Examining Selection Rates and the Qualifying Standard for the Field Radio Operators Course
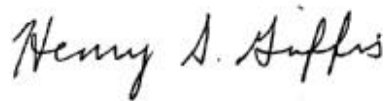
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Summary

- Qualification rates for the current ASVAB EL composite are comparable to alternative composites
- No changes in current selector composite or qualifying scores are warranted for this course

This slide summarizes our findings for examining the qualification rates for the Armed Services Vocational Aptitude Battery (ASVAB) Electronics (EL) composite and setting the enlistment standard for the Field Radio Operators Course. The selection rates for the current EL composite are very similar to alternative composite definitions. This holds true overall, and for both the race and gender groups. There is not enough evidence in the data to recommend that the Marine Corps change from using the current EL composite to screen Marines for the Field Radio Operators Course.

We estimate that an ASVAB EL score of 100 would provide an acceptable pass rate for this course without overly restricting the number of qualified applicants. However, since this course does not have a high failure rate using an EL cut score of 90, there is no compelling reason to change. Raising the qualifying score unnecessarily could affect the number of recruits available for other training courses that do require the higher standard.

Future analyses

- More meaningful analysis could be completed if better data were available
  - All schools should keep complete final course grade information
  - This includes final grades for those failing the course
  - Final grades from a recruit's first attempt through a course need to be kept for all recycles

The analysis to establish qualifying standards for this course was hindered by the data. Final course grades were only provided for those who successfully completed the course. This curtails the grade distribution since the presumably lower grades of the failures are not available.

More meaningful analysis could be conducted with complete data. This would include grades for everyone's first attempt through a course. Retaining this information as part of the school record on a regular basis would create a very useful dataset.

Background

- Changes in ASVAB composites *could* affect qualification rates of various groups
- Current aptitude standards for Field Radio Operators were established in the 1980 reference population
- Aptitude standards *may* need to change in the 1997 reference population

Any change in the ASVAB has the potential to affect the number and quality of applicants who are selected by the Marine Corps and assigned to various training schools. Since individual abilities vary, a change in the selector composite could affect the qualification rates of various groups. Changes in the reference population will be reflected in these qualification rates as well as in the minimum composite score required to be likely to succeed in the Field Radio Operators Course.

In July 2004, the reference population used to compute ASVAB standard scores changed from the 1980 Youth Population to the 1997 Youth Population. The 1997 population is the current assessment of 18- to 23-year-olds, and standards may need to change to accommodate the differences between the two populations. All analyses will be completed using the 1997 population.[1]

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1. 1997 population data provided by Defense Manpower Data Center (DMDC).

Qualification rates

- Qualification rates for ASVAB EL and alternatives are computed for race and gender subgroups
- Impact analysis limited to high school graduates

We do not recommend a change in selector composite for the Field Radio Operators Course based on validity analyses.[2] However, different composite definitions might affect the qualification rates for various population subgroups. Several alternative composites had similar validities. It is important to verify that the selection rates for the current EL composite are comparable to the suggested alternatives, especially for population subgroups. We will compare the qualification rates of the current EL composite with the alternatives that have the highest validities.

The Field Radio Operators Course comprises primarily high school graduates (HSGs), so the results are shown for HSGs. In the appendix, we show results for the total population.

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2. C. M. Hiatt, *The Relationship Between ASVAB and Training School Performance for USMC Field Radio Operators*, Apr 2005 (CNA Annotated Briefing D0012237.A1).

Selection rates by gender for the HSG population

Percentage Qualified at a Composite Cut Score of 80			
EL composite definition	Male	Female	Ratio
AR + MK + GS + EI	91.16	86.74	0.95
AR + MK + VE + EI	90.91	87.98	0.97
AR + MK + GS + MC	90.99	86.00	0.95
AR + MK + EI + AS	92.64	85.78	0.93
AR + MK + EI	91.44	87.18	0.95

Adverse impact occurs when different selection rates disadvantage a minority group. In civilian jobs, the selection rate of any minority group should be no less than 80 percent of the group with the highest selection rate.[3] While the military is not bound by these rules, they serve as a guideline.

All the composite scores are standardized to a mean of 100 and standard deviation of 20 in the 1997 population. We will examine the impact at three levels of the composite scores—at the mean and one standard deviation above and below the mean, which translates into cut scores of 80, 100, and 120.

