    -1.13276    0.04437
AO   17    1.46408    -1.12058    0.04654
AO   18    0.90133    -1.15894    0.05187
AO   19    0.68892    -0.87208    0.04935
AO   20    1.42837    -0.81359    0.21848
AO   21    1.20289    -0.72515    0.22876
AO   22    1.53127    -0.51003    0.20649
AO   23    0.89915    -0.40272    0.19925
AO   24    1.16498    -0.30876    0.21703
AO   25    0.48491    0.08342    0.1219
;
run;
/*****
/*begin creating the 1-record parameter file...*/
/*This could be looped by didn't seem worth it */
*****/
data parms; set afct.parms; run; /*Load afct.parms into memory... a little
faster*/
/*GS*/ /*create and label the a, b, c parameters for easy array usage later*/
proc transpose data=parms out=GSa prefix=GSa; where subtest='GS'; var a; run;
proc transpose data=parms out=GSb prefix=GSb; where subtest='GS'; var b; run;
proc transpose data=parms out=GSb prefix=GSb; where subtest='GS'; var b; run;
proc transpose data=parms out=GSb prefix=GSb; where subtest='GS'; var b; run;
proc transpose data=parms out=GSb prefix=GSb; where subtest='GS'; var b; run;
data GSparms; merge GSa(drop=_name_) GSb(drop=_name_) GSb(drop=_name_); run;
/*AR*/
proc transpose data=parms out=ARa prefix=ARa; where subtest='AR'; var a; run;
proc transpose data=parms out=ARb prefix=ARb; where subtest='AR'; var b; run;
proc transpose data=parms out=ARc prefix=ARc; where subtest='AR'; var c; run;
data ARparms; merge ARa(drop=_name_) ARb(drop=_name_) ARc(drop=_name_); run;
/*WK*/
proc transpose data=parms out=WKa prefix=WKa; where subtest='WK'; var a; run;
proc transpose data=parms out=WKb prefix=WKb; where subtest='WK'; var b; run;
proc transpose data=parms out=WKc prefix=WKc; where subtest='WK'; var c; run;
data WKparms; merge WKa(drop=_name_) WKb(drop=_name_) WKc(drop=_name_); run;
/*PC*/
proc transpose data=parms out=PCa prefix=PCa; where subtest='PC'; var a; run;
proc transpose data=parms out=PCb prefix=PCb; where subtest='PC'; var b; run;

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proc transpose data=parms out=PCc prefix=PCc; where subtest='PC'; var c; run;
data PCparms; merge PCa(drop=_name_) PCb(drop=_name_) PCc(drop=_name_); run;
/*MK*/
proc transpose data=parms out=MKa prefix=MKa; where subtest='MK'; var a; run;
proc transpose data=parms out=MKb prefix=MKb; where subtest='MK'; var b; run;
proc transpose data=parms out=MKc prefix=MKc; where subtest='MK'; var c; run;
data MKparms; merge MKa(drop=_name_) MKb(drop=_name_) MKc(drop=_name_); run;
/*EI*/
proc transpose data=parms out=EIa prefix=EIa; where subtest='EI'; var a; run;
proc transpose data=parms out=EIb prefix=EIb; where subtest='EI'; var b; run;
proc transpose data=parms out=EIc prefix=EIc; where subtest='EI'; var c; run;
data EIparms; merge EIa(drop=_name_) EIb(drop=_name_) EIc(drop=_name_); run;
/*AS*/
proc transpose data=parms out=ASa prefix=ASa; where subtest='AS'; var a; run;
proc transpose data=parms out=ASb prefix=ASb; where subtest='AS'; var b; run;
proc transpose data=parms out=ASc prefix=ASc; where subtest='AS'; var c; run;
data ASparms; merge ASa(drop=_name_) ASb(drop=_name_) ASc(drop=_name_); run;
/*MC*/
proc transpose data=parms out=MCa prefix=MCa; where subtest='MC'; var a; run;
proc transpose data=parms out=MCb prefix=MCb; where subtest='MC'; var b; run;
proc transpose data=parms out=MCC prefix=MCC; where subtest='MC'; var c; run;
data MCparms; merge MCa(drop=_name_) MCb(drop=_name_) MCC(drop=_name_); run;
/*A0... not really necessary*/
proc transpose data=parms out=A0a prefix=A0a; where subtest='A0'; var a; run;
proc transpose data=parms out=A0b prefix=A0b; where subtest='A0'; var b; run;
proc transpose data=parms out=A0c prefix=A0c; where subtest='A0'; var c; run;
data A0parms; merge A0a(drop=_name_) A0b(drop=_name_) A0c(drop=_name_); run;

/*Gather into 1 record of 684 variables to merge with individual subject
records*/
data afct.IRTparms;
  merge GSparms ARparms WKparms PCparms MKparms EIparms ASparms MCparms
A0parms;
  GSitems=25; ARitems=30; WKitems=35; PCitems=15; MKitems=25;
  EIitems=20; ASitems=25; MCitems=25; A0items=25;
run;
proc import datafile="Z:\ASVAB06\data\afct_complete_SAS.csv" out=WORK.ZSAS
dbms=csv replace;
delimiter=",";
getnames=yes;
run;
proc sort data=WORK.ZSAS; by SSN; run; /*for later merges*/
proc sql; /*This creates a Cartesian join... the parameters record joined to
each person*/
  create table WithParm as
  select *
  from WORK.ZSAS, afct.IRTparms;
quit;
/*****
/*The next steps do the subtest scoring and outputs theta and ID only*/
/* this could have been done in a macro loop but it was quicker to */
/* just to cut and paste, replace the subtest prefix and # of items.*/
/* I tested this code against numerical examples in Dan's PDF. */
*****/
data ScoreGS;
  set WithParm (keep=SSN GSa1-GSa25 GSb1-GSb25 GSc1-GSc25 CGS01-CGS25
GSitems);

```

```

nitems=25;
/*initialize constants*/
ta=-4; tb=4; fpd=0; mu=0; s=1;
/*set arrays*/
array a(25) GSa1-GSa25;
array b(25) GSb1-GSb25;
array c(25) GSc1-GSc25;
array u(25) CGS01-CGS25;
/*now get initial estimate of fa on the first pass through the data*/
do i = 1 to nitems;
    expval=exp(a(i)*1.7*(ta-b(i))); /*note in first call, theta=ta*/
    fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
end;
    fa = fpd + (mu - ta)/s**2 ; /*note in first call, theta=ta*/
/*first part worked... and matches Dan's cycle 0 value for fa=4.30928*/
/*now get initial estimate of fp on the second pass through the data*/
/*second part worked... and matches Dan's cycle 1 value for fp= -0.27936*/
/*now wrap it in the 15 cycle iteration for final theta*/
do krep = 1 to 15;
    tp=(ta+tb)/2;
    fpd=0 ;
    do i = 1 to nitems;
        expval=exp(a(i)*1.7*(tp-b(i))); /*note in second call, theta=tp*/
        fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
    end;
    fp = fpd + (mu - tp)/s**2 ; /*note in second call, theta=tp*/
    if fp = 0 then stop ;
    else if fa*fp > 0 then
        do;
            ta=tp; fa=fp;
        end;
    else tb=tp;
    end;
    GS_theta=(ta+tb)/2;
keep ssn GS_theta ;
run;

data ScoreAR;
set WithParm (keep=SSN ARa1-ARa30 ARb1-ARb30 ARc1-ARc30 CAR01-CAR30
ARitems);
nitems=30;
/*initialize constants*/
ta=-4; tb=4; fpd=0; mu=0; s=1;
/*set arrays*/
array a(30) ARa1-ARa30;
array b(30) ARb1-ARb30;
array c(30) ARc1-ARc30;
array u(30) CAR01-CAR30;
/*now get initial estimate of fa on the first pass through the data*/
do i = 1 to nitems;
    expval=exp(a(i)*1.7*(ta-b(i))); /*note in first call, theta=ta*/
    fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
end;
    fa = fpd + (mu - ta)/s**2 ; /*note in first call, theta=ta*/

```

```

/*first part worked... and matches Dan's cycle 0 value for fa=4.30928*/
/*now get initial estimate of fp on the second pass through the data*/
/*second part worked... and matches Dan's cycle 1 value for fp= -0.27936*/
/*now wrap it in the 15 cycle iteration for final theta*/
do krep = 1 to 15;
  tp=(ta+tb)/2;
  fpd=0 ;
  do i = 1 to nitems;
    expval=exp(a(i)*1.7*(tp-b(i))); /*note in second call, theta=tp*/
    fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
  end;
  fp = fpd + (mu - tp)/s**2 ; /*note in second call, theta=tp*/
  if fp = 0 then stop ;
  else if fa*fp > 0 then
do;
  ta=tp; fa=fp;
end;
  else tb=tp;
end;
  AR_theta=(ta+tb)/2;
keep ssn AR_theta ;
run;

data ScoreWK;
  set WithParm (keep=SSN WKa1-WKa35 Wkb1-Wkb35 WKc1-WKc35 CWK01-CWK35
WKitems);
  nitems=35;
  /*initialize constants*/
  ta=-4; tb=4; fpd=0; mu=0; s=1;
  /*set arrays*/
  array a(35) WKa1-WKa35;
  array b(35) Wkb1-Wkb35;
  array c(35) WKc1-WKc35;
  array u(35) CWK01-CWK35;
  /*now get initial estimate of fa on the first pass through the data*/
  do i = 1 to nitems;
    expval=exp(a(i)*1.7*(ta-b(i))); /*note in first call, theta=ta*/
    fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
  end;
  fa = fpd + (mu - ta)/s**2 ; /*note in first call, theta=ta*/
  /*first part worked... and matches Dan's cycle 0 value for fa=4.30928*/
  /*now get initial estimate of fp on the second pass through the data*/
  /*second part worked... and matches Dan's cycle 1 value for fp= -0.27936*/
  /*now wrap it in the 15 cycle iteration for final theta*/
  do krep = 1 to 15;
    tp=(ta+tb)/2;
    fpd=0 ;
    do i = 1 to nitems;
      expval=exp(a(i)*1.7*(tp-b(i))); /*note in second call, theta=tp*/
      fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
    end;
    fp = fpd + (mu - tp)/s**2 ; /*note in second call, theta=tp*/
    if fp = 0 then stop ;
    else if fa*fp > 0 then

```

```

do;
    ta=tp; fa=fp;
    end;
else tb=tp;
end;
WK_theta=(ta+tb)/2;
keep ssn WK_theta ;
run;

data ScorePC;
set WithParm (keep=SSN PCa1-PCa15 PCb1-PCb15 PCc1-PCc15 CPC01-CPC15
PCitems);
nitems=15;
/*initialize constants*/
ta=-4; tb=4; fpd=0; mu=0; s=1;
/*set arrays*/
array a(15) PCa1-PCa15;
array b(15) PCb1-PCb15;
array c(15) PCc1-PCc15;
array u(15) CPC01-CPC15;
/*now get initial estimate of fa on the first pass through the data*/
do i = 1 to nitems;
    expval=exp(a(i)*1.7*(ta-b(i))); /*note in first call, theta=ta*/
    fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
end;
fa = fpd + (mu - ta)/s**2 ; /*note in first call, theta=ta*/
/*first part worked... and matches Dan's cycle 0 value for fa=4.30928*/
/*now get initial estimate of fp on the second pass through the data*/
/*second part worked... and matches Dan's cycle 1 value for fp= -0.27936*/
/*now wrap it in the 15 cycle iteration for final theta*/
do krep = 1 to 15;
    tp=(ta+tb)/2;
    fpd=0 ;
    do i = 1 to nitems;
        expval=exp(a(i)*1.7*(tp-b(i))); /*note in second call, theta=tp*/
        fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
    end;
    fp = fpd + (mu - tp)/s**2 ; /*note in second call, theta=tp*/
    if fp = 0 then stop ;
    else if fa*fp > 0 then
    do;
        ta=tp; fa=fp;
        end;
    else tb=tp;
    end;
    PC_theta=(ta+tb)/2;
keep ssn PC_theta ;
run;

data ScoreMK;
set WithParm (keep=SSN MKa1-MKa25 MKb1-MKb25 MKc1-MKc25 CMK01-CMK25
MKitems);
nitems=25;
/*initialize constants*/
ta=-4; tb=4; fpd=0; mu=0; s=1;

```

```

/*set arrays*/
array a(25) MKa1-MKa25;
array b(25) MKb1-MKb25;
array c(25) MKc1-MKc25;
array u(25) CMK01-CMK25;
/*now get initial estimate of fa on the first pass through the data*/
do i = 1 to nitems;
    expval=exp(a(i)*1.7*(ta-b(i))); /*note in first call, theta=ta*/
    fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
end;
    fa = fpd + (mu - ta)/s**2 ; /*note in first call, theta=ta*/
/*first part worked... and matches Dan's cycle 0 value for fa=4.30928*/
/*now get initial estimate of fp on the second pass through the data*/
/*second part worked... and matches Dan's cycle 1 value for fp= -0.27936*/
/*now wrap it in the 15 cycle iteration for final theta*/
do krep = 1 to 15;
    tp=(ta+tb)/2;
    fpd=0 ;
    do i = 1 to nitems;
        expval=exp(a(i)*1.7*(tp-b(i))); /*note in second call, theta=tp*/
        fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
    end;
    fp = fpd + (mu - tp)/s**2 ; /*note in second call, theta=tp*/
    if fp = 0 then stop ;
    else if fa*fp > 0 then
        do;
            ta=tp; fa=fp;
        end;
    else tb=tp;
    end;
    MK_theta=(ta+tb)/2;
keep ssn MK_theta ;
run;

data ScoreEI;
set WithParm (keep=SSN EIa1-EIa20 EIb1-EIb20 EIC1-EIC20 CEI01-CEI20
EIitems);
nitems=20;
/*initialize constants*/
ta=-4; tb=4; fpd=0; mu=0; s=1;
/*set arrays*/
array a(20) EIa1-EIa20;
array b(20) EIb1-EIb20;
array c(20) EIC1-EIC20;
array u(20) CEI01-CEI20;
/*now get initial estimate of fa on the first pass through the data*/
do i = 1 to nitems;
    expval=exp(a(i)*1.7*(ta-b(i))); /*note in first call, theta=ta*/
    fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
end;
    fa = fpd + (mu - ta)/s**2 ; /*note in first call, theta=ta*/
/*first part worked... and matches Dan's cycle 0 value for fa=4.30928*/
/*now get initial estimate of fp on the second pass through the data*/
/*second part worked... and matches Dan's cycle 1 value for fp= -0.27936*/

```

```

/*now wrap it in the 15 cycle iteration for final theta*/
do krep = 1 to 15;
    tp=(ta+tb)/2;
    fpd=0 ;
    do i = 1 to nitems;
        expval=exp(a(i)*1.7*(tp-b(i))); /*note in second call, theta=tp*/
        fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
    end;
    fp = fpd + (mu - tp)/s**2 ; /*note in second call, theta=tp*/
    if fp = 0 then stop ;
    else if fa*fp > 0 then
        do;
            ta=tp; fa=fp;
        end;
    else tb=tp;
    end;
    EI_theta=(ta+tb)/2;
keep ssn EI_theta ;
run;

data ScoreAS;
set WithParm (keep=SSN ASa1-ASa25 ASb1-ASb25 ASc1-ASc25 CAS01-CAS25
ASitems);
nitems=25;
/*initialize constants*/
ta=-4; tb=4; fpd=0; mu=0; s=1;
/*set arrays*/
array a(25) ASa1-ASa25;
array b(25) ASb1-ASb25;
array c(25) ASc1-ASc25;
array u(25) CAS01-CAS25;
/*now get initial estimate of fa on the first pass through the data*/
do i = 1 to nitems;
    expval=exp(a(i)*1.7*(ta-b(i))); /*note in first call, theta=ta*/
    fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
end;
fa = fpd + (mu - ta)/s**2 ; /*note in first call, theta=ta*/
/*first part worked... and matches Dan's cycle 0 value for fa=4.30928*/
/*now get initial estimate of fp on the second pass through the data*/
/*second part worked... and matches Dan's cycle 1 value for fp= -0.27936*/
/*now wrap it in the 15 cycle iteration for final theta*/
do krep = 1 to 15;
    tp=(ta+tb)/2;
    fpd=0 ;
    do i = 1 to nitems;
        expval=exp(a(i)*1.7*(tp-b(i))); /*note in second call, theta=tp*/
        fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
    end;
    fp = fpd + (mu - tp)/s**2 ; /*note in second call, theta=tp*/
    if fp = 0 then stop ;
    else if fa*fp > 0 then
        do;
            ta=tp; fa=fp;
        end;

```

```

        else tb=tp;
        end;
        AS_theta=(ta+tb)/2;
    keep ssn AS_theta ;
run;

data ScoreMC;
    set WithParm (keep=SSN MCA1-MCA25 MCB1-MCB25 MCC1-MCC25 CMC01-CMC25
MCitems);
    nitems=25;
    /*initialize constants*/
    ta=-4; tb=4; fpd=0; mu=0; s=1;
    /*set arrays*/
    array a(25) MCA1-MCA25;
    array b(25) MCB1-MCB25;
    array c(25) MCC1-MCC25;
    array u(25) CMC01-CMC25;
    /*now get initial estimate of fa on the first pass through the data*/
    do i = 1 to nitems;
        expval=exp(a(i)*1.7*(ta-b(i))); /*note in first call, theta=ta*/
        fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
    end;
    fa = fpd + (mu - ta)/s**2 ; /*note in first call, theta=ta*/
    /*first part worked... and matches Dan's cycle 0 value for fa=4.30928*/
    /*now get initial estimate of fp on the second pass through the data*/
    /*second part worked... and matches Dan's cycle 1 value for fp= -0.27936*/
    /*now wrap it in the 15 cycle iteration for final theta*/
    do krep = 1 to 15;
        tp=(ta+tb)/2;
        fpd=0 ;
        do i = 1 to nitems;
            expval=exp(a(i)*1.7*(tp-b(i))); /*note in second call, theta=tp*/
            fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
        end;
        fp = fpd + (mu - tp)/s**2 ; /*note in second call, theta=tp*/
        if fp = 0 then stop ;
        else if fa*fp > 0 then
            do;
                ta=tp; fa=fp;
            end;
        else tb=tp;
        end;
        MC_theta=(ta+tb)/2;
    keep ssn MC_theta ;
run;

data ScoreA0;
    set WithParm (keep=SSN A0a1-A0a25 A0b1-A0b25 A0c1-A0c25 CA001-CA025
A0items);
    nitems=25;
    /*initialize constants*/
    ta=-4; tb=4; fpd=0; mu=0; s=1;
    /*set arrays*/
    array a(25) A0a1-A0a25;
    array b(25) A0b1-A0b25;

```

```

array c(25) A0c1-A0c25;
array u(25) CA001-CA025;
/*now get initial estimate of fa on the first pass through the data*/
do i = 1 to nitems;
    expval=exp(a(i)*1.7*(ta-b(i))); /*note in first call, theta=ta*/
    fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
end;
    fa = fpd + (mu - ta)/s**2 ; /*note in first call, theta=ta*/
/*first part worked... and matches Dan's cycle 0 value for fa=4.30928*/
/*now get initial estimate of fp on the second pass through the data*/
/*second part worked... and matches Dan's cycle 1 value for fp= -0.27936*/
/*now wrap it in the 15 cycle iteration for final theta*/
do krep = 1 to 15;
    tp=(ta+tb)/2;
    fpd=0 ;
    do i = 1 to nitems;
        expval=exp(a(i)*1.7*(tp-b(i))); /*note in second call, theta=tp*/
        fpd = fpd + a(i)*1.7*(-1. + 1./(1. + expval) + u(i) -
(c(i)*u(i))/(c(i) + expval));
    end;
    fp = fpd + (mu - tp)/s**2 ; /*note in second call, theta=tp*/
    if fp = 0 then stop ;
    else if fa*fp > 0 then
do;
        ta=tp; fa=fp;
        end;
    else tb=tp;
    end;
    A0_theta=(ta+tb)/2;
keep ssn A0_theta ;
run; /*Merge the 9 subtest theta estimates by ID into a single file*/
data afct.theta;
merge ScoreGS ScoreAR ScoreWK ScorePC ScoreMK ScoreEI ScoreAS ScoreMC
ScoreA0;
by SSN;
/*this creates the standand scores from EITHER version and is the */
/*method from Dan's PDF doc, chapter 4 plus data in tables 2.1, 2.2*/
/*this was tested against Dan's two subject example. */
GSs = round(47.151224 + 10.527430 * GS_theta, 1);
ARs = round(47.667251 + 9.433283 * AR_theta, 1);
WKs = round(46.644903 + 10.243609 * WK_theta, 1);
PCs = round(49.317406 + 10.097481 * PC_theta, 1);
MKs = round(47.936105 + 9.314591 * MK_theta, 1);
EIs = round(47.865784 + 11.838647 * EI_theta, 1);
ASs = round(47.914860 + 12.381293 * AS_theta, 1);
MCs = round(48.943491 + 10.677225 * MC_theta, 1);
A0s = round(50.649606 + 10.393213 * A0_theta, 1);
VEs = round(47.481779 + 6.861654*WK_theta + 4.091172*PC_theta, 1);
run;
proc print data=afct.theta; run;
/*****
*/
/*this does a table lookup for the AFQT, based on Dan's 1997 norm
publication*/
/*it works for any test version where the standard scores are on the */
/*1997 score scale. Uses temp arrays with the look up values. */

```

```

/*****
*/
data afct.theta_afqt;
  set afct.theta ;
  array sums(161) _temporary_
    (109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123,
124, 125,
126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140,
141, 142,
143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157,
158, 159,
160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174,
175, 176,
177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191,
192, 193,
194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208,
209, 210,
211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225,
226, 227,
228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242,
243, 244,
245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259,
260, 261,
262, 263, 264, 265, 266, 267, 268, 269) ;
  array afqts(161) _temporary_
    (1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3, 3, 3, 3, 3, 4, 4, 4, 4, 4, 4, 4, 4, 4,
5, 5, 5, 5, 6, 6, 6, 6, 7, 7,
7, 7, 8, 8, 9, 9, 9, 9, 10, 10, 11, 11, 11, 12, 13, 13, 14, 15, 15, 16, 16,
17, 17, 18, 19, 19, 20, 21, 22,
22, 23, 24, 25, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 35, 36, 38, 39,
40, 41, 42, 43, 44, 45,
46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 59, 60, 61, 62, 63, 64, 66,
67, 68, 69, 70, 70, 71,
72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 82, 83, 84, 85, 85, 86, 87, 88,
88, 89, 90, 90, 91, 92,
92, 93, 93, 93, 94, 94, 95, 95, 95, 96, 96, 96, 97, 97, 97, 97, 98, 98, 98,
98, 98, 99) ;
  length sum afqt 3.0;
  sum=ARs+MKs+2*VEs; /*sum the standard scores...*/
  afqt=0;
  if sum<=109 then afqt=1;
  if sum>=269 then afqt=99;
  do i=1 to 161 until (afqt>0);
    if sum=sums(i) then afqt=afqts(i);
  end;
run;
proc print data=afct.theta_afqt ; run;

```

Appendix E: Web AFCT Equating Study

Web-AFCT Equating Study

Zannette Uriell



Problem – Old Technology

- A computer-based version of the Armed Services Vocational Aptitude Battery (ASVAB) is administered to Sailors when they join the Navy
- To improve ASVAB scores while in-service (possibly to qualify for a different rating), they receive a paper-based version of the Armed Forces Classification Test (AFCT; in-service version of the ASVAB)
- As Navy moves more training and testing to the Internet, they would like to move AFCT administration to the Internet as well
 - Less time-consuming for examinees as well as administrators
 - Increased security of the test items

NPRST



2



Problem – Inaccurate Scoring and Recording

- AFCT currently does not use item response theory so cannot be scored using 1997 scale scores
- Scores are hand-entered into personnel files, increasing the potential for errors
- Does creating a web-based AFCT impact results, even though more secure and accurate?

3



Objective

- Create a web-based version of AFCT Form 19G
- Conduct platform-effects study
 - Test one group of Sailors with the paper-based Form 19G while testing a matched group using the web-based version
 - » Match on gender and majority/minority status
- Determine if there are any differences in scores overall as well as by gender and majority/minority subgroups

4

AFCT Description

- AFCT is the version of the ASVAB administered while in the service
- Test consists of 9 sections:

	Subject	Number of Questions	Time Limit
1	General Science (GS)	25	11
2	Arithmetic Reasoning (AR)	30	36
3	Word Knowledge (WK)	35	11
4	Paragraph Comprehension (PC)	15	13
5	Mathematics Knowledge (MK)	25	24
6	Electronics Information (EI)	20	9
7	Automotive and Shop (AS)	25	11
8	Mechanical Comprehension (MC)	25	19
9	Assembling Objects (AO)	25	15

5

Testing



Subjects

- Testing conducted 31 July – 13 September 2006
- Personnel assigned to NTC Great Lakes during testing may have participated
 - Majority were students in "A" School (tested by duty section) or in INDOC (after last indoctrination class ended)
 - Small portion were Not Under Instruction (NUI) while two were staff members (E-6)
- Demographic information (gender and majority/minority status) collected through sign-in sheets

7



Conditions

- Majority of subjects were assigned to the two conditions based upon the last digit of SSN
 - Those with even last digits received paper version and those with odd received web version
- Most subjects in INDOC (afternoon sessions) were assigned to the web condition until all computers were filled; remaining subjects were assigned to the paper condition
- General Form 19G instructions were adapted for experiment
 - Web-based instructions were provided as on-screen text that the subjects read

8



Paper-Based Condition

- Testing took place in either a classroom setting (individual table/chairs spaced about 2 feet apart) or in a hangar bay (large table with 2 chairs, examinees seated in every other chair)
- Standard AFCT paper administration procedures were followed throughout
- Two proctors were available to read instructions, pass out materials, and monitor the testing session
- Instructions were read to examinees about the voluntary nature of the testing as part of the standard AFCT instructions

9



Paper-Based Condition (continued)

- Each participant received a modified AFCT Privacy Act Statement indicating that scores would only count if they were better than previous ASVAB scores
- Examinees received 2 pencils, 2 pieces of scratch paper, an answer sheet, and a test book while the instructions were read
- Test administrators read instructions at the beginning of sections, including sample problem(s), number of questions, and time limit for the section

10



Paper-Based Condition (continued)

- Examinees read questions in the test book, with 4 to 10 questions per pages (depending on section)
- Responses were marked on a standard “bubble” scantron answer sheet
- Examinees were timed by test administrators
- All testing materials were collected before dismissal

11



Web-Based Condition – Similarities to Paper

- Two proctors were available to read instructions, pass out materials, and monitor testing throughout session
- Examinees were read instructions about the voluntary nature of the testing
- Each received a modified Privacy Act Statement indicating that scores would only count if they were better than previous ASVAB scores
- Each received 2 pencils and 2 pieces of scratch paper

12



Web-Based Condition – Similarities to Paper (continued)

- Section instructions prefaced each section; instructions were not timed but timing started once the first question appeared
- Within each section, the examinee could go backwards or forwards, and skip questions; subjects could not return to previously completed sections
- All testing materials were collected as each respondent finished

13

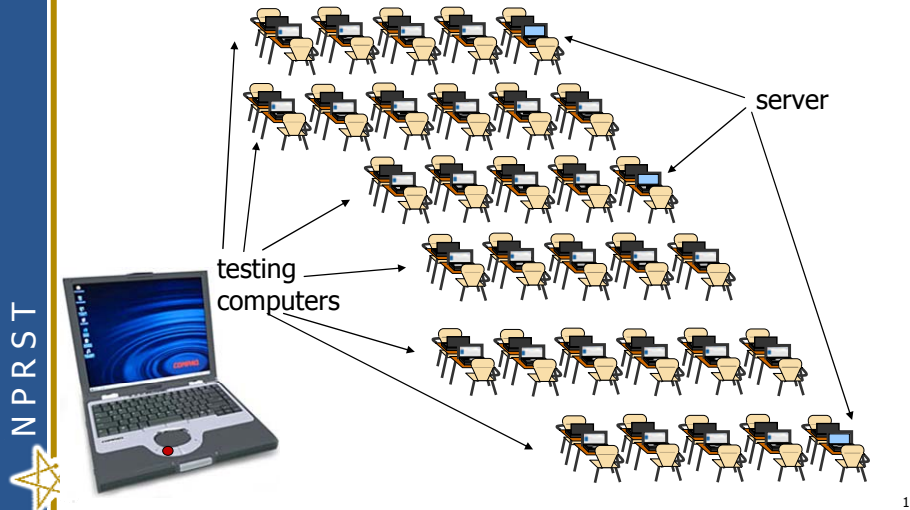


Web-Based Condition – Room Layout and Computers

- Testing took place in a classroom setting (individual table/chair)
 - Pairs of examinees faced each other with laptop screens between them
 - Each pair was about 2 feet distant from another pair
- Compaq Evo N1020v laptops with Windows XP and IE 6.x were used as testing laptops
- Up to three servers (either Windows NT or 2003) were used at a time, with, at most, 23 testing laptops connected to each
 - Win 2003 server took longer to serve up pages, but time did not count against section testing time

14

Web-Based Condition – Room Layout



15

Web-Based Condition – Differences from Paper-Based

- While waiting to begin testing, examinees were allowed to play games on the computer to get used to the koala-pad mouse; a colored dot was included on the left mouse button for ease in identification
- Examinees were directed to follow the instructions on the computer screen
- Sample questions were provided as text to read
- Questions and answers were presented in Internet Explorer (IE), one question at a time

16



Web-Based AFCT

- Each AFCT section was programmed in WebQuiz XP
 - Test questions and data stored in .mdb files
 - Question display handled by .asp files
- Each section timed through WebQuiz
- Respondent entered SSN at beginning of first section and system automatically propagated SSN to succeeding sections
 - Respondent could not go back to previous section without restarting entire AFCT

17

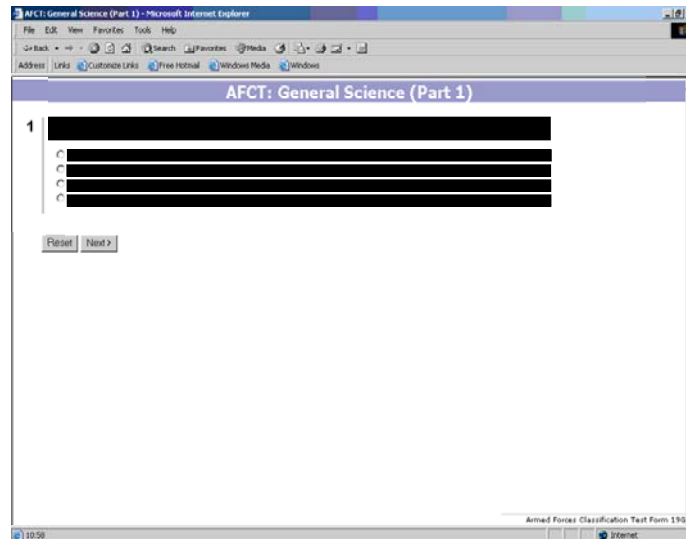


Web-Based AFCT (continued)

- For PC section, the paragraph was presented along with the first question about that paragraph; succeeding questions were on separate pages and examinee could go back to the paragraph if needed
- Time remaining was shown at the bottom left of the IE window, and respondents could continue to the next AFCT section on their own (self-paced)

18

Web-Based AFCT – Screen Layout



19

Observed Advantages of Web AFCT Administration

- The web AFCT is self-paced, so Sailors generally finished sooner than on paper
 - Paper testing requires a minimum of 2.5 hours plus time to read instructions
 - At least half of the web examinees were done within 2 hours, with a few completing in 1 hour
- Less interaction with test administrator is required (in the Fleet, this is usually another Sailor such as the Command Career Counselor)
- No need for scanning answer forms or for hand entry of data – reduces error due to incorrect entry or scanning
- Increased test question security
- Examinees definitely cannot return to previous sections
- No chance of marking two answers to one question

20

Observed Disadvantages of Web AFCT Administration

- All Windows-based computers have a calculator installed, but calculators are not allowed on AFCT
 - Calculators need to be removed from Windows program menu if not from the computer itself
- For Paragraph Comprehension section, one examinee used the IE Find function to electronically find key words in the paragraph
 - Impact of this would depend on actual questions

NPRST



21

Analysis





Data Inclusion Rules

- Only those who completed (including SSN) and signed a Privacy Act Statement are included
- Staff members are not included
 - Two staff members took the web version of the test
- Only the first set of answers is used in analyses
 - Some took the test multiple times in the same or different format
 - Two people took the test in the same week
 - » One completed one session completely and only the first section of the second session, so the complete set of answers is used in analysis
 - » One completed both versions of the test but was not included because it was unclear which version was completed first

23



Data Inclusion Rules (continued)

- Respondents with patterns to their answers (all A, ABCD repeated, AABBBCCDD repeated, etc.) are included
 - Unclear what is a "pattern" and what is a legitimate answer
 - Likely both paper and web respondents displayed this behavior
- Respondent must have completed at least half of a section to be included in analyses for that section
 - Some had to leave before completing their tests, while others chose not to answer any questions
 - List-wise deletion not recommended since some legitimately skipped questions or ran out of time on the section

24

Data Used in Analyses

- Overall data:

	Overall	Male	Female	Majority	Minority
Paper (p)	689	547	91	412	177
Web (w)	762	572	111	361	229

- Ns for each section are included on each slide

25

Data Scoring

- Test scored using item response theory¹
 - The three parameter logistic model was used
 - Respondents received a 1 (if answered correctly) or 0 (if answered incorrectly or blank)
 - Theta score computed from parameters using bisection algorithm
- Theta scores translated to standard scores (mean 50, standard deviation 10, range 20-80) on the 1997 ASVAB normative scale

¹ Segall, D. O. (November 2005). *Item Response Theory Scoring Algorithms for AFCT Forms 18F and 19G: 1997 Score Scale*.

26

Data Scoring (continued)

- Standard score ranges vary by test

	Subject	All wrong answers	All correct answers
1	General Science (GS)	19	72
2	Arithmetic Reasoning (AR)	24	68
3	Word Knowledge (WK)	15	66
4	Paragraph Comprehension (PC)	25	62
5	Mathematics Knowledge (MK)	27	67
6	Electronics Information (EI)	23	80
7	Automotive and Shop (AS)	23	76
8	Mechanical Comprehension (MC)	28	75
9	Assembling Objects (AO)	27	66
	Verbal (VE) (Composite of PC and WK)	16	66

27

Linear Equating

- Sponsor requested an equating study
 - Linear equating chosen because of the relatively small number of cases
- Based upon means (μ) and standard deviation (σ) of paper and web tests, lines were computed to convert between the two versions:

$$p = (\sigma_p / \sigma_w) * w + (\mu_p - ((\sigma_p / \sigma_w) * \mu_w))$$

$$w = (\sigma_w / \sigma_p) * p + (\mu_w - ((\sigma_w / \sigma_p) * \mu_p))$$

where p = paper and w = web

28



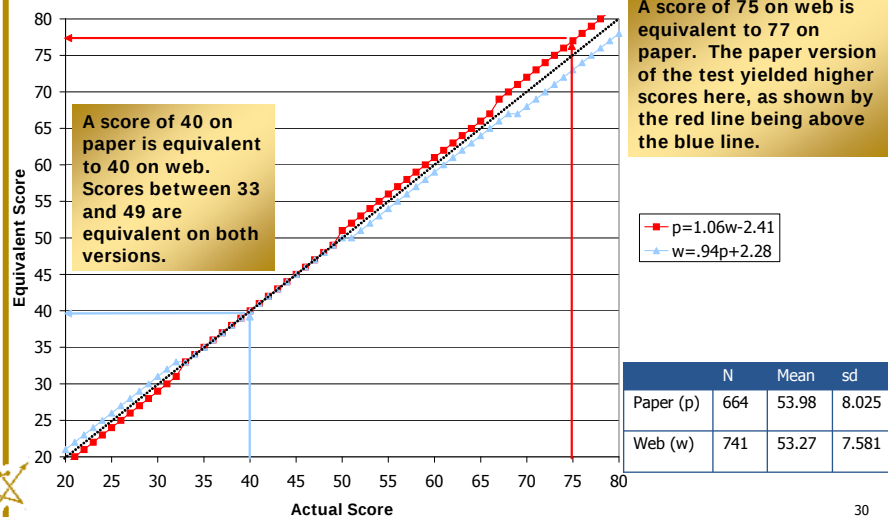
Linear Equating Graphs

- Using the formulae, equivalent scores were calculated for all possible scores between 20 and 80
- Scores were graphed as two lines
 - Red line shows the paper score for a given web score
 - Blue line shows the web score for a given paper score
- Lines that are closer together, especially at the scale mean of 50, indicate that scores from the paper and web tests are similar

29



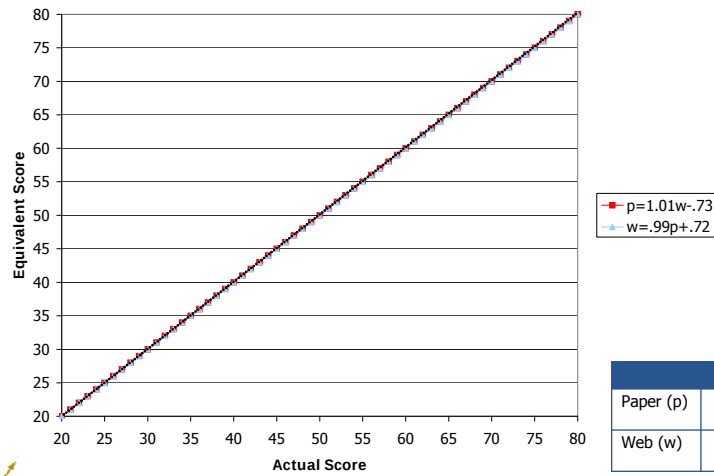
General Science (GS)



30



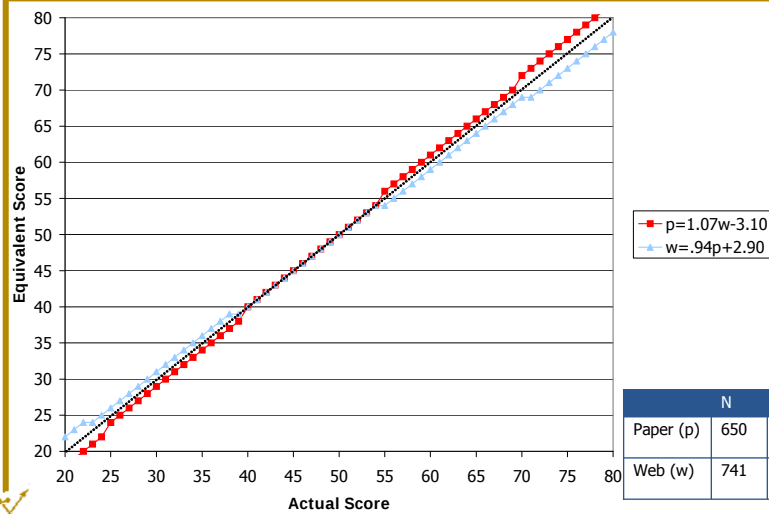
Arithmetic Reasoning (AR)



31

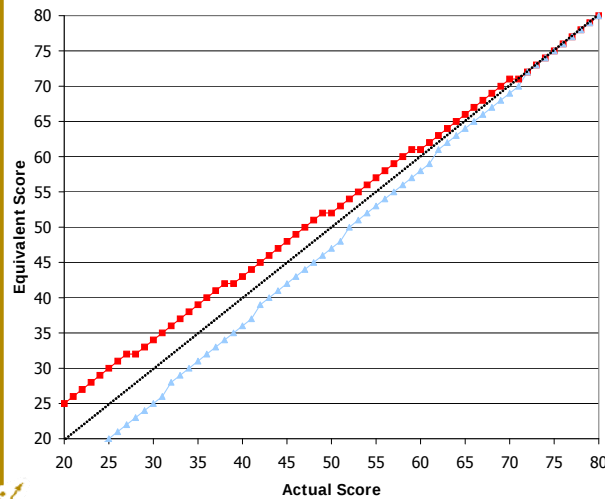


Word Knowledge (WK)



32

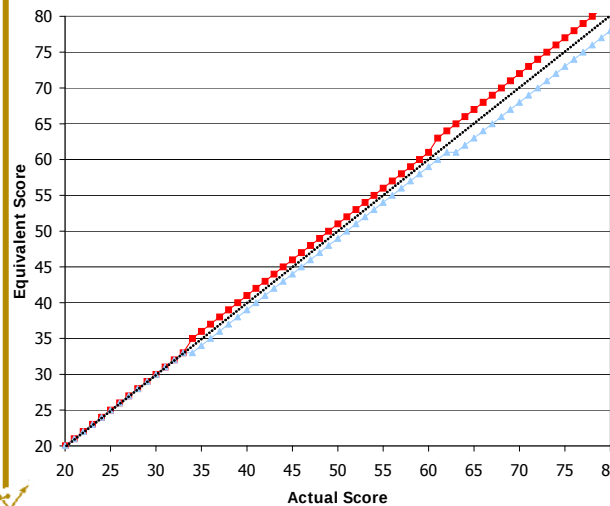
Paragraph Comprehension (PC)



* Significant difference between paper and web ($t=5.884$, $p=.00$).

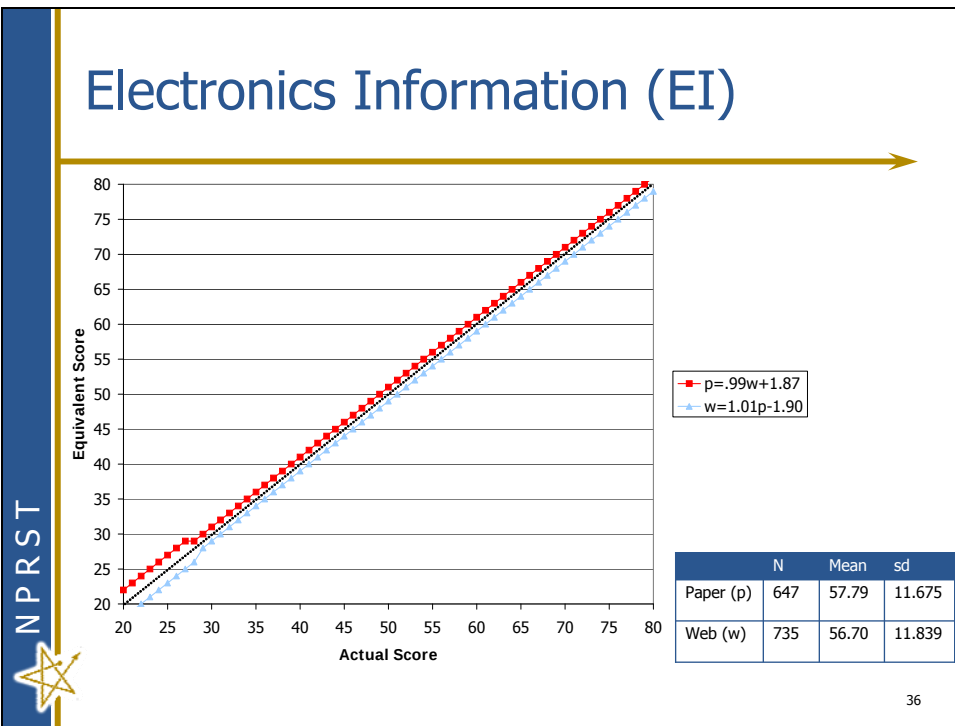
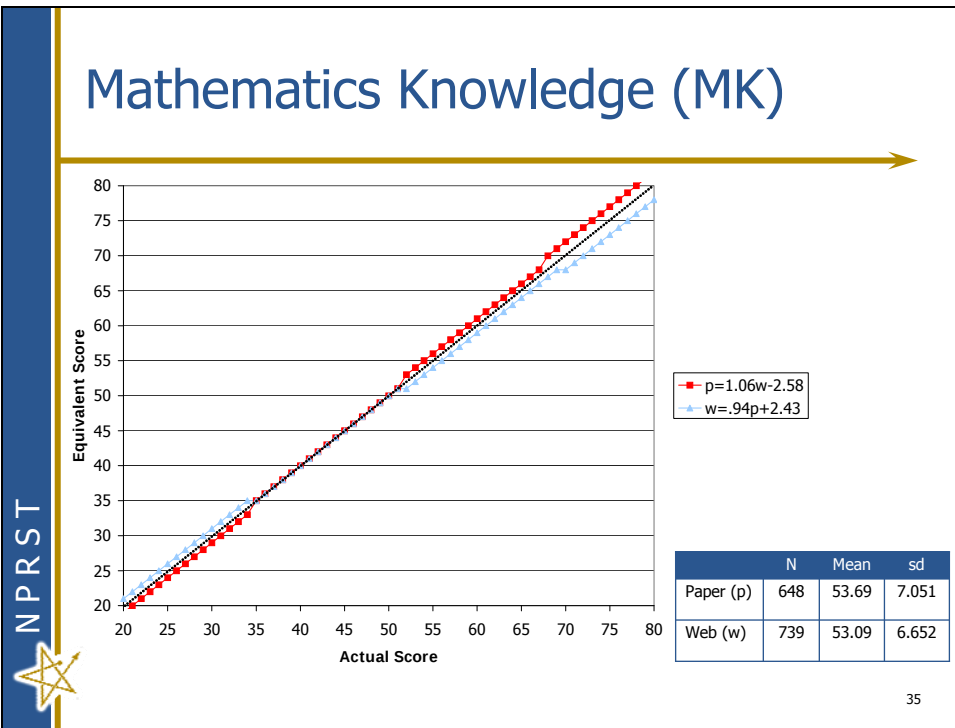
33

Verbal (VE)



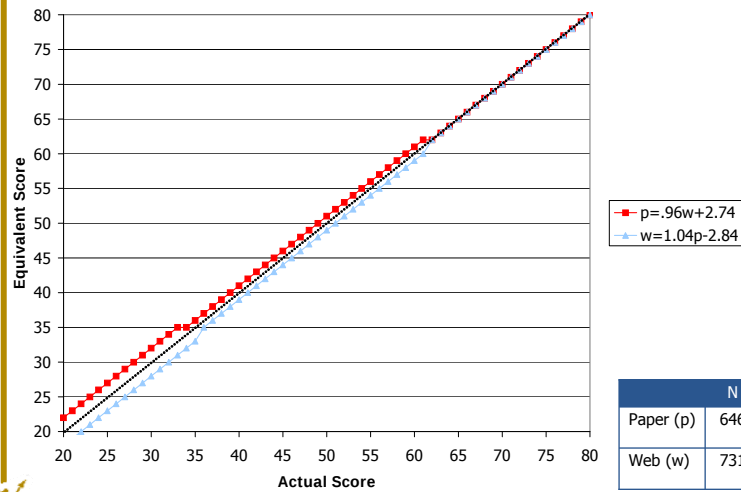
* Significant difference between paper and web ($t=3.149$, $p=.00$).

34





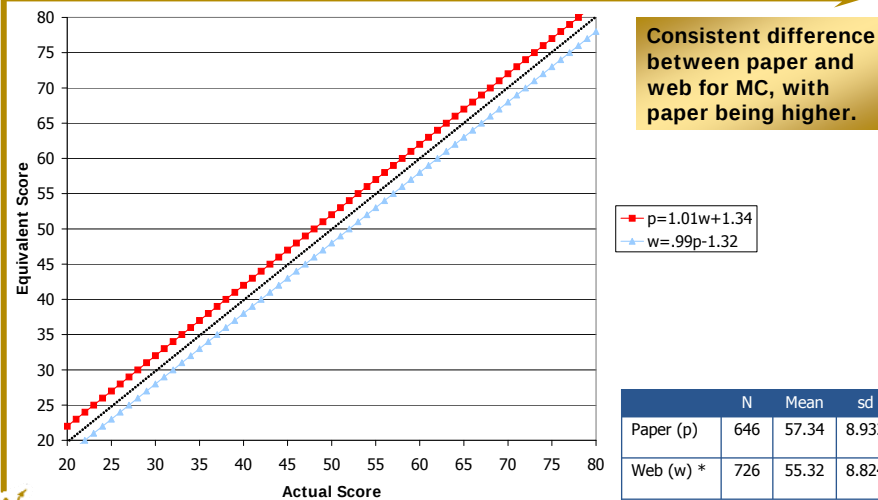
Automotive and Shop (AS)



37



Mechanical Comprehension (MC)

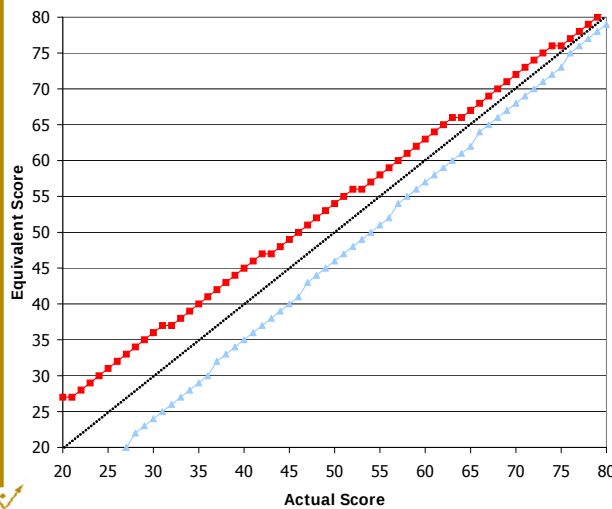


* Significant difference between paper and web ($t=4.208$, $p=.00$).

38



Assembling Objects (AO)



Large difference between AO scores at the low end of the scale.

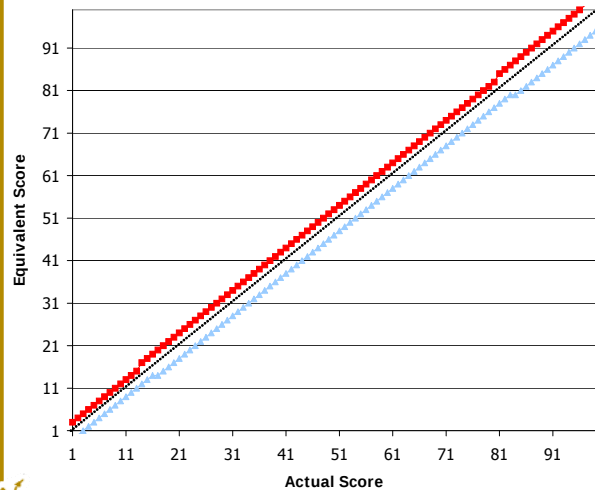
	N	Mean	sd
Paper (p)	644	55.10	9.320
Web (w) *	721	51.48	10.281

* Significant difference between paper and web ($t=6.786$, $p=.00$).

39



Armed Forces Qualification Test (AFQT)



Armed Forces Qualification Test (AFQT) is AR + MK + 2VE; scores range from 1 to 99.

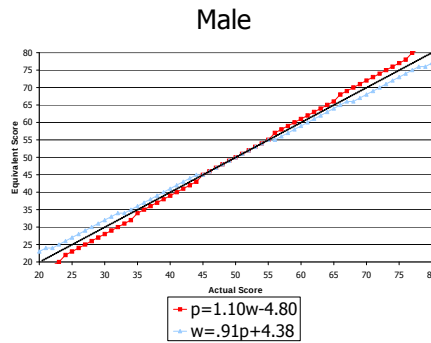
	N	Mean	sd
Paper (p)	646	61.72	22.019
Web (w) *	734	58.54	21.693

* Significant difference between paper and web ($t=2.695$, $p=.01$).

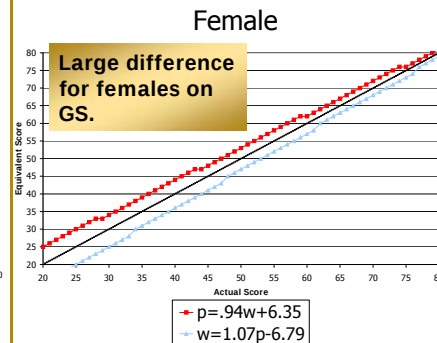
40



General Science (GS) by Gender



	N	Mean	sd
Paper (p)	525	54.62	8.010
Web (w)	552	54.22	7.309



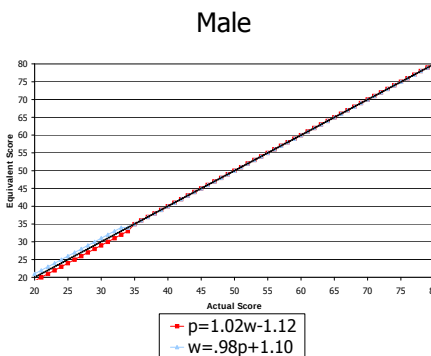
	N	Mean	sd
Paper (p)	90	53.03	7.257
Web (w) *	111	49.92	7.760

* Significant difference between paper and web for females ($t=2.908$, $p=.00$).

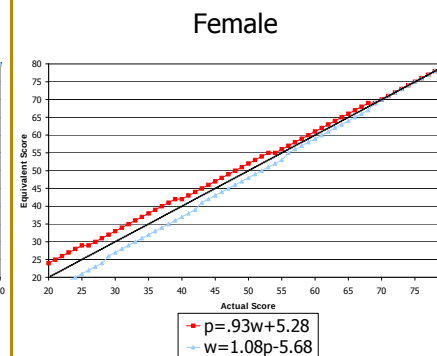
41



Arithmetic Reasoning (AR) by Gender