This slide shows selection rates by gender for a composite cut score of 80. The row of the table that is highlighted in yellow shows the current definition of ASVAB EL. The individual subtests are defined in the appendix.

Since men qualify at a higher rate than women, they are the majority group. The relationship between the selection rates of men and women is shown in the ratio column of the table. Using the 80-percent rule, or a ratio of .80, there is no adverse impact for women for any of the composite definitions at one standard deviation below the mean.

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3. Uniform Guidelines on Employee Selection Procedures, 1978. Available at http://www.dol.gov/esa/regs/cfr/41cfr/toc_Chapt60/60_3.4.htm

Selection rates by gender for the HSG population

Percentage Qualified at a Composite Cut Score of 100			
EL composite definition	Male	Female	Ratio
AR + MK + GS + EI	66.61	46.33	0.73
AR + MK + VE + EI	66.33	52.60	0.79
AR + MK + GS + MC	65.75	49.91	0.76
AR + MK + EI + AS	73.01	42.17	0.58
AR + MK + EI	68.17	49.09	0.72

Using the composite mean score of 100 as the cut score, none of the alternatives meet the 80-percent rule. The alternative that includes the Verbal (VE) subtest qualifies more women than the current EL but slightly fewer men at this score. This alternative comes the closest to meeting the 80-percent rule. The composite containing the Auto Shop (AS) has much lower ratios than the other alternatives.

Selection rates by gender for the HSG population

Percentage Qualified at a Composite Cut Score of 120			
EL composite definition	Male	Female	Ratio
AR + MK + GS + EI	25.61	11.60	0.45
AR + MK + VE + EI	23.65	13.02	0.55
AR + MK + GS + MC	24.31	13.71	0.56
AR + MK + EI + AS	28.61	6.65	0.23
AR + MK + EI	24.73	10.83	0.44

The general pattern for the qualifying rates for men and women continues for those scoring at 120 and above. The composite with the VE subtest qualifies more women but fewer men. So does the composite with the Mechanical Comprehension (MC) subtest. The composite with the AS subtest qualifies the lowest number of women but the highest percentage of men.

Qualification rates by race for HSG population

Percentage Qualified at a Composite Cut Score of 80					
				Black/White Ratio	Hispanic/White Ratio
EL composite definition	White	Black	Hispanic		
AR + MK + GS + EI	94.00	72.75	77.08	0.77	0.82
AR + MK + VE + EI	94.12	73.49	79.20	0.78	0.84
AR + MK + GS + MC	93.75	67.10	79.77	0.72	0.85
AR + MK + EI + AS	94.30	71.34	78.49	0.76	0.83
AR + MK + EI	93.64	74.41	78.98	0.79	0.84

When examining the selection rates by racial groups, Whites are accepted at the highest rate, so the Black and Hispanic selection rates are compared with that group. None of the alternative composites meet the 80-percent rule for Blacks at a cut score of 80, although most are very close. All the alternatives meet the 80-percent rule for Hispanics; the alternative that includes Mechanical Comprehension (MC) qualifies slightly more Hispanics.

Qualification rates by race for HSG population

Percentage Qualified at a Composite Cut Score of 100					
				Black/White Ratio	Hispanic/White Ratio
EL composite definition	White	Black	Hispanic		
AR + MK + GS + EI	66.78	25.32	37.03	0.38	0.55
AR + MK + VE + EI	68.97	27.84	38.44	0.40	0.56
AR + MK + GS + MC	67.08	25.60	36.79	0.38	0.55
AR + MK + EI + AS	67.48	23.56	35.74	0.35	0.53
AR + MK + EI	67.26	28.25	38.82	0.42	0.58

The 80-percent rule is not met for any of the alternatives for either Blacks or Hispanics. The ratio for the current EL is comparable to all the alternatives for a cut score of 100.

Qualification rates by race for HSG population

	White	Black	Hispanic	Black/White Ratio	Hispanic/White Ratio
Percentage Qualified at a Composite Cut Score of 120					
EL composite definition					
AR + MK + GS + EI	22.83	3.31	7.68	0.14	0.34
AR + MK + VE + EI	22.64	3.23	7.54	0.14	0.33
AR + MK + GS + MC	23.20	3.39	8.72	0.15	0.38
AR + MK + EI + AS	21.62	2.85	7.85	0.13	0.36
AR + MK + EI	21.48	3.66	8.09	0.17	0.38

At scores one standard deviation above the mean, neither the Black/White nor the Hispanic/White ratio meets the target. At this level, slightly more people qualify on alternative 3.