	N	Mean	sd
Paper (p)	521	52.20	7.788
Web (w)	549	52.37	7.650

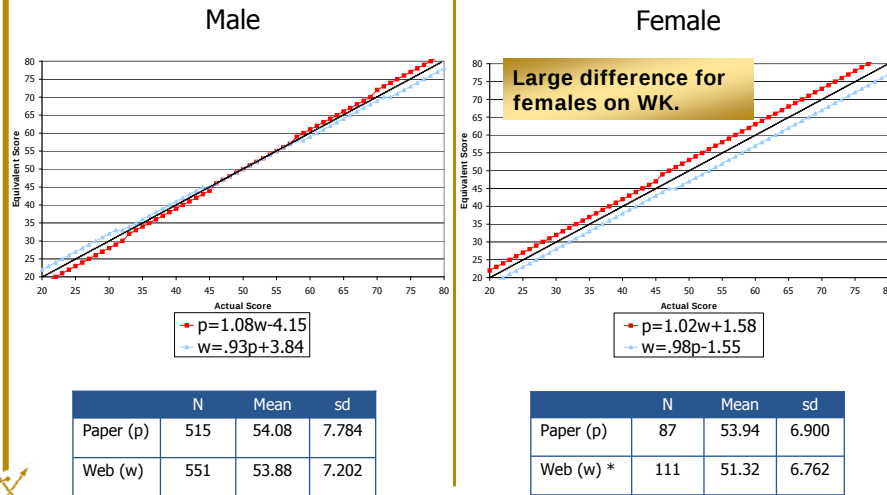


	N	Mean	sd
Paper (p)	90	51.67	6.722
Web (w)	111	49.88	7.230

42



Word Knowledge (WK) by Gender

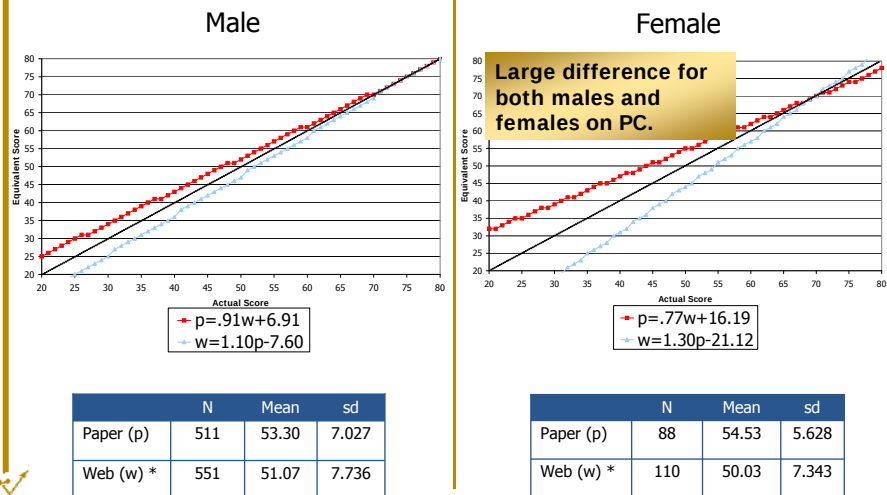


* Significant difference between paper and web for females ($t=2.682$, $p=.01$).

43



Paragraph Comprehension (PC) by Gender



* Significant difference between paper and web for males ($t=4.905$, $p=.00$) and females ($t=4.741$, $p=.00$).

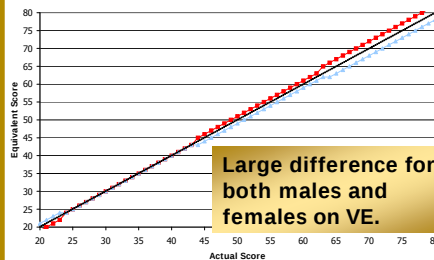
44

Verbal (VE) by Gender

NPRST



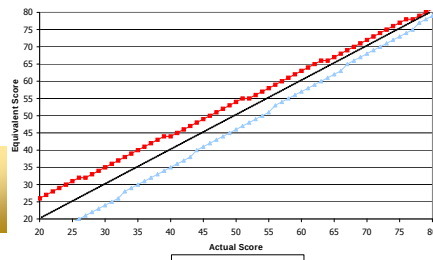
Male



$$\begin{aligned} \text{Paper (p)} &= 1.05w - 1.73 \\ \text{Web (w)} &= .95p + 1.64 \end{aligned}$$

	N	Mean	sd
Paper (p)	511	54.08	7.399
Web (w) *	550	53.06	7.035

Female



$$\begin{aligned} \text{Paper (p)} &= .92w + 7.66 \\ \text{Web (w)} &= 1.09p - 8.34 \end{aligned}$$

	N	Mean	sd
Paper (p)	87	54.52	6.344
Web (w) *	110	50.97	6.902

* Significant difference between paper and web for males ($t=2.302$, $p=.02$) and females ($t=3.714$, $p=.00$).

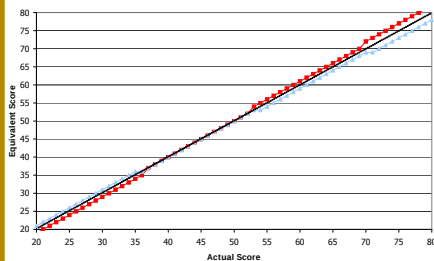
45

Mathematics Knowledge (MK) by Gender

NPRST



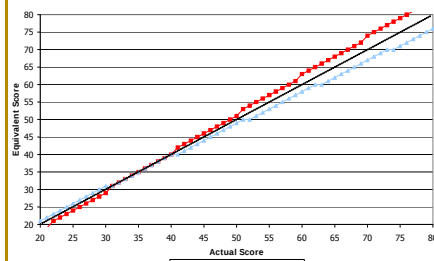
Male



$$\begin{aligned} \text{Paper (p)} &= 1.06w - 2.70 \\ \text{Web (w)} &= .94p + 2.55 \end{aligned}$$

	N	Mean	sd
Paper (p)	512	54.05	7.101
Web (w)	549	53.50	6.695

Female



$$\begin{aligned} \text{Paper (p)} &= 1.10w - 3.67 \\ \text{Web (w)} &= .91p + 3.32 \end{aligned}$$

	N	Mean	sd
Paper (p)	88	53.61	6.510
Web (w)	111	51.94	5.903

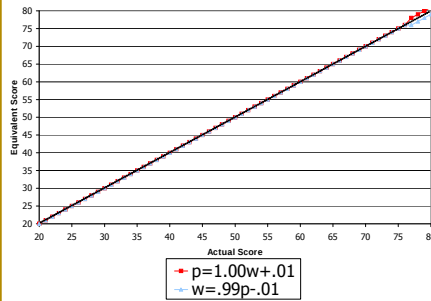
46

Electronics Information (EI) by Gender

NPRST

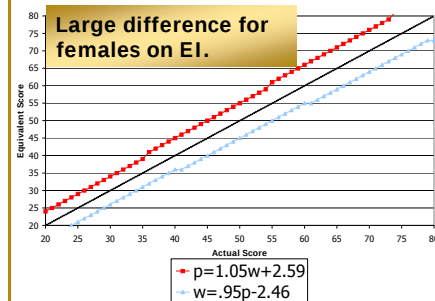


Male



	N	Mean	sd
Paper (p)	511	59.22	11.709
Web (w)	545	58.83	11.634

Female



	N	Mean	sd
Paper (p)	88	52.90	9.047
Web (w) *	111	47.77	8.590

* Significant difference between paper and web for females ($t=4.087$, $p=.00$).

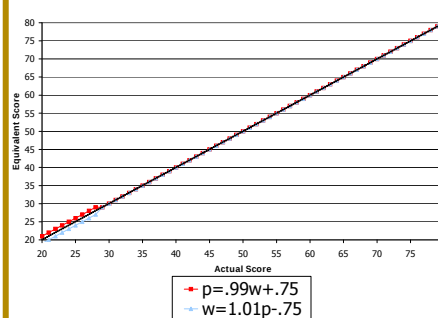
47

Automotive and Shop (AS) by Gender

NPRST

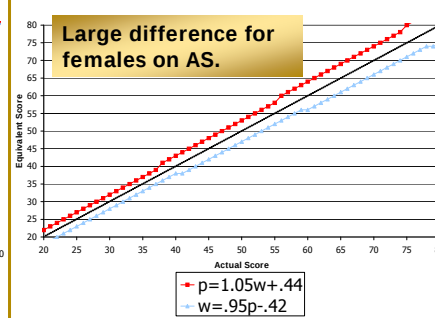


Male



	N	Mean	sd
Paper (p)	510	53.01	9.803
Web (w)	543	52.73	9.890

Female



	N	Mean	sd
Paper (p)	88	44.94	6.464
Web (w) *	110	42.19	6.128

* Significant difference between paper and web for females ($t=3.062$, $p=.00$).

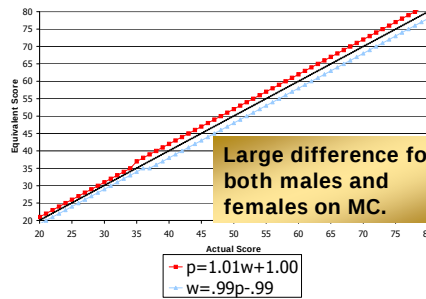
48

Mechanical Comprehension (MC) by Gender

NPRST

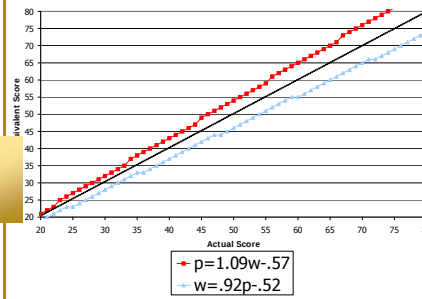


Male



	N	Mean	sd
Paper (p)	510	58.28	8.912
Web (w) *	539	56.47	8.786

Female



	N	Mean	sd
Paper (p)	88	53.98	7.680
Web (w) *	109	49.95	7.033

* Significant difference between paper and web for males ($t=3.312$, $p=.00$) and females ($t=3.837$, $p=.00$).

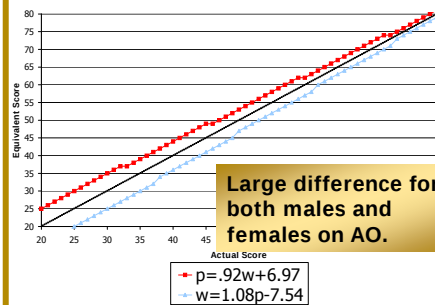
49

Assembling Objects (AO) by Gender

NPRST

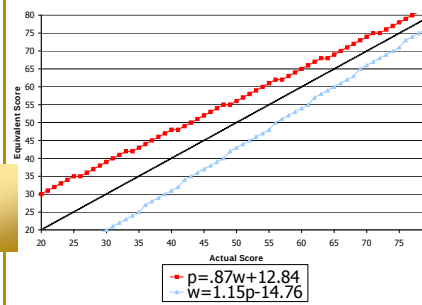


Male



	N	Mean	sd
Paper (p)	510	55.05	9.529
Web (w) *	534	52.02	10.310

Female



	N	Mean	sd
Paper (p)	87	56.29	8.215
Web (w) *	109	49.97	9.448

* Significant difference between paper and web for males ($t=4.925$, $p=.00$) and females ($t=4.927$, $p=.00$).

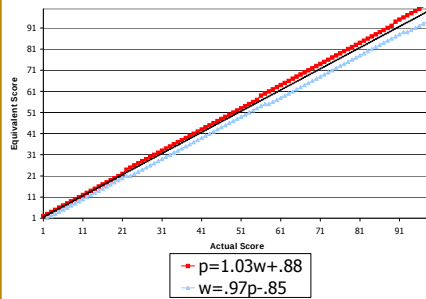
50

Armed Forces Qualification Test (AFQT) by Gender

NPRST

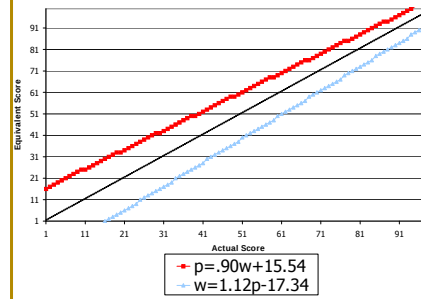


Male



	N	Mean	sd
Paper (p)	511	63.06	21.972
Web (w) *	545	60.40	21.343

Female



	N	Mean	sd
Paper (p)	87	62.62	19.524
Web (w) *	110	52.54	21.787

* Significant difference between paper and web for males ($t=1.993$, $p=.05$) and females ($t=3.376$, $p=.00$).

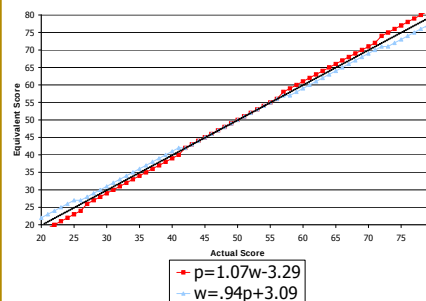
51

General Science (GS) by Ethnicity

NPRST

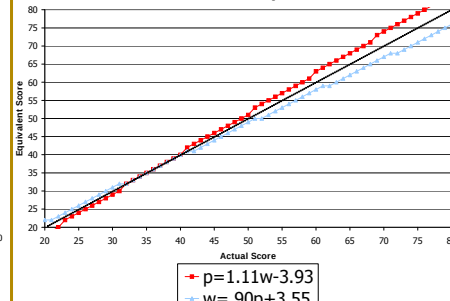


Majority



	N	Mean	sd
Paper (p)	399	55.66	7.469
Web (w)	353	55.24	6.999

Minority



	N	Mean	sd
Paper (p)	166	52.06	8.227
Web (w)	219	50.51	7.421

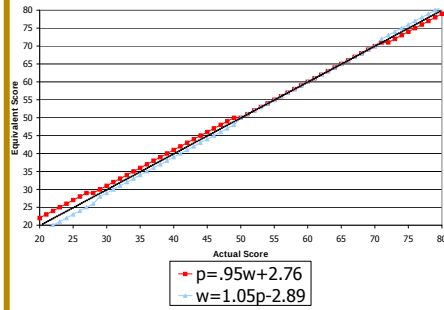
52

Arithmetic Reasoning (AR) by Ethnicity

NPRST

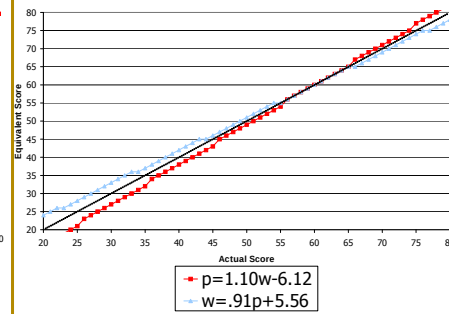


Majority



	N	Mean	sd
Paper (p)	398	52.95	7.420
Web (w)	351	52.61	7.776

Minority



	N	Mean	sd
Paper (p)	163	50.18	8.221
Web (w)	218	51.10	7.461

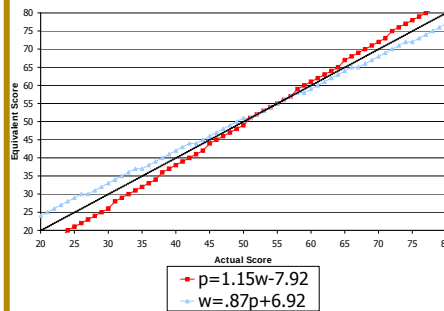
53

Word Knowledge (WK) by Ethnicity

NPRST

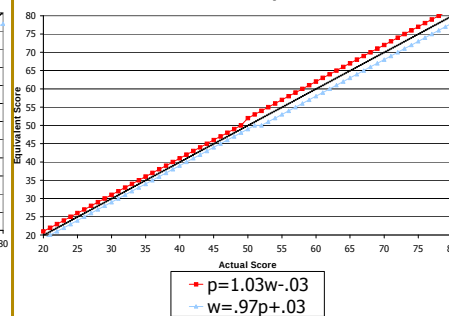


Majority



	N	Mean	sd
Paper (p)	394	55.15	7.289
Web (w)	352	55.06	6.362

Minority

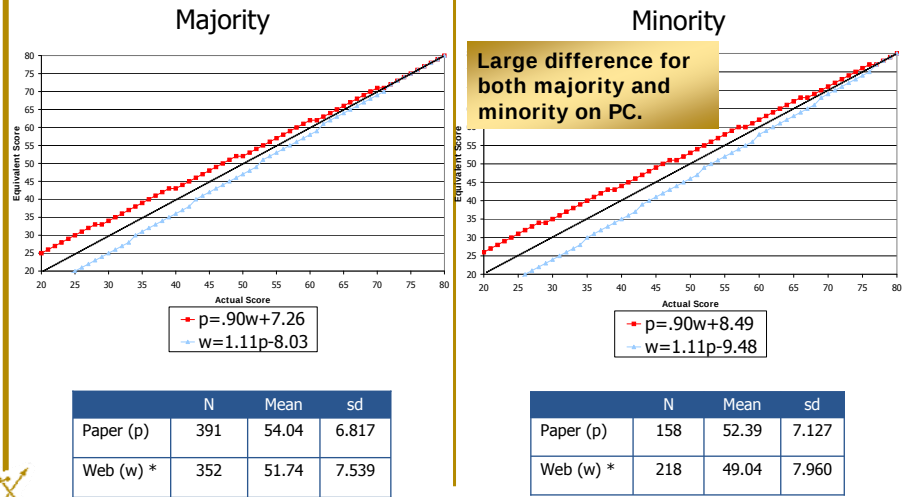


	N	Mean	sd
Paper (p)	159	52.01	8.183
Web (w)	219	50.49	7.940

54

Paragraph Comprehension (PC) by Ethnicity

NPRST

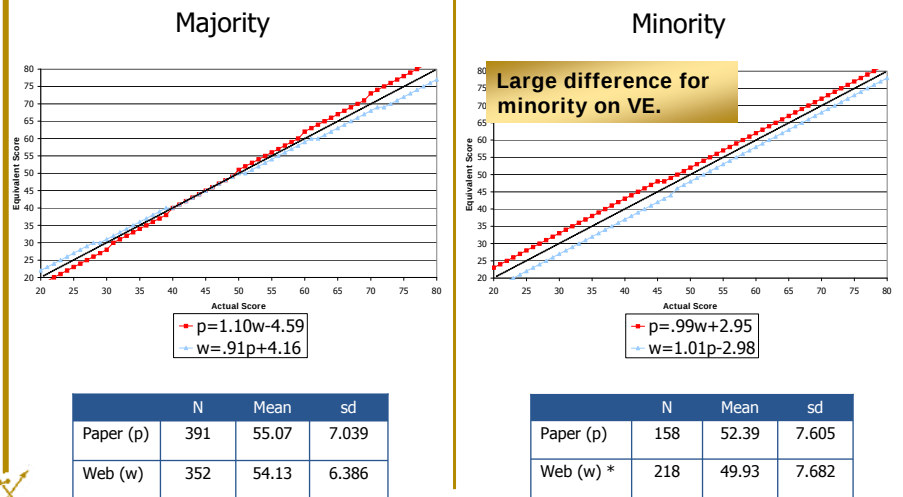


* Significant difference between paper and web for majority ($t=4.367$, $p=.00$) and minority ($t=4.207$, $p=.00$).

55

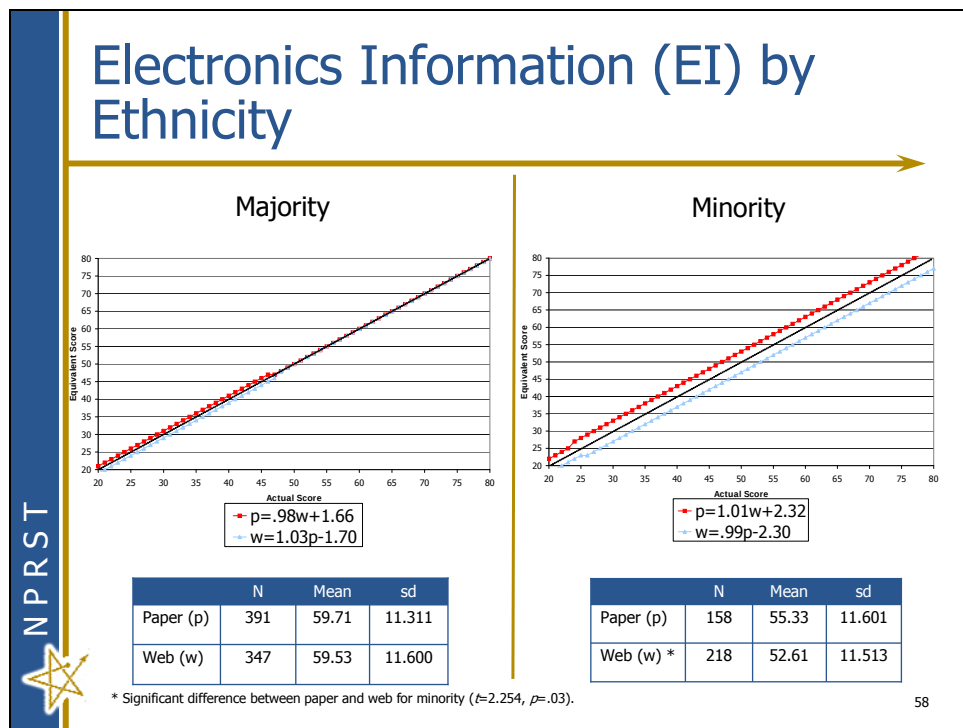
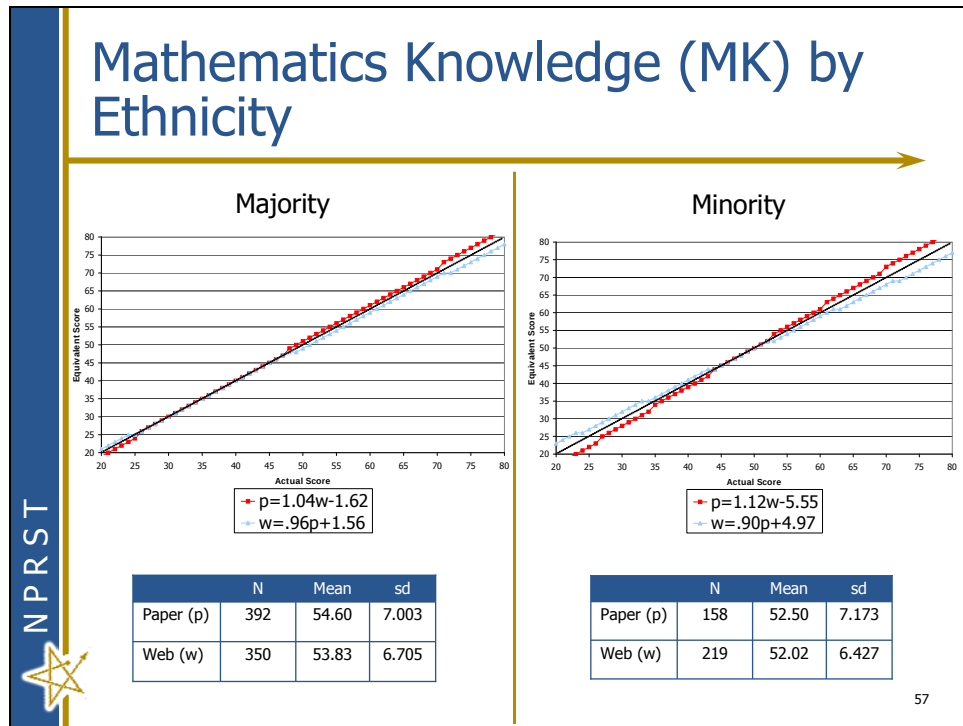
Verbal (VE) by Ethnicity

NPRST



* Significant difference between paper and web for minority ($t=3.078$, $p=.00$).

56

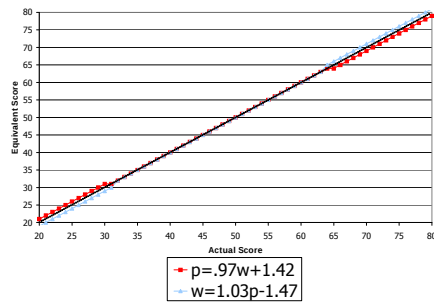


Automotive and Shop (AS) by Ethnicity

NPRST

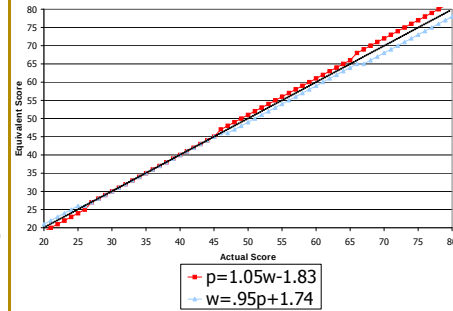


Majority



	N	Mean	sd
Paper (p)	390	53.95	9.401
Web (w)	346	54.15	9.692

Minority



	N	Mean	sd
Paper (p)	158	46.68	9.216
Web (w)	217	46.16	8.769

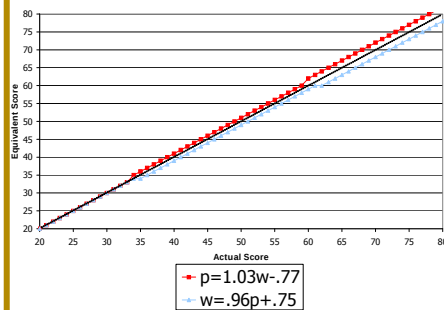
59

Mechanical Comprehension (MC) by Ethnicity

NPRST

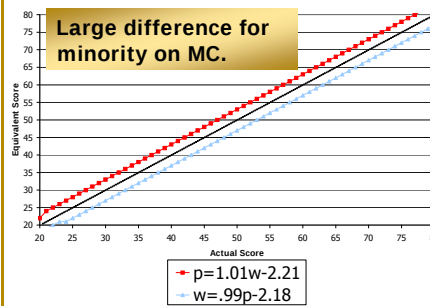


Majority



	N	Mean	sd
Paper (p)	390	58.92	8.725
Web (w)	345	57.51	8.405

Minority



	N	Mean	sd
Paper (p)	158	54.66	8.688
Web (w) *	215	51.73	8.569

* Significant difference between paper and web for minority ($t=3.244$, $p=.00$).

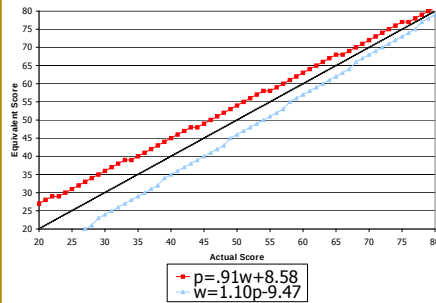
60

Assembling Objects (AO) by Ethnicity

NPRST

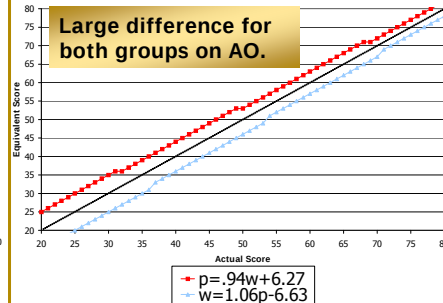


Majority



	N	Mean	sd
Paper (p)	390	55.87	9.271
Web (w) *	343	52.15	10.225

Minority



	N	Mean	sd
Paper (p)	158	53.77	9.860
Web (w) *	213	50.28	10.437

* Significant difference between paper and web for majority ($t=5.165$, $p=.00$) and minority ($t=3.260$, $p=.00$).

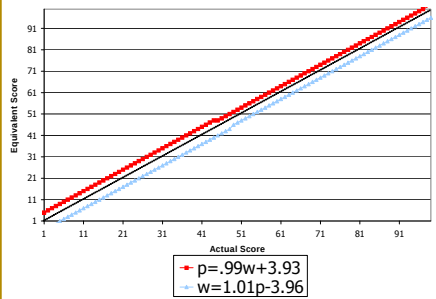
61

Armed Forces Qualification Test (AFQT) by Ethnicity

NPRST

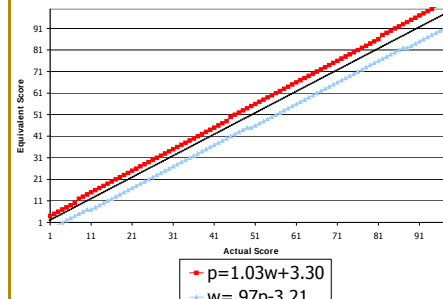


Majority



	N	Mean	sd
Paper (p)	391	66.21	20.406
Web (w) *	349	62.88	20.602

Minority



	N	Mean	sd
Paper (p)	158	56.46	23.062
Web (w) *	217	51.76	22.457

* Significant difference between paper and web for majority ($t=2.206$, $p=.03$) minority ($t=1.977$, $p=.05$).

62



Summary

- Web AFCT as programmed was stable
 - Only issue encountered related to lost connectivity of laptops to the server
- For overall scores, paper scores tend to be slightly higher, with noticeable differences for:
 - PC (5 points at lowest end of scale)
 - AO (about 7 points at lowest end of scale)
- Scores for males are similar to overall scores, with noticeable differences again for PC and AO

63



Summary (continued)

- Scores for females showed larger differences, perhaps due to the low number of women
 - Paper scores tended to be higher, with differences for PC and AO being 10 points or more
- Both majority and minority showed differences, most noticeable again on PC and AO (5 points or more)

64



Recommendations

- Record scores of study examinees, if better than their previous scores
- Determine a concept of operations for administering the Web AFCT to the Fleet
 - Decide if hosting through NKO is an option
 - Determine how to automatically update personnel files and incorporate IRT scoring
 - Find solution to administration aboard ship/submarine

65



Recommendations (continued)

- Brief MAPWG on results
 - Determine if any point difference (e.g., 2 pts or less) could be considered negligible in scores
 - Determine how web scores should be recorded in databases (i.e., record the paper equivalent score or the actual web score)
- Repeat study to test possible improvements
 - Change font type and size for PC
 - Use grease pencils on monitor or on transparency overlay for MC/AO
- Repeat or expand study to increase dataset

66

Project Team	
Customer Team Selection and Classification (N132) Dr. Steve Watson Dr. Lisa Mills	NPRST Team Zannette Uriell, Principal Investigator Evangeline Clewis, SOC programming David L. Alderton, Ph.D., programming Paul Rosenfeld, Ph.D.
TSC Great Lakes Team GSCM Christopher K. Knerr FCCS Douglas S. Berry ETCS Ryan N. Biggin FCC Christopher D. Polk GSM1 Jose Barraza MM1 Dae S. Kim EM1 Lawrence Palacio FC2 William T. Griseto	NPRST Proctors Zannette Uriell Paul Rosenfeld, Ph.D. Rosemary Schultz, Ph.D. Terri Ferraro Perry Pena Geoff Patrissi Carol Newell Gerry Wilcove Joyce Alexander Olivia Puentes Rodney Myers





Background

- NPRST conducted testing of web-based AFCT at NAVSTA Great Lakes in 2006
 - Project sponsored by Dr. Watson (N132G)
- Personnel generally assigned to two groups (paper-based administration or web-based administration) based upon last digit of SSN
 - Due to room limitations, respondents in certain sessions were more likely to take web-based administration, regardless of SSN
- At MAPWG's request, need to determine if two administration groups were different prior to testing, based upon ASVAB record scores

69



Data and Analyses

- ASVAB record data extracted for personnel with useable scores
- A few had record data scores of 0; those people were removed from both record and testing data for these analyses so that their 0 score would not impact computation of means
- *t*-test of independent means conducted, comparing the web-based administration group to the paper-based administration group, both prior to testing and with testing results

70



Record Data - Overall

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	723	54.09	7.431	657	54.85	7.446	-1.896	.058
AR	722	54.76	6.303	654	54.90	6.485	-.406	.685
WK *	724	52.39	6.995	645	53.43	6.864	-2.770	.006
PC *	722	53.81	6.079	642	54.71	5.799	-2.789	.005
MK	722	55.93	5.396	644	56.26	5.586	-.922	.357
EI *	718	54.69	8.637	643	56.03	8.386	-2.897	.004
AS	714	51.88	9.115	642	52.99	8.511	-2.310	.021
MC	707	55.67	8.364	642	56.49	8.078	-1.828	.068
AO	629	57.17	6.974	584	57.63	7.318	-1.121	.263
VE *	722	53.09	6.295	641	54.11	6.103	-3.029	.003
AFQT	716	64.41	18.065	642	66.83	17.778	-2.483	.013

* Indicates significant difference ($p < .01$) between the two groups.

71



Testing Data - Overall

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	723	53.34	7.545	657	54.02	8.015	-1.623	.105
AR	722	51.88	7.629	654	51.79	7.739	.217	.828
WK	724	53.42	7.155	645	53.77	7.627	-.876	.381
PC *	722	50.87	7.679	642	53.13	7.026	-5.646	.000
MK	722	55.93	5.396	644	56.26	5.586	-1.513	.130
EI	718	56.74	11.868	643	57.77	11.644	-1.613	.107
AS	714	50.81	10.234	642	51.58	9.861	-1.407	.160
MC *	707	55.37	8.854	642	57.34	8.939	-4.063	.000
AO *	629	51.86	10.202	584	55.17	9.233	-5.909	.000
VE *	722	52.69	7.008	641	53.82	7.290	-2.915	.000
AFQT	716	58.85	21.628	642	61.76	22.011	-2.454	.014

* Indicates significant difference ($p < .01$) between the two groups.

72



Record Data - Males

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	548	55.12	6.945	521	55.81	7.034	-1.614	.107
AR	547	55.48	6.201	517	55.37	6.354	.286	.775
WK	549	52.93	7.005	511	53.80	6.703	-2.063	.039
PC	548	54.07	6.121	508	54.89	5.872	-2.218	.027
MK	547	56.00	5.494	509	54.46	5.735	-1.331	.183
EI	543	56.16	8.334	508	57.28	8.078	-2.210	.027
AS	541	53.67	8.693	507	54.35	8.172	-1.303	.193
MC	535	57.18	7.936	507	57.64	7.912	-.937	.349
AO	473	57.63	6.853	462	57.92	7.420	-.633	.527
VE	548	53.54	6.292	508	54.44	5.996	-2.376	.018
AFQT	542	65.99	18.013	508	68.02	17.645	-1.843	.066

73



Testing Data - Males

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	548	54.26	7.298	521	54.64	8.015	-.811	.417
AR	547	52.38	7.660	517	52.20	7.786	.380	.704
WK	549	53.89	7.213	511	54.06	7.796	-.369	.712
PC *	548	54.10	7.742	508	53.31	7.042	-4.840	.000
MK	547	53.51	6.702	509	54.07	7.086	-1.320	.187
EI	543	58.84	11.653	508	59.19	11.669	-.486	.627
AS	541	52.70	9.896	507	54.35	8.172	-.476	.634
MC *	535	56.51	8.789	507	58.29	8.912	-3.245	.001
AO *	743	52.39	10.246	462	55.18	9.394	-4.337	.000
VE	548	53.07	7.045	508	54.08	7.411	-2.270	.023
AFQT	542	60.45	21.384	508	63.09	21.944	-1.974	.049

* Indicates significant difference ($p < .01$) between the two groups.

74



Record Data - Females

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	110	49.99	7.933	90	52.10	7.801	-1.885	.061
AR	110	52.27	5.809	90	53.12	7.166	-.927	.355
WK *	110	50.25	6.664	87	53.15	7.313	-2.905	.004
PC	109	52.53	5.690	88	54.61	5.621	-2.565	.011
MK	110	55.75	5.087	88	56.20	4.797	-.634	.527
EI	110	48.81	6.798	88	50.02	7.171	-1.215	.226
AS	109	43.80	5.434	88	46.06	6.970	-2.557	.011
MC *	108	48.83	5.783	88	51.42	6.612	-2.924	.004
AO	100	55.56	6.450	79	57.11	6.528	-1.588	.114
VE *	109	51.04	6.901	87	54.52	6.344	-2.971	.003
AFQT	109	58.57	16.727	87	64.95	18.197	-2.551	.012

* Indicates significant difference ($p < .01$) between the two groups.

75



Testing Data - Females

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS *	110	50.00	7.748	90	53.03	7.257	-2.831	.005
AR	110	49.96	7.212	90	51.67	6.722	-1.720	.087
WK	110	51.38	6.757	87	53.94	6.900	-2.616	.010
PC *	109	50.06	7.366	88	54.53	5.628	-4.693	.000
MK	110	51.95	5.927	88	53.61	6.510	-1.874	.062
EI *	110	47.84	8.596	88	52.90	9.047	-4.021	.000
AS *	109	42.22	6.148	88	44.94	6.464	-3.017	.003
MC *	108	49.98	7.060	88	53.98	7.680	-3.792	.000
AO *	100	49.99	9.615	79	56.37	8.426	-4.652	.000
VE *	109	51.04	6.901	87	54.52	6.344	-3.635	.000
AFQT *	109	52.77	21.748	87	62.62	19.524	-3.295	.001

* Indicates significant difference ($p < .01$) between the two groups.

76



Record Data - Majority

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	352	56.03	6.361	395	56.65	6.269	-1.340	.181
AR	350	55.92	6.019	394	55.90	6.358	.044	.965
WK	351	54.20	6.358	390	54.58	6.573	-.798	.425
PC	351	54.92	5.829	388	55.34	5.579	-1.000	.317
MK	349	56.13	5.733	389	56.56	5.590	-1.031	.303
EI	346	56.64	7.879	388	57.68	7.605	-1.818	.069
AS	345	55.23	8.288	387	55.21	7.806	.034	.973
MC	344	58.16	7.566	387	58.26	7.713	-.177	.860
AO	308	57.92	6.768	356	58.42	7.182	-.919	.359
VE	351	54.71	5.716	388	55.10	5.836	-.916	.360
AFQT	348	68.94	16.985	388	70.00	16.544	-.857	.392

* Indicates significant difference ($p < .01$) between the two groups.

77



Testing Data - Majority

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	352	55.23	7.004	395	55.70	7.465	-.884	.377
AR	350	52.61	7.788	394	52.97	7.412	-.646	.519
WK	351	55.07	6.369	390	55.14	7.304	-.138	.890
PC *	351	51.74	7.549	388	54.05	6.833	-4.366	.000
MK	349	53.83	6.714	389	54.63	6.980	-1.583	.114
EI	346	59.53	11.616	388	59.66	11.256	-.154	.878
AS	345	54.12	9.691	387	53.94	9.411	.255	.799
MC	344	57.51	8.418	387	58.93	8.723	-2.233	.026
AO *	308	52.63	10.134	356	56.08	9.085	-4.625	.000
VE	351	54.13	6.394	388	55.09	7.052	-1.931	.054
AFQT	348	62.88	20.632	388	66.28	20.346	-2.248	.025

* Indicates significant difference ($p < .01$) between the two groups.

78

Record Data - Minority

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	216	51.00	7.623	166	52.57	7.720	-1.984	.048
AR	217	53.52	6.317	163	53.34	6.757	.267	.790
WK *	218	49.61	6.875	159	52.21	6.842	-3.962	.000
PC *	216	52.06	6.084	158	54.10	6.011	-3.219	.001
MK *	218	55.82	4.997	158	56.28	5.746	6.864	.000
EI	217	51.99	8.319	158	53.27	8.979	-1.423	.156
AS	216	47.27	7.944	158	48.74	8.161	-1.747	.081
MC	212	52.06	7.930	158	53.50	7.685	-1.751	.081
AO	188	55.88	6.986	141	56.66	7.294	-.983	.326
VE *	217	50.57	6.231	158	53.12	6.134	-3.939	.000
AFQT *	215	58.01	17.647	158	63.32	19.258	-2.762	.006

* Indicates significant difference ($p < .01$) between the two groups.

79

Testing Data - Minority

	Those who took web-based AFCT			Those who took paper-based AFCT			T	p
	N	Mean	SD	N	Mean	SD		
GS	216	50.61	7.420	166	52.06	8.227	-1.806	.072
AR	217	51.14	7.447	163	50.18	8.221	1.189	.235
WK	218	50.52	7.946	159	52.01	8.183	-1.943	.053
PC *	216	49.09	7.976	158	52.39	7.127	-4.132	.000
MK	218	52.03	6.441	158	52.50	7.173	-.623	.534
EI	217	52.66	11.507	158	55.33	11.601	-2.211	.028
AS	216	46.19	8.776	158	46.68	9.216	-.522	.602
MC *	212	51.78	8.580	158	54.66	8.688	-3.177	.002
AO *	188	50.15	10.448	141	53.71	9.854	-3.133	.002
VE *	217	49.96	7.689	158	52.39	7.605	-3.036	.003
AFQT	215	51.86	22.497	158	56.46	23.062	-1.931	.054

* Indicates significant difference ($p < .01$) between the two groups.

80

Summary

- The two groups were not equivalent overall when they participated in the web-based AFCT effects study
 - Male and majority subgroups were equivalent based on record data, but females and minority were not
 - In the overall group, those who took the paper-based version were already slightly better in WK and PC (and, thereby, VE) and EI
- Effects study results for overall group show differences in PC, MC, AO, and VE
 - Original differences between the two groups for WK disappear
 - MC and AO show differences that are not directly attributable to any pre-existing differences between the two groups

Appendix F: Detailed Results by Test Question

Table F-1
GS for all respondents

Question	Web (N = 741)						Paper (N = 664)						Pearson's		
	Answered			Missing			Answered			Missing					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
GS01	689	93	51	7	1	0	607	91	57	8	0	0	2.309	2	0.315
GS02	685	92	56	8	0	0	630	95	33	5	1	0	5.039	2	0.080
GS03	725	98	15	2	1	0	639	96	25	4	0	0	4.717	2	0.095
GS04	660	89	81	11	0	0	608	92	56	8	0	0	2.482	1	0.115
GS05	674	91	67	8	0	0	598	90	66	10	0	0	0.329	1	0.566
GS06	660	89	79	11	2	0	602	91	61	9	1	0	1.097	2	0.578
GS07	661	89	78	11	2	0	602	91	62	9	0	0	2.372	2	0.305
GS08	583	79	154	21	4	0	543	82	120	18	1	0	3.230	2	0.199
GS09	630	85	110	15	1	0	571	86	93	14	0	0	1.105	2	0.575
GS10	559	75	177	25	5	1	536	81	127	19	1	0	7.175	2	0.028
GS11	722	97	17	3	2	0	637	96	27	4	0	0	5.385	2	0.068
GS12	630	85	109	15	2	0	577	87	87	13	0	0	2.584	2	0.275
GS13	435	59	305	41	1	0	416	63	245	37	3	0	3.761	2	0.153
GS14	676	91	63	8	2	0	603	91	59	8	2	0	0.078	2	0.962
GS15	398	54	343	46	0	0	347	52	315	48	2	0	2.470	2	0.291
GS16	577	78	162	22	2	0	522	79	141	21	1	0	0.322	2	0.851
GS17	563	76	175	24	3	0	510	77	152	23	2	0	0.216	2	0.897
GS18	406	55	329	45	6	1	359	54	302	46	3	0	0.825	2	0.662
GS19	478	65	255	35	8	1	427	64	234	36	3	0	1.834	2	0.400
GS20	393	53	338	47	10	1	377	57	283	43	4	0	3.566	2	0.168
GS21	399	54	328	46	14	2	367	55	292	45	5	1	3.481	2	0.175
GS22	289	39	435	61	17	2	302	45	355	55	7	1	8.359	2	0.015
GS23	219	30	501	70	21	3	213	32	439	68	12	2	2.415	2	0.299
GS24	148	20	571	80	22	3	126	19	529	81	9	1	4.616	2	0.099
GS25	301	41	411	59	29	4	273	41	377	59	14	2	3.857	2	0.145

Table F-2
GS for male respondents

Question	Web (N = 552)						Paper (N = 525)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
GS01	523	95	28	5	1	0	486	93	39	7	0	0	3.488	2	0.175
GS02	524	95	28	5	0	0	505	96	19	4	1	0	2.399	2	0.301
GS03	544	99	7	1	1	0	506	96	19	4	0	0	7.241	2	0.027
GS04	484	88	68	12	0	0	481	92	44	8	0	0	4.478	1	0.034
GS05	507	92	45	8	0	0	477	91	48	9	0	0	0.335	1	0.563
GS06	500	91	50	9	2	0	478	91	46	9	1	0	0.318	2	0.853
GS07	508	92	43	8	1	0	486	93	39	7	0	0	1.006	2	0.605
GS08	462	84	86	16	4	1	439	84	85	16	1	0	1.717	2	0.424
GS09	485	88	67	12	0	0	456	87	69	13	0	0	0.246	1	0.620
GS10	437	79	112	21	3	1	437	83	87	17	1	0	3.466	2	0.177
GS11	539	98	11	2	2	0	505	96	20	4	0	0	5.046	2	0.080
GS12	480	87	70	13	2	0	462	88	63	12	0	0	2.037	2	0.361
GS13	337	61	214	39	1	0	358	68	165	32	2	0	6.630	2	0.036
GS14	506	92	44	8	2	0	476	91	48	8	1	0	0.747	2	0.688
GS15	291	53	261	47	0	0	274	52	251	48	0	0	0.030	1	0.863
GS16	436	79	115	21	1	0	411	78	114	22	0	0	1.066	2	0.587
GS17	426	77	123	23	3	1	410	78	114	22	1	0	0.972	2	0.615
GS18	314	57	232	43	6	1	292	56	231	44	2	0	2.125	2	0.346
GS19	365	66	181	34	6	1	340	65	184	35	1	0	3.808	2	0.149
GS20	305	55	238	45	9	2	312	59	211	40	2	0	5.484	2	0.064
GS21	316	57	223	43	13	2	289	55	233	45	3	1	7.002	2	0.030
GS22	233	42	304	58	15	3	259	49	261	51	5	1	8.975	2	0.011
GS23	177	32	356	68	19	3	175	33	342	67	8	2	4.099	2	0.129
GS24	109	20	425	80	18	3	106	20	414	80	5	1	6.861	2	0.032
GS25	233	42	294	58	25	5	215	41	301	59	9	2	7.663	2	0.022

Table F-3
GS for female respondents

Question	Web (N = 111)						Paper (N = 90)						Pearson's		
	Answered			Answered			Answered			Answered					
	correctly	incorrectly	Missing	correctly	incorrectly	Missing	correctly	incorrectly	Missing	correctly	incorrectly	Missing	chi-2	df	sig
	#	%	#	%	#	%	#	%	#	%	#	%			
GS01	95	86	16	14	0	0	80	89	10	11	0	0	0.482	1	0.488
GS02	91	82	20	18	0	0	79	88	11	12	0	0	1.280	1	0.258
GS03	103	93	8	7	0	0	86	96	4	4	0	0	0.676	1	0.411
GS04	107	96	4	4	0	0	89	99	1	1	0	0	1.273	1	0.259
GS05	96	86	15	14	0	0	77	86	13	83	0	0	0.036	1	0.850
GS06	94	85	17	15	0	0	86	96	4	4	0	0	6.278	1	0.012
GS07	89	81	21	19	1	1	76	84	14	16	0	0	1.244	2	0.537
GS08	66	59	45	41	0	0	64	71	26	29	0	0	2.953	1	0.086
GS09	83	75	27	25	1	1	77	86	13	14	0	0	3.974	2	0.137
GS10	67	61	42	39	2	2	65	72	25	28	0	0	4.196	2	0.123
GS11	109	98	2	2	0	0	87	97	3	3	0	0	0.481	1	0.488
GS12	85	77	26	23	0	0	78	87	12	13	0	0	3.301	1	0.069
GS13	52	47	59	53	0	0	36	40	54	60	0	0	0.947	1	0.331
GS14	100	90	11	10	0	0	87	97	3	13	0	0	3.317	1	0.069
GS15	67	60	44	40	0	0	49	54	41	51	0	0	0.713	1	0.399
GS16	86	78	24	22	1	1	79	88	11	21	0	0	3.975	2	0.137
GS17	81	73	30	27	0	0	70	78	20	30	0	0	0.614	1	0.433
GS18	52	47	59	53	0	0	53	59	37	47	0	0	2.889	1	0.089
GS19	75	69	34	31	2	2	55	62	34	45	1	1	1.230	2	0.541
GS20	54	49	56	51	1	1	44	49	46	56	0	0	0.816	2	0.665
GS21	48	43	63	57	0	0	50	56	39	50	1	1	4.543	2	0.103
GS22	28	25	82	75	1	1	31	35	58	69	1	1	2.096	2	0.351
GS23	28	25	83	75	0	0	27	30	62	73	1	1	1.886	2	0.389
GS24	22	20	87	80	2	2	13	15	76	87	1	1	1.209	2	0.546
GS25	33	30	76	70	2	2	43	48	46	52	1	1	6.908	2	0.032

Table F-4
GS for majority respondents

Question	Web (N = 353)						Paper (N = 399)						Pearson's							
	Answered correctly			Answered incorrectly			Missing			Answered correctly							Answered incorrectly			Missing
	#	%		#	%		#	%		#	%		#	%		#	%		Chi-2	df
GS01	338	96	14	4	1	0	374	94	25	6	0	0	3.121	2	0.210					
GS02	337	95	16	5	0	0	384	96	14	4	1	0	1.388	2	0.499					
GS03	349	99	4	1	0	0	388	97	11	3	0	0	2.526	1	0.112					
GS04	312	88	41	12	0	0	374	94	25	6	0	0	6.694	1	0.010					
GS05	327	93	26	7	0	0	367	92	32	8	0	0	0.113	1	0.737					
GS06	330	93	23	7	0	0	373	93	26	7	0	0	0.000	1	1.000					
GS07	326	92	25	7	2	1	366	92	33	8	0	0	2.612	2	0.271					
GS08	303	86	48	14	2	1	340	85	59	15	0	0	2.455	2	0.293					
GS09	314	89	39	10	0	0	360	90	39	10	0	0	0.327	1	0.568					
GS10	306	87	47	13	0	0	340	85	59	15	0	0	0.335	1	0.563					
GS11	349	99	3	1	1	0	387	97	12	3	0	0	5.569	2	0.062					
GS12	304	88	48	14	1	0	355	89	44	11	0	0	2.316	2	0.314					
GS13	230	65	122	35	1	0	275	69	124	31	0	0	2.221	2	0.329					
GS14	326	92	27	8	0	0	367	92	31	8	1	0	0.891	2	0.640					
GS15	193	55	160	45	0	0	217	54	182	46	0	0	0.006	1	0.937					
GS16	288	82	64	18	1	0	334	84	65	26	0	0	1.602	2	0.449					
GS17	284	80	69	20	0	0	315	79	84	21	0	0	0.262	1	0.609					
GS18	231	65	121	34	1	0	248	62	151	38	0	0	2.106	2	0.349					
GS19	239	68	111	31	3	1	273	68	126	32	0	0	3.406	2	0.182					
GS20	199	56	151	43	3	1	239	60	159	40	1	0	2.053	2	0.358					
GS21	198	198	152	43	3	1	219	55	178	45	2	0	0.494	2	0.781					
GS22	155	44	194	55	4	1	207	52	188	48	4	1	4.768	2	0.092					
GS23	112	32	236	66.856	5	1	138	35	255	65	6	2	0.719	2	0.698					
GS24	70	20	278	78.754	5	1	86	22	209	78	4	1	0.578	2	0.749					
GS25	157	44	189	53.541	7	2	175	44	116	56	8	2	0.029	2	0.986					

Table F-5
GS for minority respondents

Question	Web (N = 219)						Paper (N = 166)						Pearson's Chi-2	df	sig		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly						Missing	
	#	%	#	%	#	%	#	%	#	%	#	%				#	%
GS01	193	88	26	12	0	0	149	90	17	10	0	0	0.253	1	0.615		
GS02	195	89	24	11	0	0	150	90	16	10	0	0	0.177	1	0.674		
GS03	209	96	9	4	1	0	157	95	9	5	0	0	1.113	2	0.573		
GS04	192	88	27	12	0	0	151	91	15	9	0	0	1.053	1	0.305		
GS05	190	87	29	13	0	0	143	86	23	14	0	0	0.030	1	0.862		
GS06	185	85	33	15	1	0	147	89	18	11	1	0	1.493	2	0.474		
GS07	186	85	33	15	0	0	150	90	16	10	0	0	2.506	1	0.113		
GS08	154	71	64	29	1	0	128	77	38	23	0	0	2.781	2	0.249		
GS09	178	81	41	19	0	0	134	81	32	19	0	0	0.019	1	0.890		
GS10*	134	61	84	39	1	0	130	78	36	22	0	0	13.215	2	0.001		
GS11	209	96	9	4	1	0	157	95	9	5	0	0	1.113	2	0.573		
GS12	185	85	33	15	1	0	141	85	25	15	0	0	0.760	2	0.684		
GS13	99	45	120	55	0	0	90	55	75	45	1	0	4.604	2	0.100		
GS14	197	91	20	8	2	1	150	90	16	10	0	0	1.544	2	0.462		
GS15	112	51	107	49	0	0	84	51	82	49	0	0	0.011	1	0.917		
GS16	162	74	57	26	0	0	120	72	46	28	0	0	0.137	1	0.712		
GS17	153	71	64	29	2	1	124	75	41	25	1	0	1.133	2	0.568		
GS18	86	40	130	60	3	1	72	44	93	56	1	0	1.104	2	0.576		
GS19	137	63	79	37	3	1	96	58	69	42	1	0	1.625	2	0.444		
GS20	107	50	108	50	4	2	87	53	78	47	1	0	1.432	2	0.489		
GS21	120	57	92	43	7	3	89	54	76	46	1	0	3.390	2	0.184		
GS22	71	33	141	67	7	3	65	39	100	35	1	0	4.530	2	0.104		
GS23	66	32	143	68	10	5	44	27	121	54	1	0	6.423	2	0.040		
GS24	38	18	172	82	9	4	24	15	141	76	1	0	5.439	2	0.066		
GS25	80	38	129	62	10	5	68	41	97	32	1	0	5.679	2	0.058		

* Significant difference between paper and web (p < .01).

Table F-6
AR for all respondents

Question	Web (N = 739)						Paper (N = 660)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AR01	707	96	28	4	4	0	621	94	39	6	0	0	5.166	1	0.023
AR02	680	92	57	8	2	0	598	91	61	9	1	0	1.243	2	0.537
AR03	668	90	68	10	3	0	603	91	56	9	1	0	1.053	2	0.591
AR04	618	84	118	16	3	0	534	81	126	19	0	0	5.073	2	0.079
AR05	610	83	124	17	5	1	527	80	131	20	2	0	3.205	2	0.201
AR06	637	86	100	14	2	0	570	86	89	14	1	0	0.798	2	0.671
AR07	651	88	87	12	1	0	571	87	88	13	1	0	0.954	2	0.621
AR08	646	87	92	13	1	0	573	87	86	13	1	0	0.221	2	0.895
AR09	604	82	133	18	2	0	537	81	121	19	2	0	0.142	2	0.931
AR10	621	84	115	16	3	0	561	85	97	15	2	0	0.642	2	0.725
AR11	612	83	122	17	5	1	549	83	110	17	1	0	2.268	2	0.322
AR12	616	83	121	17	2	0	561	85	98	15	1	0	1.176	2	0.556
AR13	533	72	201	28	5	1	465	70	192	30	3	0	1.482	2	0.477
AR14	508	69	225	31	6	1	476	72	182	28	2	0	2.554	2	0.279
AR15	421	57	305	43	13	2	369	56	284	44	7	1	2.951	2	0.229
AR16	495	67	241	33	3	0	429	65	227	35	4	0	0.596	2	0.742
AR17	524	71	209	29	6	1	450	68	203	32	7	1	1.193	2	0.551
AR18	422	57	311	43	6	1	404	61	250	39	6	1	2.552	2	0.279
AR19*	506	68	223	32	10	1	413	63	244	37	3	0	10.008	2	0.007
AR20	411	56	304	44	24	3	328	50	321	50	11	2	9.199	2	0.010
AR21	485	66	231	34	23	3	415	63	234	37	11	2	5.071	2	0.079
AR22*	292	40	406	60	41	5	319	48	327	52	14	2	18.077	2	0.000
AR23*	445	60	252	40	42	5	405	61	244	39	11	2	14.638	2	0.001
AR24*	343	46	329	54	67	9	315	48	319	52	26	4	14.440	2	0.001

Table F-6
AR for all respondents

Question	Web (N = 739)						Paper (N = 660)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AR25 *	343	46	325	54	71	10	332	50	303	50	25	4	15.758	2	0.000
AR26 *	316	43	331	57	92	12	296	45	329	55	35	5	19.840	2	0.000
AR27 *	245	33	379	67	115	16	233	35	378	65	49	7	20.852	2	0.000
AR28 *	395	53	222	47	122	16	368	56	248	44	44	7	32.660	2	0.000
AR29 *	274	37	316	63	149	20	268	41	345	59	47	7	47.492	2	0.000
AR30 *	153	21	425	79	161	22	173	26	432	74	55	8	46.661	2	0.000

* Significant difference between paper and web (p < .01).

Table F-7
AR for male respondents

Question	Web (N = 549)						Paper (N = 521)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AR01	522	95	25	5	2	0	486	93	35	7	0	0	2.679	1	0.102
AR02	503	92	44	8	2	0	467	90	53	10	1	0	1.732	2	0.421
AR03	495	90	52	10	2	0	477	92	43	8	1	0	0.960	2	0.619
AR04	459	84	87	16	3	1	419	80	102	20	0	0	5.494	2	0.064
AR05	460	84	86	16	3	1	421	81	99	19	1	0	2.865	2	0.239
AR06	487	89	61	11	1	0	457	88	63	12	1	0	0.516	2	0.773
AR07	484	88	65	12	0	0	456	88	64	12	1	0	0.045	2	0.978
AR08	482	88	66	12	1	0	458	88	62	12	1	0	0.002	2	0.999
AR09	464	85	85	15	0	0	427	82	93	18	1	0	1.049	2	0.592
AR10	478	87	69	13	2	0	454	87	65	13	2	0	0.154	2	0.926
AR11	462	84	84	16	3	1	438	84	82	16	1	0	0.931	2	0.628
AR12	466	85	81	15	2	0	447	86	73	14	1	0	0.950	2	0.622
AR13	408	74	139	26	2	0	376	72	142	28	3	1	0.709	2	0.702
AR14	386	70	160	30	3	1	379	73	140	27	2	0	0.629	2	0.730
AR15	318	58	224	42	7	1	296	57	219	43	6	1	0.991	2	0.609
AR16	379	69	169	31	1	0	349	67	169	33	3	1	0.397	2	0.820
AR17	398	72	146	28	5	1	367	70	149	30	5	1	0.866	2	0.649
AR18	333	61	211	39	5	1	326	63	190	37	5	1	0.642	2	0.725
AR19	389	71	153	29	7	1	340	65	180	35	1	0	9.217	2	0.010
AR20	310	56	220	44	19	3	266	51	248	49	7	1	8.735	2	0.013
AR21	361	66	171	34	17	3	333	64	180	36	8	2	3.529	2	0.171
AR22*	238	43	281	57	30	5	258	50	254	50	9	2	12.021	2	0.002
AR23*	343	62	174	38	32	6	331	64	185	36	5	1	17.726	2	0.000
AR24*	258	47	242	53	49	9	248	48	254	52	19	4	12.368	2	0.002
AR25*	253	46	243	54	53	10	266	51	238	49	17	3	14.943	2	0.001

Table F-7
AR for male respondents

Question	Web (N = 549)						Paper (N = 5 21)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%		#	%		#	%		#	%		Chi-2	df	sig
AR26 *	228	42		251	58		235	45		262	55		19.727	2	0.000
AR27 *	186	34		277	66		186	36		297	64		16.893	2	0.000
AR28 *	304	55		153	45		294	56		195	44		31.151	2	0.000
AR29 *	214	39		224	61		208	40		279	60		43.450	2	0.000
AR30 *	124	23		306	77		147	28		333	72		37.943	2	0.000

* Significant difference between paper and web (p < .01).

Table F-8

AR for female respondents

Question	Web (N = 111)						Paper (N = 90)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AR01	108	98	2	2	1	1	89	99	1	1	0	0	0.444	1	0.505
AR02	105	95	6	5	0	0	88	98	2	2	0	0	1.318	1	0.251
AR03	102	93	8	7	1	1	87	97	3	3	0	0	2.294	2	0.318
AR04	97	87	14	13	0	0	76	84	14	16	0	0	0.359	1	0.549
AR05	88	80	22	20	1	1	72	81	17	19	1	1	0.048	2	0.977
AR06	83	75	27	25	1	1	77	86	13	14	0	0	3.974	2	0.137
AR07	97	88	13	12	1	1	78	87	12	13	0	0	0.919	2	0.632
AR08	97	87	14	13	0	0	77	86	13	14	0	0	0.143	1	0.705
AR09	83	76	26	24	2	2	72	80	18	20	0	0	2.064	2	0.356
AR10	81	74	29	26	1	1	72	80	18	20	0	0	1.931	2	0.381
AR11	89	80	22	20	0	0	75	83	15	17	0	0	0.329	1	0.566
AR12	84	76	27	24	0	0	78	87	12	13	0	0	3.839	1	0.050
AR13	74	68	35	32	2	2	62	69	28	31	0	0	1.661	2	0.436
AR14	64	59	44	41	3	3	68	76	22	24	0	0	8.352	2	0.015
AR15	63	58	45	42	3	3	55	62	34	38	1	1	0.890	2	0.641
AR16	63	57	47	43	1	1	56	62	34	38	0	0	1.319	2	0.517
AR17	72	65	39	35	0	0	53	60	36	40	1	1	1.834	2	0.400
AR18	53	48	58	52	0	0	51	57	39	43	0	0	1.583	1	0.208
AR19	57	52	52	48	2	2	52	58	38	42	0	0	2.238	2	0.327