Qualification rate summary

- Current EL composite meets target for no adverse impact for women and Hispanics scoring 80 and above
- No alternative composite stands out as a better choice
- Slight differences do not warrant change in composite definition

The current EL composite meets the target for no adverse impact only for women and Hispanics scoring 80 or above. While the alternative composite that contains the VE subtest instead of the General Science (GS) subtest does qualify slightly more people in all subgroups, it does not meet the 80-percent level any better than the current composite.

The EL composite is used to assign Marines to many training schools. While all these alternatives were equally valid for predicting performance in the Field Radio Operators Course, that may not hold true for some other training schools. The slight differences seen here are not enough to suggest a change in the current definition of the composite.

Establishing qualification standard

- Estimate performance in Youth Population
- Establish performance standard
- Access qualification scores

Every USMC training school has a minimum ASVAB qualification score. Anyone scoring below this number will not be admitted to the school without a waiver. The standards are necessary to ensure a reasonable chance of success in the training school. The current standard for the Field Radio Operators Course is an EL score of 90 and above. We will provide guidelines for setting the qualification standard for the Field Radio Operators Course by estimating school performance for everyone in the 1997 Youth Population. The estimated scores will be examined to determine a reasonable prediction of success in the training school. Then the expected pass rates at various levels of the EL composite will be analyzed.

Estimate performance

- Estimate performance using regression computed in Field Radio Operators Course

- Using the coefficients below, we can compute:
Estimated final course grade = 70.18 + 0.176 (EL) + error

Regression Coefficients		
Intercept	EL	Standard error of estimate
70.18	0.176	4.545

A final course grade is estimated for each person in the 1997 Youth Population. This estimate is based on the regression computed in the Field Radio Operators Course. Since the relationship between EL and course grade is not perfect, we multiplied the standard error of estimate for the regression by a random normal deviate (mean of 0, standard deviation of 1) to achieve the proper distribution of estimated grades in the population.

Establish performance standard

- Few academic failures included in course data
- Establish standard by selecting the percentage of the applicant population expected to succeed

Ideally, we should be able to predict unsuccessful performance based on individuals with estimated course grades below the passing grade. However, no final course grades were available for academic failures in the Field Radio Operators Course. Since the estimate of school performance is based on the regression computed using the course data, there are very few low score estimations in the youth population. About 1 percent of the population have an estimated score below 75. This restriction on the estimated grade distribution means we cannot use the estimated score distribution to establish the qualifying standard.

Another way to distinguish successful from unsuccessful performers is to specify the percentage of the applicant population that is likely to perform successfully in the course. This percentage is based on the relative difficulty of the course. It is usually referred to as the base rate. More difficult courses will have lower base rates since a smaller percentage of the population would be expected to succeed. In a previous study, base rates were estimated at about 50 percent for radio repairers, 70 percent for automotive mechanics, and 80 percent for infantrymen.[3] Using these estimates as a guideline, the suggested base rate for Radio Operators would fall in the 70-percent range for the total population.

Since we are examining the high school graduate population, the base rate should be set higher than in the total population. Compared with the total population, about 5 percent more of the HSG population score above the mean EL score. Using this as an estimate for this course, we will suggest a base rate of 75 for HSGs. Since the selection of base rate is a subjective judgment, we present a range of rates so various levels can be examined.

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3. M. H. Maier and C. M. Hiatt, *An Evaluation of Using Job Performance Tests to Validate ASVAB Qualification Standards*, May 1984 (CNA Report 89).

Computing pass rates

- Estimated course grades are transformed to *z scores*

- Cut scores for various percentages are defined using standard tables to compute area under the standard normal distribution

The first step in establishing the performance standard is to transform the estimated final course grades to *z scores.* This is a standard score whose distribution has a mean of zero and standard deviation of one. Once this transformation has been computed, standard statistical tables[4] are used to establish cut scores for the various base rates shown in the tables. These cut scores are based on the percentage of the normal distribution that would exceed that value. The *z scores* used for each base rate are shown in the appendix.

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4. Kirk, Roger E., *Introductory Statistics*, Monterey, CA: Brooks/Cole, 1978.

Estimated pass rates by EL cut score for HSG population

	Estimated pass rate (percentage) by EL cut score				
Base rate	80	90	100	110	120
60	65	70	76	84	89
65	71	76	81	87	92
70	75	80	85	90	95
75	81	85	89	93	97
80	86	90	93	96	98
85	90	93	95	98	99
90	94	96	98	99	100

Here we show the estimated pass rate for different base rates at various EL cut scores. For example, if the base rate for Field Radio Operators were set at 75 percent, the assumption is that 75 percent of the HSG population would be successful in the Field Radio Operators Course regardless of EL score. This implies that 25 percent would not pass the course—a failure rate that is higher than what is usually accepted in USMC training courses.

Historically, the Marine Corps policy is that academic failure rates should not exceed 10 percent. Although there is some flexibility in this rule, it can be used as a benchmark for establishing an acceptable failure rate. Using this rule, if we look in the highlighted row of the table for the base rate of 75, we see that 89 percent of the population with EL scores above 100 are likely to be successful. Raising the EL requirement to a score of 110 would result in an estimated pass rate of 93 percent.

Determining aptitude standard

- Aptitude standards cannot be established by pass rates alone
- Selection decisions fall into four categories
  - Correct acceptance (selected and succeed)
  - Incorrect acceptance (selected and fail)
  - Correct rejection (not selected and fail)
  - Incorrect rejection (not selected and pass)

An aptitude standard cannot be established by just examining the predicted pass rates. In general, the higher the standard, the higher the pass rate. As can be seen in the qualification rates, setting the standard too high can result in not enough recruits being available for various courses. The goal in setting the enlistment standard is to choose a standard that provides the most correct selection decisions. The standard should select as many people who are likely to succeed while rejecting those who would be unsuccessful.

The following tables show the percentage of correct decisions for the different base rates and cut scores. This is the sum of the correct acceptances and correct rejections divided by the total number of decisions. For example, using a cut score of 80 and a base rate of 75, the correct decisions are those with an EL score of 80 or above who also have an estimated final course grade above -0.67 or an EL score below 80 and course grade estimate below -0.67.

Percentage of correct decisions by EL cut score for HSG population

Base rate	Percentage of correct decisions by EL cut score				
	80	90	100	110	120
60	67	71	70	64	55
65	71	74	71	62	51
70	75	77	70	59	46
75	79	79	69	56	42
80	83	80	68	53	37
85	86	81	67	49	33
90	89	81	64	45	28

Again looking at the suggested base rate of 75, we can see that setting the standard at 110 would result in a much lower percentage of correct selection decisions than setting the standard at 100. While the pass rate at 110 is higher (93 percent versus 89 percent), the number of incorrect selection decisions is also higher. Setting the standard closer to 100 would yield an acceptable pass rate and not reject as many successful performers.

While setting the standard for this course at an EL score of 100 would yield an acceptable pass rate there is no compelling reason to raise the current standard of 90. Since this course does not currently have a high failure rate it is appropriate to keep the standard at 90.

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Appendix: Additional analysis

ASVAB subtests

Subtest		Content factor
General Science	GS	Verbal
Arithmetic Reasoning	AR	Math
Word Knowledge	WK	Verbal
Paragraph Comprehension	PC	Verbal
Auto Shop Information	AS	Technical
Mathematics Knowledge	MK	Math
Mechanical Comprehension	MC	Technical
Electronics Information	EI	Technical
Assembling Objects*	AO	Spatial

These are the current ASVAB subtests and their associated content factors. These subtests were combined to create various alternative composites for predicting performance in the Field Radio Operators Course.

Selection rates by gender for the total population

Percentage Qualified at a Composite Cut Score of 80			
EL composite definition	Male	Female	Ratio
AR + MK + GS + EI	88.09	81.66	0.93
AR + MK + VE + EI	87.67	83.03	0.95
AR + MK + GS + MC	87.85	81.23	0.92
AR + MK + EI + AS	89.95	80.86	0.90
AR + MK + EI	88.41	82.27	0.93

These are the qualification rates by gender at a composite cut score of 80 for the total population.