AR20	61	56	47	44	3	3	46	52	43	48	1	1	1.099	2	0.577
AR21	67	63	39	37	5	5	58	64	32	36	0	0	4.190	2	0.123
AR22*	27	26	77	74	7	6	45	51	44	49	1	1	15.980	2	0.000
AR23	64	60	42	40	5	5	54	60	36	40	0	0	4.160	2	0.125
AR24	51	50	51	50	9	8	47	53	41	47	2	2	3.549	2	0.170

Table F-8
AR for female respondents

Question	Web (N = 111)						Paper (N = 90)					
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly		
	#	%	#	%	#	%	#	%	#	%	#	%
AR25	52	51	49	49	10	9	41	47	47	53	2	2
AR26	56	57	42	43	13	12	44	52	40	48	6	7
AR27	31	33	63	67	17	15	34	40	50	60	6	7
AR28	48	52	44	48	19	17	51	61	33	49	6	7
AR29	33	38	54	62	24	22	39	48	43	52	8	9
AR30	19	22	66	78	26	23	23	28	58	72	9	10

* Significant difference between paper and web (p < .01).

Table F-9
AR for majority respondents

Question	Web (N = 351)						Paper (N = 398)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AR01	331	94	18	5	2	1	378	95	20	5	0	0	2.105	1	0.147
AR02	317	90	34	10	0	0	357	90	40	10	1	0	0.923	2	0.630
AR03	312	89	36	10	3	1	368	92	29	7	1	0	3.382	2	0.184
AR04	294	84	55	16	2	1	319	80	79	20	0	0	4.436	2	0.109
AR05	294	84	55	16	2	1	331	83	66	17	1	0	0.585	2	0.746
AR06	307	87	43	12	1	0	359	90	39	10	0	0	2.278	2	0.320
AR07	311	89	40	11	0	0	356	89	41	10	1	0	1.092	2	0.579
AR08	312	89	39	11	0	0	361	91	37	9	0	0	0.650	1	0.420
AR09	292	83	58	17	1	0	330	83	68	17	0	0	1.175	2	0.556
AR10	301	86	48	14	2	1	355	89	41	10	2	1	2.007	2	0.367
AR11	295	84	56	16	0	0	341	86	57	14	0	0	0.365	1	0.546
AR12	289	82	61	17	1	0	345	87	52	13	1	0	2.662	2	0.264
AR13	278	79	72	21	1	0	303	76	95	24	0	0	2.349	2	0.309
AR14	249	71	98	28	4	1	297	75	101	25	0	0	5.275	2	0.072
AR15	204	58	142	40	5	1	243	61	152	38	3	1	1.921	2	0.383
AR16	244	70	106	30	1	0	279	70	119	30	0	0	2.279	2	0.320
AR17	259	74	91	26	1	0	282	71	113	28	3	1	0.736	2	0.692
AR18	218	62	131	37	2	1	255	64	140	35	3	1	0.369	2	0.832
AR19	240	68	108	31	3	1	261	66	137	34	0	0	5.663	2	0.059
AR20*	215	61	125	36	11	3	204	51	190	48	4	1	14.440	2	0.001
AR21	230	66	113	32	8	2	268	67	124	31	6	2	1.189	2	0.552
AR22*	164	47	168	48	19	5	204	51	188	47	6	2	10.330	2	0.006
AR23*	222	63	109	31	20	6	260	65	137	34	1	0	21.606	2	0.000
AR24	170	48	156	44	25	7	202	51	185	46	11	3	8.503	2	0.014

Table F-9
AR for majority respondents

Question	Web (N = 351)						Paper (N = 398)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AR25 *	175	50	148	42	28	8	204	51	186	47	8	2	15.093	2	0.001
AR26 *	146	42	164	47	41	12	179	45	206	52	13	3	20.134	2	0.000
AR27 *	129	37	172	49	50	14	155	39	220	55	23	6	15.819	2	0.000
AR28 *	197	56	106	30	48	14	244	61	137	34	17	4	21.288	2	0.000
AR29 *	137	39	149	42	65	19	175	44	205	52	18	5	37.605	2	0.000
AR30 *	82	23	200	57	69	20	120	30	255	64	23	6	34.364	2	0.000

* Significant difference between paper and web (p < .01).

Table F-10
AR for minority respondents

Question	Web (N = 218)						Paper (N = 163)						Pearson's						
	Answered			Missing			Answered			Missing									
	#	%	correctly	#	%	incorrectly	#	%	Missing	#	%	correctly	#	%	incorrectly	#	%	Chi-2	df
AR01	211	97		6	3	1	0	149	91	14	9	0	0	1.833	1	0.176			
AR02	209	96		8	4	1	0	149	91	14	9	0	0	4.636	2	0.098			
AR03	200	92		18	8	0	0	151	93	12	7	0	0	0.267	1	0.605			
AR04	188	87		29	13	1	0	134	82	29	18	0	0	2.037	2	0.361			
AR05	175	81		41	19	2	1	121	74	42	26	0	0	3.801	2	0.149			
AR06	182	84		35	16	1	0	134	83	28	17	1	1	0.114	2	0.945			
AR07	194	89		23	11	1	0	130	80	33	20	0	0	6.630	2	0.036			
AR08	188	87		29	13	1	0	129	79	34	21	0	0	4.871	2	0.088			
AR09	181	83		36	17	1	0	127	78	36	22	0	0	2.121	2	0.346			
AR10	181	83		36	17	1	0	129	79	34	21	0	0	1.807	2	0.405			
AR11	182	84		35	16	1	0	127	78	36	22	0	0	2.416	2	0.299			
AR12	181	83		36	17	1	0	139	85	24	15	0	0	0.909	2	0.635			
AR13	141	65		75	35	2	1	100	63	60	37	3	0	0.920	2	0.631			
AR14	145	67		71	33	2	1	114	70	48	30	1	1	0.427	2	0.808			
AR15	124	58		89	42	5	2	80	50	81	50	2	1	3.622	2	0.163			
AR16	134	62		83	38	1	0	97	60	64	40	2	1	0.629	2	0.730			
AR17	145	68		69	32	4	2	104	65	56	35	3	2	0.365	2	0.833			
AR18	11	5		105	95	2	1	89	55	73	45	1	1	0.476	2	0.788			
AR19	140	66		73	34	5	2	93	57	69	43	1	1	3.310	2	0.191			
AR20	111	53		98	47	9	4	87	54	73	46	3	2	0.697	2	0.706			
AR21*	143	69		64	31	11	5	90	56	71	44	2	1	9.409	2	0.009			
AR22*	65	32		140	68	13	6	78	49	82	51	3	2	13.742	2	0.001			
AR23	130	64		74	36	14	6	96	60	65	40	2	1	4.734	2	0.094			
AR24	97	50		98	50	23	10	72	46	85	54	6	4	5.285	2	0.071			
AR25	91	47		103	53	24	10	76	49	79	51	8	5	2.712	2	0.258			

Table F-10
AR for minority respondents

Question	Web (N = 218)						Paper (N = 163)					
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly		
	#	%	#	%	#	%	#	%	#	%	#	%
AR26	94	49	97	51	27	12	79	53	71	47	13	8
AR27	64	35	119	65	35	16	46	31	101	69	16	10
AR28*	105	60	69	40	44	20	69	47	78	53	16	10
AR29	80	47	90	53	48	22	59	41	85	59	19	12
AR30	46	28	118	72	54	24	37	26	104	64	22	13

* Significant difference between paper and web (p < .01).

Pearson's

Chi-2

df

sig

2

0.515

2

0.298

2

0.003

2

0.041

2

0.052

Table F-11
WK for all respondents

Question	Web (N = 741)						Paper (N = 650)						Pearson's		
	Answered			Missing			Answered			Missing					
	#	%	incorrectly	#	%		#	%	incorrectly	#	%		Chi-2	df	sig
WK01*	727	98	10	2	4	0	629	97	21	3	0	0	10.812	2	0.004
WK02*	729	98	11	2	1	0	636	98	14	2	0	0	10.700	2	0.005
WK03*	734	99	5	1	2	0	635	98	13	2	2	0	15.109	2	0.001
WK04*	697	94	44	6	0	0	618	95	32	5	0	0	12.304	2	0.002
WK05*	725	98	15	2	1	0	628	97	22	3	0	0	11.877	2	0.003
WK06	727	98	11	2	3	0	636	98	14	2	0	0	7.129	2	0.028
WK07*	731	99	9	1	1	0	634	98	16	2	0	0	13.104	2	0.001
WK08*	733	99	8	1	0	0	627	96	23	4	0	0	22.245	2	0.000
WK09*	697	94	43	6	1	0	618	95	32	5	0	0	9.822	2	0.007
WK10*	735	99	5	1	1	0	637	98	13	2	0	0	15.018	2	0.001
WK11*	734	99	6	1	1	0	640	98	10	2	0	0	11.652	2	0.003
WK12	711	96	27	4	3	0	628	97	22	3	0	0	5.908	2	0.052
WK13	636	86	100	14	5	1	577	89	71	11	2	0	6.992	2	0.030
WK14*	623	84	118	16	0	0	549	84	100	16	1	0	12.956	2	0.002
WK15	727	98	12	2	2	0	640	98	9	2	1	0	8.519	2	0.014
WK16*	706	95	33	5	2	0	631	97	18	3	1	0	12.328	2	0.002
WK17*	694	94	45	6	2	0	608	94	40	6	2	0	10.554	2	0.005
WK18*	644	87	96	13	1	0	580	89	70	11	0	0	12.134	2	0.002
WK19*	653	88	88	12	0	0	582	90	66	10	2	0	16.178	2	0.000
WK20*	661	89	80	11	0	0	585	90	63	10	2	0	15.500	2	0.000
WK21*	651	88	89	12	1	0	575	88	74	12	1	0	11.729	2	0.003
WK22	634	86	104	14	3	0	569	88	80	12	1	0	8.713	2	0.013
WK23*	648	87	90	13	3	0	582	90	65	10	3	0	11.332	3	0.003
WK24*	658	89	82	11	1	0	591	91	58	9	1	0	13.366	2	0.001

Table F-11
WK for all respondents

Question	Web (N = 741)						Paper (N = 650)						Pearson's				
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly							
	#	%		#	%		#	%		#	%		Chi-2	df	sig		
WK25*	482	65		257	35	2	0	430	66		214	34	6	1	15.172	2	0.001
WK26	581	78		155	22	5	1	512	79		134	21	4	0	7.563	2	0.023
WK27*	667	90		71	10	3	0	577	89		67	11	6	1	12.974	2	0.002
WK28	633	85		102	15	6	1	575	88		74	12	1	0	5.853	2	0.054
WK29	471	64		266	36	4	0	427	66		220	34	3	0	8.683	2	0.013
WK30	522	70		212	30	7	1	464	71		184	29	2	0	3.715	2	0.156
WK31	466	63		265	37	10	1	384	59		257	41	9	1	8.044	2	0.018
WK32	394	53		336	47	11	1	345	53		299	47	6	1	3.082	2	0.214
WK33	183	25		546	75	12	1	176	27		467	73	7	1	3.936	2	0.140
WK34	401	54		331	46	9	1	391	60		255	40	4	0	8.049	2	0.018
WK35	393	53		331	47	17	2	327	50		315	50	8	1	2.460	2	0.292

* Significant difference between paper and web (p < .01).

Table F-12
WK for male respondents

Question	Web (N = 551)						Paper (N = 515)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
WK01	542	98	8	2	1	0	499	97	16	3	0	0	9.105	2	0.011
WK02	541	98	9	2	1	0	503	98	12	2	0	0	6.472	2	0.039
WK03*	546	99	4	1	1	0	500	97	13	3	2	0	13.262	2	0.001
WK04	519	94	32	6	0	0	486	94	29	6	0	0	7.923	2	0.019
WK05	537	97	13	3	1	0	498	97	17	3	0	0	6.664	2	0.036
WK06	541	98	7	2	3	1	503	98	12	2	0	0	4.596	2	0.100
WK07	542	98	8	2	1	0	50	10	465	23	0	0	8.485	2	0.014
WK08*	546	99	5	1	0	0	499	97	16	3	0	0	14.572	2	0.001
WK09	520	94	30	6	1	0	492	96	23	4	0	0	6.360	2	0.042
WK10	545	99	5	1	1	0	503	98	12	2	0	0	9.228	2	0.010
WK11	545	99	5	1	1	0	506	98	9	2	0	0	7.251	2	0.027
WK12	530	96	20	4	1	0	495	96	20	4	0	0	5.855	2	0.054
WK13	475	86	73	14	3	1	458	89	55	11	2	0	6.168	2	0.046
WK14	465	84	86	16	0	0	439	85	75	15	1	0	9.162	2	0.010
WK15	544	99	7	1	0	0	507	98	8	2	0	0	8.061	2	0.018
WK16	528	96	21	4	2	0	498	97	16	3	1	0	5.451	2	0.066
WK17	512	93	37	7	2	0	481	93	33	7	1	0	5.094	2	0.078
WK18	482	87	69	13	0	0	456	89	59	11	0	0	8.194	2	0.017
WK19*	494	90	57	10	0	0	470	91	43	9	2	0	11.195	2	0.004
WK20*	499	91	52	9	0	0	463	90	50	10	2	0	10.024	2	0.007
WK21	494	90	56	10	1	0	463	90	52	10	0	0	5.812	2	0.055
WK22	475	86	75	14	1	0	454	88	61	12	0	0	6.576	2	0.037
WK23	485	88	63	12	3	1	463	90	50	10	2	0	5.333	2	0.070
WK24	499	91	51	9	1	0	477	93	38	7	0	0	7.056	2	0.029

Table F-12
WK for male respondents

Question	Web (N = 551)						Paper (N = 515)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
WK25	364	66	185	34	2	0	338	66	173	34	4	1	7.811	2	0.020
WK26	454	82	95	18	2	0	415	81	97	19	3	1	7.349	2	0.025
WK27 *	503	91	47	9	1	0	460	89	52	11	3	1	9.568	2	0.008
WK28	476	86	70	14	5	1	462	90	53	10	0	0	2.883	2	0.237
WK29	366	66	183	34	2	0	345	67	169	33	1	0	5.075	2	0.079
WK30	409	74	137	26	5	1	386	75	129	25	0	0	1.230	2	0.541
WK31	348	63	194	37	9	2	300	58	210	42	5	1	4.515	2	0.105
WK32	305	55	238	45	8	1	277	54	236	46	2	0	1.108	2	0.575
WK33	138	25	403	75	10	2	143	28	369	72	3	1	1.077	2	0.584
WK34	300	54	243	46	8	1	315	61	199	39	1	0	4.272	2	0.118
WK35	296	54	240	46	15	3	264	51	247	49	4	1	1.387	2	0.500

* Significant difference between paper and web (p < .01).

Table F-13
WK for female respondents

Question	Web (N = 111)						Paper (N = 87)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
WK01	106	98	2	2	3	3	85	98	2	2	0	0	0.521	2	0.771
WK02	109	98	2	2	0	0	85	98	2	2	0	0	3.008	2	0.222
WK03	109	99	1	1	1	1	87	100	0	0	0	0	0.615	2	0.735
WK04	105	95	6	5	0	0	86	99	1	1	0	0	3.737	2	0.154
WK05	110	99	1	1	0	0	84	97	3	3	0	0	4.055	2	0.132
WK06	109	98	2	2	0	0	86	99	1	1	0	0	2.547	2	0.280
WK07	111	100	0	0	0	0	86	99	1	1	0	0	5.034	2	0.081
WK08	110	99	1	1	0	0	86	99	1	1	0	0	7.543	2	0.023
WK09	108	97	3	3	0	0	82	94	5	6	0	0	3.618	2	0.164
WK10	111	100	0	0	0	0	83	95	4	5	0	0	5.034	2	0.081
WK11	110	99	1	1	0	0	86	99	1	1	0	0	2.519	2	0.284
WK12	103	94	6	6	2	2	87	100	0	0	0	0	1.350	2	0.509
WK13	96	87	14	13	1	1	86	99	1	1	0	0	0.675	2	0.713
WK14	90	81	21	19	0	0	78	90	9	10	0	0	3.086	2	0.214
WK15	105	96	4	4	2	2	75	87	11	13	1	1	0.786	2	0.675
WK16	103	93	8	7	0	0	85	98	2	2	0	0	6.197	2	0.045
WK17	107	96	4	4	0	0	85	98	2	2	0	0	4.038	2	0.133
WK18	93	85	17	15	1	1	80	92	7	8	0	0	3.993	2	0.136
WK19	92	83	19	17	0	0	75	86	12	14	0	0	4.163	2	0.125
WK20	97	87	14	13	0	0	77	89	10	11	0	0	3.813	2	0.149
WK21	90	81	21	19	0	0	72	84	14	16	1	1	5.263	2	0.072
WK22	87	80	22	20	2	2	76	87	11	13	0	0	2.442	2	0.295
WK23	97	87	14	13	0	0	82	94	5	6	0	0	6.396	2	0.041
WK24	88	79	23	21	0	0	77	89	10	11	0	0	6.734	2	0.034

Table F-13

* Significant difference between paper and web ($p < .01$).

Table F-14
WK for majority respondents

Question	Web (N = 352)						Paper (N = 394)						Pearson's				
	Answered			Missing			Answered			Missing							
	#	%		#	%		#	%		#	%		Chi-2	df	sig		
WK01	348	99		4	1	0	0	383	97		11	3	0	0	4.813	2	0.090
WK02	347	99		5	1	0	0	389	99		5	1	0	0	2.258	2	0.323
WK03	347	99		3	1	2	1	382	97		12	3	0	0	4.252	2	0.119
WK04	339	96		13	4	0	0	375	95		19	5	0	0	2.803	2	0.246
WK05	348	99		4	1	0	0	384	97		8	2	2	1	4.211	2	0.122
WK06	348	99		4	1	0	0	385	98		9	2	0	0	3.657	2	0.161
WK07	347	99		4	1	1	0	382	97		12	3	0	0	4.168	2	0.124
WK08	350	99		2	1	0	0	382	97		12	3	0	0	8.426	2	0.015
WK09	344	98		7	2	1	0	383	97		11	3	0	0	1.458	2	0.482
WK10	350	99		1	0	1	0	385	98		9	2	0	0	6.563	2	0.038
WK11	348	99		3	1	1	0	389	99		5	1	0	0	1.257	2	0.533
WK12	344	98		8	2	0	0	381	97		13	3	0	0	2.943	2	0.230
WK13	319	91		31	9	2	1	369	94		25	6	0	0	2.721	2	0.257
WK14	308	88		44	13	0	0	350	89		44	11	0	0	2.543	2	0.280
WK15	351	99		1	0	0	0	388	98		5	1	1	0	5.297	2	0.071
WK16	340	97		11	3	1	0	384	97		10	3	0	0	1.198	2	0.549
WK17	336	95		15	4	1	0	377	96		17	4	0	0	0.958	2	0.619
WK18	313	89		39	11	0	0	371	94		23	6	0	0	8.933	2	0.011
WK19	328	93		24	7	0	0	370	94		24	6	0	0	2.389	2	0.303
WK20	323	92		29	8	0	0	363	92		31	8	0	0	3.119	2	0.210
WK21	314	89		37	11	1	0	358	91		36	9	0	0	1.372	2	0.504
WK22	315	89		36	10	1	0	363	92		30	8	1	0	2.252	2	0.324
WK23	326	93		25	7	1	0	365	93		29	7	0	0	1.563	2	0.458
WK24	324	92		27	8	1	0	374	95		20	5	0	0	3.108	2	0.211

Table F-14
WK for majority respondents

Question	Web (N = 352)						Paper (N = 394)						Pearson's				
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly							
	#	%		#	%	Missing	#	%		#	%	Missing	Chi-2	df	sig		
WK25	234	66		116	33	2	1	264	67		129	33	1	0	1.188	2	0.552
WK26	309	88		43	12	0	0	339	86		55	14	0	0	3.407	2	0.182
WK27	323	92		29	8	0	0	354	90		38	10	2	1	5.039	2	0.081
WK28	311	88		40	11	1	0	356	90		37	9	1	0	1.565	2	0.457
WK29	244	69		108	31	0	0	277	70		114	29	3	1	2.312	2	0.315
WK30	279	79		71	20	2	1	301	76		93	24	0	0	1.477	2	0.478
WK31	225	64		125	36	2	1	241	61		153	39	0	0	2.848	2	0.241
WK32	206	59		144	41	2	1	219	56		175	44	0	0	1.419	2	0.492
WK33	97	28		253	72	2	1	121	31		269	68	4	1	2.664	2	0.264
WK34	202	57		149	42	1	0	236	60		157	40	1	0	2.042	2	0.360
WK35	204	58		144	41	4	1	210	53		181	46	3	1	2.186	2	0.335

Table F-15
WK for minority respondents

Question	Web (N = 219)						Paper (N = 159)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
WK01	211	97	6	3	2	1	151	95	8	5	0	0	5.822	2	0.054
WK02	212	97	6	3	1	0	152	96	7	4	0	0	7.309	2	0.026
WK03*	217	99	2	1	0	0	156	98	3	2	0	0	10.071	2	0.007
WK04*	197	90	22	10	0	0	150	94	9	6	0	0	11.744	2	0.003
WK05	210	96	8	4	1	0	152	96	7	4	0	0	6.690	2	0.035
WK06	212	98	5	2	2	1	155	97	4	3	0	0	4.532	2	0.104
WK07*	216	99	3	1	0	0	157	99	2	1	0	0	9.415	2	0.009
WK08*	217	99	2	1	0	0	152	96	7	4	0	0	14.201	2	0.001
WK09*	197	90	22	10	0	0	145	91	14	9	0	0	9.569	2	0.008
WK10*	215	98	4	2	0	0	156	98	3	2	0	0	9.408	2	0.009
WK11*	216	99	3	1	0	0	155	97	4	3	0	0	10.067	2	0.007
WK12	200	92	17	8	2	1	153	96	6	4	0	0	7.136	2	0.028
WK13	170	78	47	22	2	1	125	79	34	21	0	0	4.518	2	0.104
WK14*	169	77	50	23	0	0	126	80	32	20	1	1	11.134	2	0.004
WK15*	209	96	9	4	1	0	156	99	2	1	1	1	10.498	2	0.005
WK16*	202	92	17	8	0	0	152	96	7	4	0	0	11.144	2	0.004
WK17	196	90	22	10	1	0	146	92	13	8	0	0	6.960	2	0.031
WK18	186	85	32	15	1	0	126	79	33	21	0	0	8.927	2	0.012
WK19*	174	79	45	21	0	0	136	86	22	14	1	1	13.514	2	0.001
WK20*	187	85	32	15	0	0	134	84	25	16	0	0	9.494	2	0.009
WK21*	187	85	32	15	0	0	137	87	21	13	1	1	10.910	2	0.004
WK22	168	77	50	23	1	0	127	80	32	20	0	0	6.986	2	0.030
WK23	178	82	40	18	1	0	138	87	21	13	0	0	8.343	2	0.015
WK24*	177	81	42	19	0	0	141	89	18	11	0	0	13.638	2	0.001

Table F-15
WK for minority respondents

Question	Web (N = 219)						Paper (N = 159)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
WK25*	126	58	93	42	0	0	102	65	56	35	1	1	12.658	2	0.002
WK26	145	67	72	33	2	1	101	64	57	36	1	1	6.032	2	0.049
WK27	193	89	25	11	1	0	141	89	17	11	1	1	7.918	2	0.019
WK28	175	81	41	19	3	1	139	87	20	13	0	0	5.770	2	0.056
WK29	126	58	91	42	2	1	89	56	70	44	0	0	4.677	2	0.096
WK30	132	61	84	39	3	1	101	64	58	36	0	0	3.251	2	0.197
WK31	134	63	80	37	5	2	98	62	60	38	1	1	1.875	2	0.392
WK32	99	46	114	54	6	3	86	54	72	46	1	1	3.452	2	0.178
WK33	45	21	167	79	7	3	35	22	124	78	0	0	0.314	2	0.855
WK34*	105	49	108	51	6	3	104	65	55	35	0	0	10.212	2	0.006
WK35	105	50	106	50	8	4	76	48	81	52	2	1	0.766	2	0.682

* Significant difference between paper and web (p < .01).

Table F-16
PC for all respondents

Question	Web (N = 740)						Paper (N = 647)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%		#	%	Missing	#	%		#	%	Missing	Chi-2	df	sig
PC01*	664	90		74	10	2	616	95		31	5	0	21.731	2	0.000
PC02*	599	81		141	19	0	569	88		78	12	0	24.660	2	0.000
PC03	671	91		64	9	5	585	90		62	10	0	3.980	2	0.137
PC04*	591	80		147	20	2	575	89		71	11	1	27.184	2	0.000
PC05*	609	82		128	18	3	582	90		65	10	0	20.934	2	0.000
PC06*	633	86		105	14	2	580	90		66	10	1	12.692	2	0.002
PC07*	616	83		122	17	2	584	90		63	10	0	20.996	2	0.000
PC08*	619	84		118	16	3	583	90		64	10	0	17.193	2	0.000
PC09*	584	79		153	21	3	554	86		91	14	2	18.262	2	0.000
PC10*	673	91		62	9	5	611	94		34	6	2	12.423	2	0.002
PC11*	550	74		182	26	8	517	80		123	20	7	13.672	2	0.001
PC12*	429	58		299	42	12	416	64		222	36	9	10.720	2	0.005
PC13*	368	50		351	50	21	363	56		262	44	22	12.635	2	0.002
PC14	443	60		264	40	33	406	63		214	37	27	3.462	2	0.177
PC15*	340	46		351	54	49	388	60		235	40	24	22.707	2	0.000

* Significant difference between paper and web (p < .01).

Table F-17
PC for male respondents

Question	Web (N = 551)						Paper (N = 511)						Pearson's			
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly						
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig	
PC01*	496	90	53	10	2	0	486	90	25	10	0	0	13.646	2	0.001	
PC02*	448	81	103	19	0	0	449	81	62	19	0	0	17.161	2	0.000	
PC03	498	91	50	9	3	1	467	91	44	9	0	0	4.136	2	0.126	
PC04*	450	82	100	18	1	0	459	82	51	18	1	0	21.172	2	0.000	
PC05*	457	83	92	17	2	0	460	83	51	17	0	0	15.383	2	0.000	
PC06*	470	86	79	14	2	0	457	86	53	14	1	0	9.811	2	0.007	
PC07*	467	85	82	15	2	0	462	85	49	15	0	0	12.791	2	0.002	
PC08*	463	84	86	16	2	0	461	84	50	16	0	0	13.966	2	0.001	
PC09	448	82	100	18	3	1	441	82	70	18	0	0	8.623	2	0.013	
PC10	498	91	48	9	5	1	483	91	28	9	0	0	8.021	2	0.018	
PC11*	400	74	143	26	8	1	413	74	94	26	4	1	12.670	2	0.002	
PC12	312	58	228	42	11	2	323	58	183	42	5	1	6.025	2	0.049	
PC13	279	52	255	48	17	3	290	52	205	48	16	3	7.976	2	0.019	
PC14	338	64	188	36	25	5	321	64	169	36	21	4	2.102	2	0.350	
PC15*	265	51	251	49	35	6	315	51	177	49	19	4	16.569	2	0.000	

* Significant difference between paper and web ($p < .01$).

Table F-18
PC for female respondents

Question	Web (N = 110)						Paper (N = 88)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
PC01*	95	86	15	14	0	0	87	99	1	1	0	0	12.637	2	0.002
PC02	89	81	21	19	0	0	79	90	9	10	0	0	5.381	2	0.068
PC03	103	95	5	5	2	2	80	91	8	9	0	0	1.607	2	0.448
PC04*	80	73	30	27	0	0	80	91	8	9	0	0	10.996	2	0.004
PC05	87	80	22	20	1	1	80	91	8	9	0	0	4.684	2	0.096
PC06	96	87	14	13	0	0	84	95	4	5	0	0	4.544	2	0.103
PC07*	89	81	21	19	0	0	85	97	3	3	0	0	11.861	2	0.003
PC08*	92	84	17	16	1	1	87	99	1	1	0	0	12.302	2	0.002
PC09*	81	74	29	26	0	0	80	91	8	9	0	0	10.176	2	0.006
PC10	102	93	8	7	0	0	83	94	5	6	0	0	0.792	2	0.673
PC11	88	80	22	20	0	0	72	82	16	18	0	0	0.694	2	0.707
PC12	66	60	44	40	0	0	66	76	21	24	1	1	7.021	2	0.030
PC13	53	48	57	52	0	0	52	60	35	40	1	1	4.121	2	0.127
PC14	66	61	42	39	2	2	59	68	28	32	1	1	1.009	2	0.604
PC15*	41	41	60	59	9	8	56	64	31	26	1	1	13.282	2	0.001

* Significant difference between paper and web (p < .01).

Table F-19
PC for majority respondents

Question	Web (N = 352)						Paper (N = 391)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%		#	%		#	%		#	%		Chi-2	df	sig
PC01	322	91		29	8		376	96		15	4		8.779	2	0.012
PC02	292	83		60	17		344	88		47	12		7.704	2	0.021
PC03	323	92		25	7		362	93		29	7		0.149	2	0.928
PC04*	293	83		58	16		359	92		32	8		13.564	2	0.001
PC05	292	83		58	16		352	90		39	10		8.308	2	0.016
PC06	305	87		47	13		356	91		35	9		7.555	2	0.023
PC07	300	85		51	14		357	91		34	9		9.166	2	0.010
PC08	304	86		46	13		357	91		34	9		5.529	2	0.063
PC09	294	84		56	16		343	88		48	12		3.858	2	0.145
PC10	319	91		30	9		373	95		18	5		5.755	2	0.056
PC11	267	76		81	23		321	82		68	17		4.965	2	0.084
PC12	216	61		130	37		259	66		128	33		2.419	2	0.298
PC13	188	53		156	44		241	62		141	36		6.979	2	0.031
PC14	225	64		117	33		257	66		122	31		2.036	2	0.361
PC15*	171	49		163	46		256	65		124	32		19.479	2	0.000

* Significant difference between paper and web (p < .01).

Table F-20
PC for minority respondents

Question	Web (N=218)						Paper (N=158)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
PC01*	182	84	35	16	1	0	149	94	9	6	0	0	17.322	2	0.000
PC02*	173	79	45	21	0	0	139	88	19	12	0	0	15.473	2	0.000
PC03	189	87	28	13	1	0	143	91	15	9	0	0	6.735	2	0.034
PC04*	158	72	60	28	0	0	136	87	21	13	1	1	19.905	2	0.000
PC05*	173	80	44	20	1	0	142	90	16	10	0	0	12.661	2	0.002
PC06	182	84	34	16	2	1	142	90	15	10	1	1	8.164	2	0.017
PC07	179	82	38	18	1	0	140	89	18	11	0	0	8.373	2	0.015
PC08*	174	80	43	20	1	0	144	91	14	9	0	0	14.157	2	0.001
PC09*	165	76	52	24	1	0	134	85	24	15	0	0	10.024	2	0.007
PC10	199	92	18	8	1	0	144	91	14	9	0	0	5.732	2	0.057
PC11	153	71	62	29	3	1	125	80	32	20	1	1	7.157	2	0.028
PC12	104	49	110	51	4	2	99	63	59	37	0	0	9.082	2	0.011
PC13	90	42	122	58	6	3	79	52	74	48	5	3	7.110	2	0.029
PC14	121	59	84	41	13	6	94	62	57	38	7	4	1.324	2	0.516
PC15	88	44	110	56	20	9	92	61	60	39	6	4	9.071	2	0.011

* Significant difference between paper and web (p < .01).

Table F-21
MK for all respondents

Question	Web (N = 739)						Paper (N = 648)						Pearson's			
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly						
	#	%		#	%	Missing	#	%		#	%	Missing	Chi-2	df	sig	
MK01*	709	96		29	4	1	0	0	604	93		44	7	0	0	0.000
MK02*	715	97		24	3	0	0	0	624	96		24	4	0	0	0.001
MK03*	704	95		34	5	1	0	0	624	96		23	4	1	0	0.002
MK04	515	70		218	30	6	0	0	463	71		179	29	6	0	0.022
MK05	637	86		99	14	3	0	0	573	88		73	12	2	0	0.013
MK06*	695	94		43	6	1	0	0	587	91		60	9	1	0	0.000
MK07	612	83		117	17	10	1	0	553	85		94	15	1	0	0.447
MK08*	587	79		147	21	5	0	0	525	81		113	19	10	1	0.002
MK09*	539	73		198	27	2	0	0	461	71		186	29	1	0	0.005
MK10	537	73		193	27	9	1	0	512	79		134	21	2	0	0.019
MK11	565	76		167	24	7	0	0	509	79		136	21	3	0	0.106
MK12	500	68		238	32	1	0	0	439	68		209	32	0	0	0.013
MK13	499	68		235	32	5	0	0	450	69		192	31	6	0	0.011
MK14	532	72		204	28	3	0	0	470	73		175	27	3	0	0.015
MK15*	552	75		186	25	1	0	0	490	76		157	24	1	0	0.007
MK16	283	38		449	62	7	0	0	242	37		401	63	5	0	0.062
MK17*	500	68		234	32	5	0	0	459	71		183	29	6	0	0.007
MK18	468	63		266	37	5	0	0	439	68		208	32	1	0	0.033
MK19	430	58		306	42	3	0	0	382	59		265	41	1	0	0.017
MK20	367	50		366	50	6	0	0	339	52		306	48	3	0	0.019
MK21	432	58		297	42	10	1	0	375	58		265	42	8	1	0.059

Table F-21
MK for all respondents

Question	Web (N = 739)						Paper (N = 648)						Pearson's				
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly							
	#	%		#	%		#	%		#	%		Chi-2	df	sig		
MK22	321	43		403	57	15	2	319	49		324	51	5	0	4.609	2	0.100
MK23	264	36		465	64	10	1	235	36		404	64	9	1	5.419	2	0.067
MK24	395	53		333	47	11	1	383	59		258	41	7	1	7.666	2	0.022
MK25	371	50		351	50	17	2	331	51		313	49	4	0	0.260	2	0.878

* Significant difference between paper and web (p < .01).

Table F-22
MK for male respondents

Question	Web (N = 549)						Paper (N = 512)						Pearson's			
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly						
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig	
MK01*	528	96	20	4	1	0	475	93	37	7	0	0	13.556	2	0.001	
MK02*	535	97	14	3	0	0	494	96	18	4	0	0	9.996	2	0.007	
MK03	523	95	25	5	1	0	495	97	16	3	1	0	8.929	2	0.012	
MK04	395	72	151	28	3	1	367	72	140	28	5	1	6.772	2	0.034	
MK05	472	86	75	14	2	0	453	89	57	11	2	0	6.966	2	0.031	
MK06*	521	95	27	5	1	0	464	91	47	9	1	0	14.341	2	0.001	
MK07	456	84	84	16	9	2	431	84	80	16	1	0	0.279	2	0.870	
MK08	445	82	99	18	5	1	412	82	92	18	8	2	6.692	2	0.035	
MK09	408	75	139	25	2	0	375	73	136	27	1	0	6.458	2	0.040	
MK10	400	74	143	26	6	1	407	80	104	20	1	0	6.329	2	0.042	
MK11	436	80	107	20	6	1	416	82	94	18	2	0	2.135	2	0.344	
MK12	390	71	158	29	1	0	358	70	154	30	0	0	5.512	2	0.064	
MK13	379	70	166	30	4	1	362	71	146	29	4	1	5.165	2	0.076	
MK14	403	74	145	26	1	0	383	75	126	25	3	1	8.289	2	0.016	
MK15	428	78	120	22	1	0	399	78	112	22	1	0	6.182	2	0.045	
MK16	211	39	331	61	7	1	193	38	315	62	4	1	2.380	2	0.304	
MK17	381	70	164	30	4	1	365	72	142	28	5	1	6.000	2	0.050	
MK18	347	64	198	26	4	1	351	69	161	31	0	0	4.963	2	0.084	
MK19	319	58	227	36	3	1	309	60	203	40	0	0	4.413	2	0.110	
MK20	281	52	263	48	5	1	266	52	244	48	2	0	3.414	2	0.181	
MK21	323	60	119	40	7	1	305	60	201	40	6	1	4.243	2	0.120	

Table F-22
MK for male respondents

Question	Web (N = 549)						Paper (N = 512)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
MK22	254	47	282	53	13	2	262	52	246	48	4	1	1.999	2	0.368
MK23	198	37	343	63	8	1	189	37	117	63	6	1	2.692	2	0.260
MK24	293	54	248	46	8	1	306	60	200	40	6	1	6.886	2	0.032
MK25	281	52	257	48	11	2	274	54	235	46	3	1	0.529	2	0.768

* Significant difference between paper and web (p < .01).

Table F-23
MK for female respondents

Question	Web (N = 111)						Paper (N = 88)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
MK01	105	95	6	5	0	0	84	95	4	5	0	0	2.567	2	0.277
MK02	104	94	7	6	0	0	83	94	5	6	0	0	2.525	2	0.283
MK03	106	95	5	5	0	0	84	95	4	5	0	0	2.492	2	0.288
MK04	72	66	37	34	2	2	66	75	22	25	0	0	1.901	2	0.387
MK05	95	86	15	24	1	1	81	92	7	8	0	0	2.186	2	0.335
MK06	103	93	8	7	0	0	82	93	6	7	0	0	2.503	2	0.286
MK07*	89	80	22	20	0	0	84	95	4	5	0	0	12.549	2	0.002
MK08	89	80	22	20	0	0	76	87	11	13	1	1	5.558	2	0.062
MK09	75	68	36	32	0	0	59	67	29	33	0	0	2.498	2	0.287
MK10	84	78	24	22	3	3	74	84	14	26	0	0	1.284	2	0.526
MK11	78	71	32	29	1	1	61	69	27	31	0	0	0.649	2	0.723
MK12	62	56	49	44	0	0	54	61	34	39	0	0	3.102	2	0.212
MK13	70	63	41	37	0	0	62	71	25	29	1	1	5.227	2	0.073
MK14	68	62	41	38	2	2	59	67	29	33	0	0	0.506	2	0.776
MK15	69	62	42	38	0	0	60	68	28	32	0	0	3.270	2	0.195
MK16	45	41	66	59	0	0	39	45	48	55	1	1	4.122	2	0.127
MK17	68	62	42	38	1	1	65	75	22	25	1	1	5.180	2	0.075
MK18	71	65	39	35	1	1	57	65	31	35	0	0	0.591	2	0.744
MK19	70	63	41	37	0	0	53	60	35	40	0	0	2.658	2	0.265
MK20	49	44	62	54	0	0	47	53	41	47	0	0	4.175	2	0.124
MK21	65	60	44	40	2	2	52	60	35	40	1	1	0.481	2	0.786

Table F-23
MK for female respondents

Question	Web (N = 111)						Paper (N = 88)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
	Missing	#	%	Missing	#	%	Missing	#	%	Missing	#	%			
MK22	38	35	72	65	1	1	41	47	47	53	0	0	3.544	2	0.170
MK23	42	38	68	62	1	1	33	38	53	62	2	2	2.574	2	0.276
MK24	60	55	50	45	1	1	56	64	32	36	0	0	2.253	2	0.324
MK25	51	47	57	53	3	3	38	43	50	57	0	0	0.367	2	0.832

* Significant difference between paper and web (p < .01).

Table F-24
MK for majority respondents

Question	Web (N = 350)						Paper (N = 3 92)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
MK01	333	95	16	5	1	0	367	94	25	6	0	0	3.411	2	0.182
MK02	340	97	10	3	0	0	380	97	12	3	0	0	3.883	2	0.144
MK03	330	94	19	5	1	0	379	97	12	3	1	0	5.494	2	0.064
MK04	252	72	96	27	2	1	285	73	105	27	2	1	1.421	2	0.491
MK05	305	87	45	13	0	0	344	88	46	12	2	1	3.888	2	0.143
MK06	335	96	15	4	0	0	356	91	36	9	0	0	9.224	2	0.010
MK07	295	84	47	13	8	2	338	86	53	14	1	0	0.553	2	0.759
MK08	285	81	63	18	2	1	323	82	65	17	4	1	2.742	2	0.254
MK09	269	77	79	23	2	1	290	74	102	26	0	0	2.361	2	0.307
MK10	255	73	90	26	5	1	321	82	70	18	1	0	7.102	2	0.029
MK11	290	83	57	16	3	1	334	85	57	15	1	0	0.840	2	0.657
MK12	247	71	102	29	1	1	274	70	118	30	0	0	1.249	2	0.535
MK13	252	72	96	27	2	1	283	72	107	27	2	1	1.390	2	0.499
MK14	255	73	93	27	2	1	310	79	80	20	2	1	5.258	2	0.072
MK15	271	77	78	22	1	1	313	80	79	20	0	0	1.672	2	0.433
MK16	142	41	205	59	3	1	152	39	236	60	4	1	1.897	2	0.387
MK17	240	69	109	31	1	1	288	73	100	26	4	1	6.345	2	0.042
MK18	227	65	121	35	2	1	277	71	115	29	0	0	3.183	2	0.204
MK19	216	62	132	38	2	1	242	62	150	38	0	0	0.517	2	0.772
MK20	177	51	171	49	2	1	207	53	183	47	2	0	1.707	2	0.426
MK21	208	59	139	40	3	1	247	63	142	36	3	1	2.059	2	0.357

Table F-24
MK for majority respondents

Question	Web (N = 350)						Paper (N = 3 92)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
MK22	172	49	173	49	5	1	223	57	167	43	2	0	3.870	2	0.144
MK23	129	37	117	33	4	1	147	38	239	61	6	2	1.226	2	0.542
MK24	196	56	152	43	2	1	237	60	150	38	5	1	3.979	2	0.137
MK25	183	52	162	46	5	1	212	54	177	45	3	1	0.202	2	0.904

Table F-25
MK for minority respondents

Question	Web (N=219)						Paper (N=158)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%		#	%	Missing	#	%		#	%	Missing	Chi-2	df	sig
MK01*	213	97	6	3	0	0	146	92	12	8	0	0	15.502	2	0.000
MK02*	210	96	9	4	0	0	149	94	9	6	0	0	11.283	2	0.004
MK03*	214	98	5	2	0	0	151	96	7	4	0	0	12.141	2	0.002
MK04	146	68	70	32	3	1	112	72	44	18	2	1	7.017	2	0.030
MK05*	180	83	38	17	1	0	146	92	12	8	0	0	15.508	2	0.000
MK06	201	92	17	8	1	0	144	91	14	9	0	0	8.008	2	0.018
MK07*	179	82	40	18	0	0	135	85	23	15	0	0	11.678	2	0.003
MK08*	177	81	41	19	1	0	128	83	26	17	4	3	13.498	2	0.001
MK09*	150	68	69	32	0	0	106	68	51	32	1	1	12.198	2	0.002
MK10	162	75	54	25	3	1	116	73	42	27	0	0	4.167	2	0.124
MK11	146	67	71	33	2	1	102	65	56	35	0	0	5.996	2	0.050
MK12*	136	62	83	38	0	0	106	67	52	33	0	0	11.764	2	0.003
MK13*	132	61	86	39	1	0	108	69	48	31	2	1	13.499	2	0.001
MK14	143	66	75	34	1	0	95	60	63	40	0	0	9.044	2	0.011
MK15*	154	70	65	30	0	0	106	68	51	32	1	1	12.492	2	0.002
MK16	77	35	141	65	1	0	60	38	98	62	0	0	8.149	2	0.017
MK17	144	67	72	33	3	1	103	66	54	34	1	1	5.179	2	0.075
MK18	129	59	89	41	1	0	97	61	61	49	0	0	8.059	2	0.018
MK19*	118	54	101	46	0	0	84	53	74	47	0	0	10.797	2	0.005
MK20	104	48	114	52	1	0	82	52	76	48	0	0	8.512	2	0.014
MK21	125	57	93	43	1	0	83	53	75	47	0	0	8.723	2	0.013

Table F-25
MK for minority respondents

Question	Web (N=219)						Paper (N=158)						Pearson's			
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly						
	#	%		#	%		#	%		#	%		Chi-2	df	sig	
MK22	75	35		142	65	2	1	60	38	97	62	1	1	7.439	2	0.024
MK23	76	35		141	65	2	1	56	35	102	65	0	0	5.702	2	0.058
MK24*	107	50		109	50	3	1	98	62	60	38	0	0	9.764	2	0.008
MK25	105	49		108	51	6	3	76	48	82	52	0	0	1.217	2	0.544

* Significant difference between paper and web (p < .01).

Table F-26
EI for all respondents

Question	Web (N = 735)						Paper (N = 647)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
EI01	637	87	98	13	0	0	566	87	80	13	1	0	6.463	2	0.040
EI02	667	91	67	9	1	0	595	92	52	8	0	0	4.923	2	0.085
EI03	488	66	245	34	2	0	422	65	225	35	0	0	3.752	2	0.153
EI04	495	67	240	33	0	0	468	72	179	28	0	0	9.135	2	0.010
EI05	629	86	104	14	2	0	551	85	96	15	0	0	3.719	2	0.156
EI06	560	76	173	24	2	0	506	78	138	22	3	0	6.668	2	0.036
EI07	539	73	195	27	1	0	493	76	153	24	1	0	6.408	2	0.041
EI08	677	92	57	8	1	0	597	92	50	8	0	0	4.394	2	0.111
EI09	612	83	119	17	4	0	529	82	117	18	1	0	3.522	2	0.172
EI10	524	71	208	29	3	0	484	75	163	25	0	0	3.675	2	0.159
EI11	590	80	143	20	2	0	531	82	115	18	1	0	3.823	2	0.148
EI12	418	57	315	43	2	0	387	60	253	40	7	1	9.255	2	0.010
EI13	255	35	478	65	2	0	245	38	400	62	2	0	5.383	2	0.068
EI14	442	60	289	40	4	0	394	61	251	39	2	0	2.554	2	0.279