Selection rates by gender for the total population

Percentage Qualified at a Composite Cut Score of 100			
EL composite definition	Male	Female	Ratio
AR + MK + GS + EI	60.18	42.80	0.71
AR + MK + VE + EI	59.31	46.68	0.79
AR + MK + GS + MC	59.59	44.25	0.74
AR + MK + EI + AS	67.56	37.44	0.55
AR + MK + EI	61.47	43.51	0.71

These are the qualification rates by gender at a composite cut score of 100 for the total population.

Selection rates by gender for the total population

Percentage Qualified at a Composite Cut Score of 120			
EL composite definition	Male	Female	Ratio
AR + MK + GS + EI	22.19	10.12	0.46
AR + MK + VE + EI	20.45	11.35	0.56
AR + MK + GS + MC	21.02	11.99	0.57
AR + MK + EI + AS	24.98	5.79	0.23
AR + MK + EI	21.49	9.45	0.44

These are the qualification rates by gender at a composite cut score of 120 in the total population.

Qualification rates by race for total population

Percentage Qualified at a Composite Cut Score of 80					
				Black/White Ratio	Hispanic/White Ratio
EL composite definition	White	Black	Hispanic		
AR + MK + GS + EI	92.25	65.31	69.53	0.71	0.75
AR + MK + VE + EI	92.14	66.13	72.11	0.72	0.78
AR + MK + GS + MC	92.03	59.96	72.55	0.65	0.79
AR + MK + EI + AS	92.91	63.82	71.45	0.69	0.77
AR + MK + EI	91.81	66.99	72.27	0.73	0.79

 These are the qualification rates by racial group at a composite cut score of 80.

Qualification rates by race for total population

Percentage Qualified at a Composite Cut Score of 100					
EL composite definition	White	Black	Hispanic	Black/White Ratio	Hispanic/White Ratio
AR + MK + GS + EI	62.41	21.52	29.63	0.34	0.47
AR + MK + VE + EI	64.18	23.48	30.22	0.37	0.47
AR + MK + GS + MC	62.92	21.72	29.03	0.35	0.46
AR + MK + EI + AS	64.10	20.26	30.53	0.32	0.48
AR + MK + EI	62.81	23.94	31.20	0.38	0.50

These are the qualification rates by racial group at a composite cut score of 100. The row for the current EL composite is highlighted in yellow.

Qualification rates by race for total population

Percentage Qualified at a Composite Cut Score of 120					
EL composite definition	White	Black	Hispanic	Black/White Ratio	Hispanic/White Ratio
AR + MK + GS + EI	20.90	2.67	5.58	0.13	0.27
AR + MK + VE + EI	20.68	2.61	5.48	0.13	0.26
AR + MK + GS + MC	21.23	2.73	6.31	0.13	0.30
AR + MK + EI + AS	19.96	2.28	5.88	0.11	0.29
AR + MK + EI	19.74	2.95	5.87	0.15	0.30

These are the qualification rates by racial group at a composite cut score of 120. The row for the current EL composite is highlighted in yellow.

Estimated pass rates by EL cut score for total population

	Estimated pass rate (percentage) by EL cut score				
Base rate	80	90	100	110	120
60	68	72	79	85	92
65	72	77	84	89	94
70	77	82	88	93	97
75	82	86	91	95	99
80	85	90	94	97	99
85	91	93	96	98	99
90	95	97	98	99	100

These are the estimated pass rates by EL cut score in the total population. The suggested base rate for the total population is 70.

Percentage of correct decisions by EL cut score for total population

	Percentage of correct decisions by EL cut score				
Base rate	80	90	100	110	120
60	70	72	70	62	54
65	73	74	70	60	49
70	77	76	70	58	46
75	80	77	68	54	41
80	82	78	66	50	36
85	85	77	63	46	31
90	87	77	60	41	26

These are the percentages of correct selection decisions by EL composite cut scores for the total population. The suggested base rate for the total population is 70.

Z scores used to establish base rate cut scores

Base rate	*Z-score*
60	-0.25
65	-0.39
70	-0.52
75	-0.67
80	-0.84
85	-1.04
90	-1.28

Here we show the *z scores* used as the cut score for the various base rates. The base rate is the percentage of the total distribution that has a *z score* at or above the given cut point. For example, 70 percent of a normal distribution will exceed a *z score* of -0.52.

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