EI15	426	58	304	42	5	0	411	64	234	36	2	0	6.024	2	0.049
EI16	458	62	274	38	3	0	438	68	207	32	2	0	7.414	2	0.025
EI17	255	35	474	65	6	0	217	34	424	66	6	0	4.261	2	0.119
EI18	360	49	369	51	6	0	341	53	300	47	6	0	6.156	2	0.046
EI19	330	45	396	55	9	1	298	46	340	54	9	0	3.967	2	0.138
EI20*	300	41	430	59	5	0	296	46	341	54	10	1	11.668	2	0.003

* Significant difference between paper and web ($p < .01$).

Table F-27
EI for male respondents

Question	Web (N = 545)						Paper (N = 511)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
EI01	470	86	75	14	0	0	455	89	55	11	1	0	5.310	2	0.070
EI02	506	93	38	7	1	0	476	93	35	7	0	0	2.034	2	0.362
EI03	379	70	165	30	1	0	339	66	172	34	0	0	3.189	2	0.203
EI04	390	72	155	28	0	0	389	76	122	24	0	0	5.375	2	0.068
EI05	481	88	63	12	1	0	437	86	74	14	0	0	4.224	2	0.121
EI06	433	80	110	20	2	0	405	80	104	20	2	0	2.383	2	0.304
EI07	426	78	118	22	1	0	397	78	113	22	1	0	2.617	2	0.270
EI08	510	94	34	6	1	0	471	92	40	8	0	0	2.768	2	0.251
EI09	476	88	67	12	2	0	427	84	83	16	1	0	5.192	2	0.075
EI10	418	77	124	23	3	1	412	81	99	19	0	0	2.323	2	0.313
EI11	452	83	91	17	2	0	427	84	84	16	0	0	0.908	2	0.635
EI12	327	60	216	40	2	0	322	64	185	36	4	1	3.900	2	0.142
EI13	201	37	343	63	1	0	206	40	304	60	1	0	3.122	2	0.210
EI14	357	66	186	34	2	0	331	65	179	35	1	0	1.405	2	0.495
EI15	342	63	199	37	4	1	349	68	161	32	1	0	3.543	2	0.170
EI16	369	68	174	32	2	0	360	70	151	30	0	0	1.706	2	0.426
EI17	200	37	340	63	5	1	170	34	337	66	4	1	2.971	2	0.226
EI18	303	56	236	44	6	1	294	58	213	42	4	1	1.444	2	0.486
EI19	261	49	276	51	8	1	245	48	261	52	5	1	0.719	2	0.698
EI20	238	44	302	54	5	1	243	48	262	42	6	1	4.215	2	0.122

Table F-28
EI for female respondents

Question	Web (N = 111)						Paper (N = 88)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
EI01	95	86	16	14	0	0	71	81	17	19	0	0	3.343	2	0.188
EI02	93	84	18	16	0	0	77	88	11	12	0	0	3.035	2	0.219
EI03	57	51	54	49	0	0	60	68	28	32	0	0	8.216	2	0.016
EI04	53	48	58	52	0	0	48	55	40	45	0	0	3.397	2	0.183
EI05	80	73	30	27	1	1	78	89	10	11	0	0	8.255	2	0.016
EI06	70	63	41	37	0	0	65	75	22	25	1	1	6.795	2	0.033
EI07	61	55	50	45	0	0	62	70	26	30	0	0	7.475	2	0.024
EI08	97	87	14	13	0	0	82	93	6	7	0	0	4.310	2	0.116
EI09	74	67	36	33	1	1	69	78	19	22	0	0	3.608	2	0.165
EI10	45	41	66	59	0	0	43	49	45	51	0	0	3.867	2	0.145
EI11	79	71	32	29	0	0	65	74	23	26	0	0	2.669	2	0.263
EI12	51	46	60	54	0	0	43	49	44	51	1	1	3.992	2	0.136
EI13	25	23	85	77	1	1	28	32	60	68	0	0	2.648	2	0.266
EI14	42	38	68	62	1	1	40	45	48	55	0	0	1.654	2	0.437
EI15	43	39	68	61	0	0	40	45	48	55	0	0	3.400	2	0.183
EI16*	49	44	62	56	0	0	56	64	32	36	0	0	9.956	2	0.007
EI17	33	30	78	70	0	0	32	36	56	64	0	0	3.471	2	0.176
EI18	22	20	89	80	0	0	28	32	60	68	0	0	6.238	2	0.044
EI19	40	36	71	64	0	0	36	41	52	59	0	0	2.984	2	0.225
EI20*	31	28	80	72	0	0	39	45	48	55	1	1	9.828	2	0.007

* Significant difference between paper and web ($p < .01$).

Table F-29
EI for majority respondents

Question	Web (N = 347)						Paper (N = 391)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
EI01	308	89	39	11	0	0	360	92	31	8	0	0	2.443	2	0.295
EI02	328	95	19	5	0	0	363	93	28	7	0	0	0.972	2	0.615
EI03	240	69	107	31	0	0	259	66	132	34	0	0	0.813	2	0.666
EI04	262	76	85	24	0	0	300	77	91	23	0	0	0.247	2	0.884
EI05	310	89	37	11	0	0	343	88	48	12	0	0	0.565	2	0.754
EI06	270	78	75	22	2	1	312	80	78	20	1	0	0.336	2	0.845
EI07	265	76	81	23	1	0	312	80	78	20	1	0	1.326	2	0.515
EI08	326	94	21	6	0	0	362	93	29	7	0	0	0.638	2	0.727
EI09	306	88	38	11	3	1	334	85	57	15	0	0	2.279	2	0.320
EI10	254	73	91	26	2	1	310	79	81	21	0	0	3.340	2	0.188
EI11	295	85	52	15	0	0	334	85	57	15	0	0	0.120	2	0.942
EI12	223	64	124	36	0	0	254	65	133	34	4	1	1.522	2	0.467
EI13	128	37	219	63	0	0	154	39	236	60	1	0	0.822	2	0.663
EI14	231	67	114	33	2	1	248	63	142	36	1	0	0.914	2	0.633
EI15	232	67	115	33	1	0	266	68	125	32	0	0	0.081	2	0.960
EI16	254	73	93	27	0	0	289	74	102	26	0	0	0.144	2	0.931
EI17	126	36	220	63	1	0	132	34	256	65	3	1	0.941	2	0.625
EI18	196	56	150	43	1	0	234	60	155	40	2	1	1.160	2	0.560
EI19	163	47	182	52	2	1	185	47	202	52	4	1	0.420	2	0.810
EI20	154	44	193	56	0	0	196	50	191	49	4	1	4.252	2	0.119

Table F-30
EI for minority respondents

Question	Web (N = 218)						Paper (N = 158)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
EI01*	175	80	43	20	0	0	122	78	35	22	1	1	12.547	2	0.002
EI02	189	87	28	13	1	0	143	91	15	9	0	0	9.150	2	0.010
EI03*	135	62	82	38	1	0	110	70	48	30	0	0	10.245	2	0.006
EI04*	122	56	96	44	0	0	102	65	56	35	0	0	13.445	2	0.001
EI05	174	81	42	19	2	1	130	82	28	18	0	0	5.854	2	0.054
EI06*	162	74	56	26	0	0	119	76	37	23	2	1	13.801	2	0.001
EI07*	150	69	68	31	0	0	114	72	44	28	0	0	11.226	2	0.004
EI08	194	89	23	11	1	0	143	91	15	9	0	0	8.097	2	0.017
EI09*	163	75	55	25	0	0	120	76	37	23	1	1	12.275	2	0.002
EI10	143	66	74	34	1	0	113	72	45	28	0	0	7.020	2	0.030
EI11	159	74	57	26	2	1	119	75	39	25	0	0	4.186	2	0.123
EI12	99	46	117	54	2	1	84	53	74	47	0	0	6.000	2	0.050
EI13	67	31	149	68	2	1	58	37	100	63	0	0	5.369	2	0.068
EI14	112	52	105	48	1	0	93	59	65	41	0	0	7.621	2	0.022
EI15*	105	49	111	51	2	1	96	61	62	39	0	0	9.437	2	0.009
EI16	109	50	107	49	2	1	95	60	63	40	0	0	7.467	2	0.024
EI17	81	38	135	62	2	1	57	36	101	64	0	0	4.127	2	0.127
EI18	82	38	132	61	4	2	60	38	97	61	1	1	2.655	2	0.265
EI19	98	46	115	53	5	2	70	44	88	56	0	0	1.272	2	0.530
EI20	74	35	140	64	4	2	63	40	94	59	1	1	3.846	2	0.146

* Significant difference between paper and web (p < .01).

Table F-31
AS for all respondents

Question	Web (N = 731)						Paper (N = 646)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AS01	506	69	224	31	1	0	459	71	187	29	0	0	4.766	2	0.092
AS02	628	86	103	14	0	0	565	87	81	13	0	0	4.740	2	0.093
AS03	642	88	89	12	0	0	576	89	70	11	0	0	4.747	2	0.093
AS04	429	59	301	41	1	0	379	59	266	41	1	0	3.178	2	0.204
AS05	564	77	166	23	1	0	534	83	112	17	0	0	8.879	2	0.012
AS06	400	55	327	45	4	0	370	57	273	43	3	0	3.037	2	0.219
AS07	522	71	208	29	1	0	489	76	157	24	0	0	5.497	2	0.064
AS08	565	77	166	23	0	0	491	76	151	24	4	0	6.241	2	0.044
AS09	295	40	433	60	3	0	237	37	409	63	0	0	4.208	2	0.122
AS10	511	70	217	30	3	0	464	72	182	28	0	0	2.493	2	0.287
AS11*	474	65	256	35	1	0	482	75	162	25	2	0	20.782	2	0.000
AS12	448	61	282	39	1	0	400	62	245	38	1	0	2.605	2	0.272
AS13	373	51	354	49	4	0	345	53	299	47	2	0	2.571	2	0.277
AS14	571	78	157	22	3	0	508	79	137	21	1	0	1.936	2	0.380
AS15	459	63	271	37	1	0	424	66	221	34	1	0	4.513	2	0.105
AS16	293	40	432	60	6	0	285	44	356	56	5	0	4.491	2	0.106
AS17	313	43	412	57	6	0	263	41	381	59	2	0	1.504	2	0.471
AS18	287	39	440	61	4	0	269	42	373	58	4	0	2.621	2	0.270
AS19	310	42	414	58	7	0	266	41	370	59	10	1	3.130	2	0.209
AS20	289	40	434	60	8	1	259	40	377	60	10	1	2.530	2	0.282
AS21	264	36	457	64	10	1	245	38	391	62	10	1	2.485	2	0.289

Table F-31
AS for all respondents

Question	Web (N = 731)					Paper (N = 646)					Pearson's		
	Answered correctly		Answered incorrectly		Missing	Answered correctly		Answered incorrectly		Missing			
	#	%	#	%	# %	#	%	#	%	# %	Chi-2	df	sig
AS22	258	35	462	65	11 1	236	37	397	63	13 2	3.556	2	0.169
AS23	229	31	490	69	12 1	220	34	412	66	14 2	4.026	2	0.134
AS24	303	41	413	59	15 2	250	39	379	61	17 2	3.998	2	0.135
AS25	257	35	464	65	10 1	247	38	382	62	17 2	7.411	2	0.025

* Significant difference between paper and web ($p < .01$).

Table F-32

Paper (N = 510)

Table F-32

Question	Web (N = 543)						Paper (N = 510)								
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%			
													Missing	Missing	Missing
													Chi-2	df	sig
AS22	218	41	317	59	8	1	208	42	292	58	10	2	2.610	2	0.271
AS23	179	34	355	66	9	2	187	38	311	62	12	2	4.208	2	0.122
AS24	247	46	287	54	9	2	207	42	289	58	14	3	5.432	2	0.066
AS25	207	39	329	61	7	1	204	41	292	59	14	3	5.308	2	0.070

* Significant difference between paper and web ($p < .01$).

Table F-33
AS for female respondents

Question	Web (N = 110)						Paper (N = 88)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AS01	58	53	52	47	0	0	53	60	35	40	0	0	3.754	2	0.153
AS02	84	76	26	24	0	0	75	85	13	15	0	0	4.817	2	0.090
AS03	77	70	33	30	0	0	66	75	22	25	0	0	3.039	2	0.219
AS04	42	38	68	62	0	0	31	35	57	65	0	0	2.750	2	0.253
AS05	83	75	27	25	0	0	72	82	16	18	0	0	3.582	2	0.167
AS06	34	31	76	69	0	0	30	34	58	66	0	0	2.637	2	0.267
AS07	40	36	70	64	0	0	43	49	45	51	0	0	5.347	2	0.069
AS08	68	62	42	38	0	0	68	77	30	23	0	0	2.947	2	0.229
AS09	26	24	84	76	0	0	20	23	68	77	0	0	2.505	2	0.286
AS10	82	75	28	25	0	0	60	68	28	32	0	0	3.544	2	0.170
AS11	53	48	57	52	0	0	58	66	30	34	0	0	9.039	2	0.011
AS12	53	48	57	52	0	0	43	49	45	51	0	0	2.516	2	0.284
AS13	35	32	75	68	0	0	40	45	48	55	0	0	6.533	2	0.038
AS14	83	76	26	24	1	1	71	81	17	19	0	0	1.126	2	0.570
AS15	57	52	53	48	0	0	58	66	30	34	0	0	6.745	2	0.034
AS16	23	21	85	79	2	2	28	32	60	68	0	0	2.959	2	0.228
AS17	29	27	80	73	1	1	25	28	63	72	0	0	0.693	2	0.707
AS18	14	13	95	87	1	1	19	22	69	78	0	0	2.715	2	0.257
AS19	34	31	74	69	2	2	27	31	60	69	1	1	0.073	2	0.964
AS20	25	23	84	77	1	1	15	17	72	83	1	1	1.445	2	0.486
AS21	18	17	90	83	2	2	19	22	68	78	1	1	0.906	2	0.636

Table F-33

Question	Web (N = 110)						Paper (N = 88)						Pearson's		
	Answered			Answered			Answered			Answered					
	correctly	incorrectly	Missing	correctly	incorrectly	Missing	correctly	incorrectly	Missing	correctly	incorrectly	Missing	Chi-2	df	sig
AS22	22	20	87	80	1	1	18	21	69	79	1	1	0.488	2	0.783
AS23	24	22	84	78	2	2	18	21	69	79	1	1	0.135	2	0.935
AS24	22	21	85	79	3	3	23	27	63	73	2	2	1.111	2	0.574
AS25	25	23	84	77	1	1	24	28	63	72	1	1	1.038	2	0.595

Table F-34

AS for majority respondents

Question	Web (N = 346)						Paper (N = 390)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	Missing	#	%	Missing	#	%	Missing	#	%	Missing	Chi-2	df	sig
AS01	262	76	0	84	24	0	297	76	0	93	24	0	0.338	2	0.844
AS02	315	91	0	31	9	0	350	90	0	40	10	0	0.665	2	0.717
AS03	328	95	0	18	5	0	365	94	0	25	6	0	0.796	2	0.672
AS04	219	63	0	127	37	0	239	61	1	150	38	1	0.501	2	0.779
AS05	299	86	0	47	14	0	335	86	0	55	14	0	0.344	2	0.842
AS06	221	64	0	124	36	1	259	66	2	129	33	2	0.770	2	0.680
AS07	260	75	0	85	25	1	312	80	0	78	20	0	2.281	2	0.320
AS08	283	82	0	63	18	0	320	82	2	68	17	2	0.538	2	0.764
AS09	150	43	0	195	56	1	159	41	0	231	59	0	0.569	2	0.752
AS10	243	70	1	101	29	2	281	72	0	109	28	0	0.234	2	0.890
AS11	267	77	0	79	23	0	326	84	1	63	16	0	5.674	2	0.059
AS12	210	61	0	136	39	0	249	64	1	139	36	0	1.091	2	0.579
AS13	210	61	0	135	39	1	229	59	0	161	41	0	0.458	2	0.795
AS14	272	79	0	74	21	0	313	80	1	76	19	0	0.947	2	0.623
AS15	233	67	0	113	33	0	270	69	1	119	31	0	1.019	2	0.601
AS16	169	49	1	175	51	2	195	50	4	191	49	1	0.850	2	0.654
AS17	160	46	1	183	53	3	169	43	2	219	56	1	0.707	2	0.702
AS18	163	47	0	183	53	0	174	45	3	213	55	1	1.138	2	0.566
AS19	153	44	1	191	55	2	172	44	6	212	54	2	0.895	2	0.639
AS20	163	47	0	182	53	1	186	48	6	198	51	2	1.512	2	0.470
AS21	149	43	0	196	57	1	165	42	3	222	57	1	0.420	2	0.810

Table F-34
AS for majority respondents

Question	Web (N = 346)						Paper (N = 390)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	Missing	#	%	Missing	#	%	Missing	#	%	Missing	Chi-2	df	sig
AS22	144	42		198	57	4	162	42		221	57	7	0.778	2	0.678
AS23	128	37		217	63	1	149	38		233	60	8	2.597	2	0.273
AS24	160	46		183	53	3	161	41		219	56	10	3.218	2	0.200
AS25	151	44		194	56	1	157	40		223	57	10	3.816	2	0.148

Table F-35
AS for minority respondents

Question	Web (N = 217)						Paper (N = 158)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AS01	136	63	80	37	1	0	96	61	62	39	0	0	5.836	2	0.054
AS02	174	80	43	20	0	0	131	83	27	17	0	0	8.289	2	0.016
AS03	174	80	43	20	0	0	121	77	37	23	0	0	8.613	2	0.013
AS04	118	54	99	46	0	0	83	53	75	47	0	0	8.027	2	0.018
AS05	134	62	82	38	1	0	114	72	44	28	0	0	9.719	2	0.008
AS06	92	43	124	57	1	0	67	43	90	57	1	1	6.916	2	0.031
AS07	145	67	72	33	0	0	105	66	53	34	0	0	7.883	2	0.019
AS08 *	154	71	63	29	0	0	105	67	52	33	1	1	9.801	2	0.007
AS09	74	34	143	66	0	0	46	29	112	71	0	0	8.849	2	0.012
AS10	143	66	73	34	1	0	110	70	48	30	0	0	6.137	2	0.046
AS11	106	49	110	51	1	0	88	56	69	44	1	1	8.795	2	0.012
AS12	132	61	84	39	1	0	89	56	69	44	0	0	6.455	2	0.040
AS13	79	37	136	63	2	1	71	45	86	54	1	1	7.945	2	0.019
AS14	166	77	49	23	2	1	112	71	46	29	0	0	6.028	2	0.049
AS15	126	58	90	41	1	0	91	58	67	42	0	0	5.703	2	0.058
AS16	61	28	154	71	2	1	50	32	108	68	0	0	4.552	2	0.103
AS17 *	91	42	125	58	1	0	46	29	112	71	0	0	12.138	2	0.002
AS18	58	27	157	72	2	1	59	37	99	63	0	0	7.325	2	0.026
AS19	80	37	135	62	2	1	57	36	101	64	0	0	2.851	2	0.240
AS20	63	29	152	70	2	1	39	25	118	75	1	1	4.644	2	0.098
AS21	57	27	156	72	4	2	39	25	117	74	2	1	2.702	2	0.259

Table F-35
AS for minority respondents

Question	Web (N = 217)						Paper (N = 158)						Pearson's				
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly							
	#	%	%	#	%	%	#	%	%	#	%	%	Chi-2	df	sig		
AS22	59	27		156	72		2		1	45	29		111	70		2	0.089
AS23	50	24		161	74		6		3	41	26		116	73		2	0.612
AS24	76	36		135	62		6		3	54	35		102	65		2	0.530
AS25	53	25		160	74		4		2	54	35		102	65		2	0.035

* Significant difference between paper and web (p < .01).

Table F-36
MC for all respondents

Question	Web (N = 726)						Paper (N = 646)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
MC01	500	69	220	31	6	0	479	74	164	26	3	0	5.242	2	0.073
MC02 *	605	83	121	17	0	0	580	90	66	10	0	0	14.855	2	0.001
MC03	657	91	67	9	2	0	608	94	38	6	0	0	6.050	2	0.049
MC04	549	76	175	24	2	0	519	81	125	19	2	0	6.208	2	0.045
MC05	457	63	266	37	3	0	433	67	213	33	0	0	2.682	2	0.262
MC06	476	66	248	34	2	0	448	69	197	31	1	0	3.393	2	0.183
MC07	615	85	109	15	2	0	572	89	74	11	0	0	4.500	2	0.105
MC08	504	70	221	30	1	0	462	72	184	28	0	0	1.754	2	0.416
MC09	485	67	239	33	2	0	472	73	174	27	0	0	7.067	2	0.029
MC10	427	59	295	41	4	0	370	57	275	43	1	0	0.727	2	0.695
MC11 *	416	58	306	42	4	0	427	66	219	34	0	0	10.070	2	0.007
MC12	443	61	281	39	2	0	443	69	201	31	2	0	8.587	2	0.014
MC13	511	71	213	29	2	0	474	74	170	26	2	0	1.899	2	0.387
MC14	487	67	237	33	2	0	456	71	186	29	4	0	1.913	2	0.384
MC15	239	33	486	67	1	0	251	39	393	61	2	0	5.975	2	0.050
MC16	504	70	219	30	3	0	474	74	169	26	3	0	2.878	2	0.237
MC17	434	60	287	40	5	0	406	63	236	37	4	0	0.677	2	0.713
MC18	386	53	336	47	4	0	344	54	297	46	5	0	0.700	2	0.705
MC19	501	70	216	30	9	1	482	75	158	25	6	0	4.893	2	0.087
MC20	355	49	363	51	8	1	341	53	298	47	7	1	2.443	2	0.295
MC21	471	66	245	34	10	1	440	69	196	31	10	1	1.891	2	0.389

Table F-36

* Significant difference between paper and web ($p < .01$).

Table F-37
MC for male respondents

Question	Web (N = 539)						Paper (N = 510)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
MC01	379	71	154	29	6	1	383	76	124	24	3	1	3.044	2	0.218
MC02 *	459	85	80	15	0	0	463	91	47	8	0	0	9.862	2	0.007
MC03	491	91	46	9	2	0	480	94	30	6	0	0	2.889	2	0.236
MC04 *	410	76	128	24	1	0	423	83	85	17	2	0	9.415	2	0.009
MC05	361	67	176	33	2	0	351	69	159	31	0	0	0.600	2	0.741
MC06	378	70	159	30	2	0	365	72	144	28	1	0	0.887	2	0.642
MC07	456	85	81	15	2	0	455	89	55	11	0	0	4.316	2	0.116
MC08	395	73	143	27	1	0	374	73	136	27	0	0	0.519	2	0.772
MC09	366	68	171	32	2	0	376	74	134	26	0	0	4.297	2	0.117
MC10	338	63	197	37	4	1	301	59	208	41	1	0	1.879	2	0.391
MC11 *	324	60	212	40	3	1	356	70	154	30	0	0	9.932	2	0.007
MC12	334	62	203	38	2	0	359	71	149	29	2	0	8.286	2	0.016
MC13	397	74	140	26	2	0	387	76	121	24	2	0	0.959	2	0.619
MC14	377	70	160	30	2	0	368	72	140	28	2	0	0.773	2	0.679
MC15	187	35	352	65	0	0	214	42	296	58	0	0	5.827	2	0.054
MC16	391	73	145	27	3	1	378	74	131	26	1	0	0.251	2	0.882
MC17	353	66	183	34	3	1	338	66	171	34	1	0	0.022	2	0.989
MC18	300	56	236	44	3	1	282	56	225	44	3	1	0.112	2	0.946
MC19	384	72	149	28	6	1	390	77	117	23	3	1	3.103	2	0.212
MC20	275	52	258	48	6	1	287	57	219	43	4	1	2.640	2	0.267
MC21	368	69	164	31	7	1	363	72	140	28	7	1	1.127	2	0.569

Table F-37
MC for male respondents

Question	Web (N = 539)						Paper (N = 510)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
MC22	325	61	204	39	10	2	337	67	164	33	9	1	3.912	2	0.141
MC23	261	50	262	50	16	3	250	51	245	49	15	3	0.147	2	0.929
MC24	276	53	246	47	17	3	284	57	213	43	13	2	1.880	2	0.391
MC25*	267	52	248	48	24	4	304	61	191	39	15	3	9.918	2	0.007

* Significant difference between paper and web (p < .01).

Table F-38
MC for female respondents

Question	Web (N = 109)						Paper (N = 88)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	chi-2	df	sig
MC01	69	63	40	37	0	0	61	69	27	31	0	0	1.531	2	0.465
MC02	79	72	30	28	0	0	76	86	12	14	0	0	6.665	2	0.036
MC03	93	85	16	15	0	0	83	94	5	6	0	0	4.635	2	0.098
MC04	76	70	33	30	0	0	63	72	25	28	0	0	0.736	2	0.692
MC05	51	47	57	53	1	1	54	61	34	39	0	0	3.697	2	0.157
MC06	50	46	59	54	0	0	58	66	30	34	0	0	8.127	2	0.017
MC07	90	83	19	17	0	0	76	86	12	14	0	0	1.079	2	0.583
MC08	61	56	48	44	0	0	57	65	31	35	0	0	2.351	2	0.309
MC09	68	62	41	38	0	0	66	75	22	25	0	0	4.468	2	0.107
MC10	43	39	66	61	0	0	43	49	45	51	0	0	2.147	2	0.342
MC11	46	43	62	57	1	1	44	50	44	50	0	0	1.119	2	0.571
MC12	55	50	54	50	0	0	53	60	35	40	0	0	1.920	2	0.383
MC13	64	59	45	41	0	0	60	68	28	32	0	0	1.915	2	0.384
MC14	62	57	47	43	0	0	57	66	30	34	1	1	1.991	2	0.370
MC15	22	20	86	80	1	1	23	26	64	74	1	1	1.067	2	0.587
MC16	66	61	43	39	0	0	62	71	25	29	1	1	2.928	2	0.231
MC17	34	32	73	68	2	2	32	37	54	63	2	1	0.717	2	0.699
MC18	45	42	63	58	1	1	41	47	46	53	1	1	0.650	2	0.722
MC19	64	60	43	40	2	2	62	72	24	28	2	1	3.261	2	0.196
MC20	40	37	67	63	2	2	36	42	50	58	2	1	0.492	2	0.782
MC21	51	48	56	52	2	2	48	56	38	44	2	1	1.359	2	0.507

Table F-38
MC for female respondents

Question	Web (N = 109)					Paper (N = 88)					Pearson's		
	Answered correctly		Answered incorrectly		Missing	Answered correctly		Answered incorrectly		Missing			
	#	%	#	%	# %	#	%	#	%	# %	chi-2	df	sig
MC22	44	42	61	58	4 4	43	50	43	50	2 1	1.348	2	0.510
MC23	49	46	58	54	2 2	38	44	48	56	2 1	0.142	2	0.932
MC24	38	36	69	64	2 2	43	49	44	51	1 1	3.830	2	0.147
MC25	34	32	73	68	2 2	37	43	49	57	2 1	2.683	2	0.261

Table F-39
MC for majority respondents

Question	Web (N = 345)						Paper (N = 390)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
MC01	250	72	91	26	6	2	298	76	90	23	2	1	1.258	2	0.533
MC02 *	294	85	51	15	0	0	365	94	25	6	0	0	14.733	2	0.001
MC03	320	93	24	7	1	0	370	95	20	5	0	0	1.134	2	0.567
MC04	282	82	62	18	1	0	325	83	65	17	0	0	0.268	2	0.874
MC05	237	69	107	31	1	0	279	72	111	28	0	0	0.707	2	0.702
MC06	248	72	95	28	2	1	292	75	98	25	0	0	0.795	2	0.672
MC07	295	86	49	14	1	0	358	92	32	8	0	0	6.710	2	0.035
MC08	262	76	83	24	0	0	295	76	95	24	0	0	0.081	2	0.961
MC09	243	70	101	29	1	0	304	78	86	22	0	0	5.036	2	0.081
MC10	213	62	131	38	1	0	236	61	154	39	0	0	0.177	2	0.915
MC11	220	64	123	36	2	1	275	71	115	29	0	0	3.347	2	0.188
MC12	231	67	114	33	0	0	277	71	113	29	0	0	1.424	2	0.491
MC13	261	76	84	24	0	0	305	78	85	22	0	0	0.674	2	0.714
MC14	249	72	95	28	1	0	282	72	108	28	0	0	0.070	2	0.966
MC15	126	37	219	63	0	0	163	42	227	58	0	0	2.133	2	0.344
MC16	250	72	95	28	0	0	291	75	99	25	0	0	0.436	2	0.804
MC17	236	68	108	31	1	0	259	66	131	34	0	0	0.470	2	0.791
MC18	197	57	146	42	2	1	222	57	167	43	1	0	0.087	2	0.957
MC19	258	75	86	25	1	0	295	76	94	24	1	0	0.070	2	0.966
MC20	180	52	162	47	3	1	215	55	174	45	1	0	0.766	2	0.682
MC21	251	73	91	26	3	1	287	74	99	25	4	1	0.099	2	0.952

Table F-39
MC for majority respondents

Question	Web (N = 345)					Paper (N = 390)					Pearson's	
	Answered correctly		Answered incorrectly		Missing	Answered correctly		Answered incorrectly		Missing		
	#	%	#	%	# %	#	%	#	%	# %	Chi-2	df sig
MC22	219	63	122	35	4 1	262	67	123	32	5 1	1.395	2 0.498
MC23	180	52	160	46	5 1	201	52	181	46	8 2	0.390	2 0.823
MC24	186	54	154	45	5 1	225	58	156	40	9 2	2.098	2 0.350
MC25	181	52	155	45	9 3	236	61	145	37	9 2	5.209	2 0.074

* Significant difference between paper and web (p < .01).

Table F-40
MC for minority respondents

Question	Web (N = 215)						Paper (N = 158)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
MC01	133	62	82	38	0	0	111	70	47	30	0	0	8.299	2	0.016
MC02	170	79	45	21	0	0	131	83	27	17	0	0	6.674	2	0.036
MC03	182	85	32	15	1	0	146	92	12	8	0	0	7.430	2	0.024
MC04*	139	65	76	35	0	0	120	76	37	23	1	1	10.909	2	0.004
MC05	132	61	83	39	0	0	92	58	66	42	0	0	4.472	2	0.107
MC06	120	56	95	44	0	0	98	62	60	38	0	0	5.611	2	0.060
MC07	173	81	41	19	1	0	131	83	27	17	0	0	3.039	2	0.219
MC08	132	62	82	38	1	0	95	60	63	40	0	0	2.915	2	0.233
MC09	127	59	88	41	0	0	104	66	54	34	0	0	5.946	2	0.051
MC10	114	54	99	46	2	1	77	49	81	51	0	0	2.608	2	0.271
MC11	102	48	112	52	1	0	94	59	64	41	0	0	8.082	2	0.018
MC12	113	53	101	47	1	0	101	64	57	36	0	0	6.444	2	0.040
MC13	135	63	80	37	0	0	107	68	50	32	1	1	6.401	2	0.041
MC14	134	62	81	38	0	0	106	68	51	32	1	1	4.803	2	0.091
MC15	51	24	163	76	1	0	52	33	106	67	0	0	6.233	2	0.044
MC16	141	66	72	33	2	1	112	71	45	28	1	0	2.914	2	0.233
MC17	90	43	121	56	4	2	81	52	75	47	2	1	4.277	2	0.118
MC18	101	47	112	52	2	1	76	48	81	51	1	1	1.849	2	0.397
MC19*	126	60	84	39	5	2	119	76	37	23	2	1	11.429	2	0.003
MC20	89	42	122	57	4	2	81	52	76	48	1	1	3.900	2	0.142
MC21	113	54	97	45	5	2	91	58	66	42	1	1	0.991	2	0.609

Table F-40
MC for minority respondents

Question	Web (N = 215)						Paper (N = 158)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
MC22	96	46	113	53	6	3	88	56	68	43	2	1	4.321	2	0.115
MC23	83	40	123	57	9	4	66	43	88	56	4	3	0.499	2	0.779
MC24	81	40	123	57	11	5	74	47	82	52	2	1	2.263	2	0.323
MC25	77	39	123	57	15	7	75	48	80	51	3	2	4.049	2	0.132

* Significant difference between paper and web ($p < .01$).

Table F-41
AO for all respondents

Question	Web (N = 721)						Paper (N = 644)						Pearson's		
	answered correctly			answered incorrectly			answered correctly			answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	chi-2	df	sig
AO01*	533	74	185	26	3	0	543	84	101	16	0	0	19.895	2	0.000
AO02*	576	80	142	20	3	0	584	91	60	8	0	0	30.502	2	0.000
AO03*	577	80	140	20	4	0	582	90	62	10	0	0	26.222	2	0.000
AO04*	529	74	188	26	4	0	559	87	85	13	0	0	36.645	2	0.000
AO05*	535	75	182	25	4	0	551	86	93	14	0	0	25.241	2	0.000
AO06*	553	77	166	23	2	0	540	84	104	16	0	0	10.175	2	0.006
AO07*	555	77	162	23	4	0	549	85	94	15	1	0	14.030	2	0.001
AO08*	480	67	240	33	1	0	500	78	143	22	1	0	20.030	2	0.000
AO09*	482	67	237	33	2	0	480	75	162	25	2	0	9.999	2	0.007
AO10	507	71	210	29	4	0	494	77	148	23	2	0	6.882	2	0.032
AO11	381	53	337	47	3	0	377	59	265	41	2	0	4.384	2	0.112
AO12	534	75	182	25	5	0	515	80	126	20	3	0	5.892	2	0.053
AO13*	606	85	109	15	6	0	599	93	45	7	0	0	22.232	2	0.000
AO14*	588	82	130	18	3	0	568	88	76	12	0	0	9.966	2	0.007
AO15	618	86	102	14	1	0	581	90	61	10	2	0	6.819	2	0.033
AO16*	554	77	163	23	4	0	556	87	86	13	2	0	18.947	2	0.000
AO17*	580	81	140	19	1	0	567	88	76	12	1	0	14.501	2	0.001
AO18*	560	78	157	22	4	0	552	86	90	14	2	0	14.233	2	0.001
AO19*	511	72	200	28	10	1	510	80	128	20	6	1	11.852	2	0.003
AO20*	554	78	157	22	10	1	559	88	76	12	9	1	24.700	2	0.000
AO21	541	77	164	23	16	2	527	83	105	17	12	1	8.905	2	0.012

Table F-41
AO for all respondents

Question	Web (N = 721)						Paper (N = 644)						Pearson's		
	answered correctly			answered incorrectly			answered correctly			answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	chi-2	df	sig
AO22 *	538	76	172	24	11	1	528	84	103	16	13	2	12.354	2	0.002
AO23 *	495	70	210	30	16	2	498	80	127	20	19	3	15.434	2	0.000
AO24	527	75	174	25	20	2	498	81	120	19	26	4	6.061	2	0.048
AO25	439	64	250	36	32	4	427	69	189	31	28	4	4.426	2	0.109

* Significant difference between paper and web ($p < .01$).

Table F-42
AO for male respondents

Question	Web (N = 534)						Paper (N = 510)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AO01*	410	77	122	23	2	0	435	85	75	15	0	0	11.472	2	0.003
AO02*	431	81	100	19	3	0	462	91	48	9	0	0	20.244	2	0.000
AO03*	431	81	100	19	3	0	462	91	48	9	0	0	19.188	2	0.000
AO04*	396	75	135	25	3	0	443	87	67	13	0	0	26.151	2	0.000
AO05*	394	74	136	26	4	1	434	85	76	15	0	0	18.572	2	0.000
AO06	415	78	117	22	2	0	429	84	81	16	0	0	6.543	2	0.038
AO07	411	78	119	22	4	1	430	84	79	16	1	0	8.470	2	0.014
AO08	367	69	166	31	1	0	391	77	118	23	1	0	8.088	2	0.018
AO09	359	67	174	33	1	0	377	74	131	26	2	0	6.256	2	0.044
AO10	383	72	148	28	3	0	392	77	116	23	2	0	3.783	2	0.151
AO11	294	55	239	45	1	0	302	59	206	41	2	0	1.981	2	0.371
AO12	410	77	121	23	3	0	409	81	99	19	2	0	1.764	2	0.414
AO13*	450	85	80	15	4	1	469	92	41	8	0	0	13.442	2	0.001
AO14	442	83	90	17	2	0	454	89	56	11	0	0	7.999	2	0.018
AO15	461	86	72	14	1	0	459	90	49	10	2	0	3.942	2	0.139
AO16	422	80	108	20	4	1	435	86	73	14	2	0	6.847	2	0.033
AO17	435	81	99	19	0	0	448	88	61	12	1	0	8.833	2	0.012
AO18	424	80	107	20	3	0	434	85	74	15	2	0	5.881	2	0.053
AO19	380	72	166	28	8	1	401	79	104	21	5	1	7.686	2	0.021
AO20*	418	79	108	21	8	1	445	89	57	11	8	1	16.716	2	0.000
AO21	403	78	117	22	14	2	418	84	81	16	11	2	6.768	2	0.034

Table F-42
AO for male respondents

Question	Web (N = 534)						Paper (N = 510)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	Missing		Missing		Missing		Missing		Missing		Missing				
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AO22	408	77	119	23	7	1	420	84	78	16	12	2	7.684	2	0.021
AO23	375	72	147	28	12	2	390	79	102	21	18	3	7.491	2	0.024
AO24	396	76	124	24	14	2	389	80	98	20	23	4	2.567	2	0.277
AO25	322	63	191	37	21	4	330	68	155	32	25	4	2.963	2	0.227

* Significant difference between paper and web (p < .01).

Table F-43
AO for female respondents

Question	Web (N = 109)						Paper (N = 87)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AO01	71	66	37	34	1	1	72	83	15	17	0	0	7.422	2	0.024
AO02	83	76	26	24	0	0	81	93	6	19	0	0	10.426	2	0.005
AO03	88	81	21	19	0	0	80	92	7	20	0	0	5.152	2	0.076
AO04*	76	70	32	30	1	1	79	91	8	21	0	0	12.647	2	0.002
AO05	81	74	28	26	0	0	77	89	10	23	0	0	6.459	2	0.040
AO06	80	73	29	27	0	0	71	82	16	29	0	0	2.004	2	0.367
AO07	86	79	23	21	0	0	81	93	6	19	0	0	7.954	2	0.019
AO08*	65	60	44	40	0	0	73	84	14	27	0	0	14.059	2	0.001
AO09	68	63	40	37	1	1	67	77	20	33	0	0	4.724	2	0.094
AO10	69	64	39	36	1	1	67	77	20	33	0	0	4.178	2	0.124
AO11	53	49	56	51	0	0	50	57	37	50	0	0	1.997	2	0.368
AO12*	67	63	40	37	2	2	73	84	14	27	0	0	10.843	2	0.004
AO13	91	85	16	15	2	2	85	98	2	15	0	0	9.142	2	0.010
AO14	91	84	17	16	1	1	74	85	13	26	0	0	0.092	2	0.955
AO15	93	85	16	15	0	0	79	91	8	21	0	0	1.832	2	0.400
AO16*	76	70	33	30	0	0	79	91	8	21	0	0	13.455	2	0.001
AO17	87	81	21	19	1	1	79	91	8	21	0	0	4.063	2	0.131
AO18	84	77	25	23	0	0	79	91	8	21	0	0	6.993	2	0.030
AO19*	75	69	34	31	0	0	75	87	11	25	1	1	10.341	2	0.006
AO20	82	76	26	24	1	1	76	88	10	24	1	1	5.346	2	0.069
AO21	81	75	27	25	1	1	73	85	13	27	1	1	3.300	2	0.192

Table F-43
AO for female respondents

Question	Web (N = 109)						Paper (N = 87)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AO22	79	74	28	26	2	2	73	85	13	27	1	1	3.570	2	0.168
AO23	77	72	30	28	2	2	71	83	15	29	1	1	3.083	2	0.214
AO24	76	73	28	27	5	4	73	86	12	27	2	2	4.650	2	0.098
AO25	72	72	28	28	9	8	64	75	21	36	2	2	1.543	2	0.462

* Significant difference between paper and web (p < .01).

Table F-44
AO for majority respondents

Question	Web (N = 343)						Paper (N = 390)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AO01*	261	76	82	24	0	0	344	88	46	12	0	0	19.777	2	0.000
AO02*	276	81	66	19	1	0	359	92	31	8	0	0	20.770	2	0.000
AO03*	268	78	74	22	1	0	353	91	37	9	0	0	21.504	2	0.000
AO04*	254	74	88	26	1	0	343	88	47	12	0	0	23.193	2	0.000
AO05*	254	74	87	25	2	1	337	86	53	14	0	0	17.065	2	0.000
AO06	262	77	87	25	2	1	326	84	64	16	0	0	5.720	2	0.057
AO07	262	77	79	23	2	1	332	85	57	15	1	0	8.827	2	0.012
AO08	239	70	81	24	0	0	306	79	83	21	1	0	7.810	2	0.020
AO09	231	68	110	32	2	1	295	76	93	24	2	1	6.465	2	0.039
AO10	256	75	86	25	1	0	311	80	78	20	1	0	3.023	2	0.221
AO11	195	57	148	43	0	0	237	61	151	39	2	1	1.352	2	0.509
AO12	260	76	82	24	1	1	315	81	73	19	2	1	2.829	2	0.243
AO13*	288	85	52	15	3	1	363	93	27	7	0	0	14.520	2	0.001
AO14	280	82	61	18	2	1	347	89	43	11	0	0	7.919	2	0.019
AO15	301	88	41	12	1	0	355	91	35	9	0	0	2.314	2	0.314
AO16	272	80	69	20	2	1	339	87	51	13	0	0	7.690	2	0.021
AO17*	277	81	66	19	0	0	347	89	43	11	0	0	9.982	2	0.007
AO18	274	80	67	20	2	1	340	87	49	13	1	0	7.283	2	0.026
AO19*	241	71	99	29	3	1	319	82	69	18	2	1	13.625	2	0.001
AO20*	270	79	71	21	2	1	347	90	39	10	4	1	16.205	2	0.000
AO21	266	79	70	20	7	2	327	85	58	15	5	1	4.895	2	0.087

Table F-44
AO for majority respondents

Question	Web (N = 343)						Paper (N = 390)						Pearson's Chi-2	df	sig
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%			
AO22	267	79	73	21	3	1	326	85	57	15	7	2	5.356	2	0.069
AO23	249	73	92	27	2	1	308	81	71	18	11	3	8.172	2	0.017
AO24	270	79	70	20	3	1	313	83	63	16	14	4	3.517	2	0.172
AO25	220	66	113	33	10	3	267	71	107	27	16	4	2.450	2	0.294

* Significant difference between paper and web (p < .01).

Table F-45
AO for minority respondents

Question	Web (N = 213)						Paper (N = 158)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%		#	%	Missing	#	%		#	%	Missing	Chi-2	df	sig
AO01	152	72		59	28	2	124	78		34	22	0	3.004	2	0.223
AO02	165	78		46	22	2	140	89		18	11	0	8.294	2	0.016
AO03	176	83		36	17	1	142	90		16	10	0	5.238	2	0.073
AO04*	152	72		59	28	2	136	86		22	14	0	10.878	2	0.004
AO05	152	71		61	29	0	130	82		28	18	0	7.076	2	0.029
AO06	162	76		51	24	0	132	84		26	16	0	4.248	2	0.120
AO07	158	75		53	25	2	134	85		24	15	0	5.707	2	0.058
AO08*	131	62		81	38	1	122	77		36	23	0	10.599	2	0.005
AO09	133	62		80	38	0	112	71		46	29	0	4.041	2	0.133
AO10	134	64		77	36	2	113	72		45	28	0	3.476	2	0.176
AO11	111	52		101	47	1	88	56		70	44	0	1.069	2	0.586
AO12	157	75		53	25	3	126	80		32	20	0	1.373	2	0.503
AO13	176	84		34	16	3	147	93		11	7	0	7.260	2	0.027
AO14	173	82		39	18	1	139	88		19	12	0	3.437	2	0.179
AO15	173	81		40	19	0	137	88		19	12	2	5.463	2	0.065
AO16	155	73		57	27	1	131	84		25	16	2	7.885	2	0.019
AO17	169	79		44	21	0	134	85		23	15	1	4.005	2	0.135
AO18	157	74		56	26	0	130	83		27	17	1	7.238	2	0.027
AO19	146	70		64	30	3	122	79		32	20	4	6.063	2	0.048
AO20	156	75		53	25	4	129	84		24	15	5	7.673	2	0.022
AO21	153	74		54	25	6	123	81		29	18	6	4.457	2	0.108

Table F-45
AO for minority respondents

Question	Web (N = 213)						Paper (N = 158)						Pearson's		
	Answered correctly			Answered incorrectly			Answered correctly			Answered incorrectly					
	#	%	#	%	#	%	#	%	#	%	#	%	Chi-2	df	sig
AO22	151	72	58	27	4	2	123	80	30	19	5	3	4.960	2	0.084
AO23	144	71	60	28	9	4	119	79	32	20	7	4	3.672	2	0.159
AO24	137	68	64	30	12	6	108	73	40	25	10	6	1.707	2	0.426
AO25	116	59	81	38	16	8	98	66	51	32	9	6	1.710	2	0.425

* Significant difference between paper and web (p < .01).

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