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Title:

An Exploratory Study on Selection Ratio: The Effects of Selection Strategy and Model

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Summary

Human resources professionals consider many factors when they build selection systems. Some of these factors are technical and they may include the selection strategy (compensatory vs. conjunctive), type of selection instruments, number of selection instruments, cutoff scores on these selection instruments, and the order in which the selection instruments are administered (especially if a conjunctive strategy is used). Other factors are more practical and they include such things as cost, administration time, utility, labor market conditions, consistency with past practices, etc.

This study is the first in a series in which we will examine the technical considerations pertaining to the building of selection systems using criterion-referenced assessments. In conducting this study, we explored the impact of selection strategy and selection model on selection ratio. Using archival data in the ACT Work Keys system, we built selection models for the occupation of retail salesperson using assessments for eight skills. The sample consisted of 3,236 individuals who had taken all eight of the Work Keys assessments in the past year. The sample includes primarily adults and is approximately 42 percent female.

The results of the study indicate that the conjunctive strategy was consistently more selective than the compensatory strategy. In addition, the selection models did not differ in their impact on selection ratio, though it was clear that there were two subsets of selection models.

Since the effects of the number and type of selection instruments were confounded in this study, further investigation will address that issue, and will examine the effect of cutoff scores and the order of administration of the selection instruments.

Abstract

The effect of the compensatory and conjunctive selection strategies on selection ratio was investigated using eight different selection instruments. The results show that the conjunctive strategy screens out more applicants than does the compensatory strategy.

An Exploratory Study on Selection Ratio:
The Effects of Selection Strategy and Model

In practice, human resource professionals rarely limit themselves to using only one instrument to select employees into jobs. It is common to use multiple instruments. When multiple instruments are used for employee selection, the challenge is to find the best way to administer these instruments in order to shortlist the applicants who meet the selection requirements. One approach is to use a compensatory model and administer all the instruments to the applicants at roughly the same time (Guion, 1991). The applicants' scores on all of the instruments are then combined using multiple regression to provide a composite score. Ideally, this work is cross-validated as part of the multiple regression procedure. Applicants are then ranked according to their composite scores and those who meet a cutoff are considered for the jobs.

Another approach is to use a conjunctive model such that instruments are administered in sequential stages (Guion, 1991). At the end of each stage, the process yields a shorter list of applicants. This approach is noncompensatory, that is, applicants who do not do well on a particular instrument will not advance to the next stage of the process and will not be administered another assessment. Regardless of which approach one uses in designing a selection system, one faces the questions of what instruments and how many instruments to use. The answers of course depend on what will maximize the predictive power of the selection system. In addition to prediction, one must also deal with practical considerations, such as selection ratio, cost, time, utility, labor market conditions, and consistency with past practices, etc. All of these considerations ultimately affect the design of a selection system.

This exploratory study was conducted because of current changes in labor market conditions. Given the low unemployment rate throughout the nation, human resources professionals have had an especially hard time finding qualified people to fill job vacancies. Since the applicant pool is

small, the selection strategy should be designed to screen out some, but not too many, applicants. The number of applicants being screened out is affected primarily by the selection strategy, number and type of selection instruments, and the cutoff scores of the selection instruments. Briefly, the way to build a selection system is to

1. conduct a job analysis to identify job requirements, specifically the knowledge, skills, and abilities required to perform the job;
2. identify the knowledge, skills, and abilities that will be assessed;
3. develop or identify assessments for the knowledge, skills, and abilities chosen in step 2;
4. identify a selection strategy (i.e., a compensatory or a conjunctive model); and
5. identify the appropriate cutoff scores.

For this study, we followed this general approach when building hypothetical selection systems, and examined the impact of these various systems on the selection ratios (i.e., the proportions of individuals in a specified population whose predictor scores exceed the cutoff); looking at specifically, (1) the effect of selection strategy (compensatory vs. conjunctive) on selection ratios, and (2) the effect of the selection model (based on the number and type of selection instruments) on selection ratios. To complete this study, we chose to use ACT's Work Keys system because we have access to the Work Keys job analysis and assessment data. For the purposes of this study, we assumed that only the Work Keys assessments (which are criterion-referenced measuring basic employability skills) were being used to select applicants.

The Work Keys system enables human resources professionals to conduct a job analysis to identify the tasks and general, transferable skills required to perform the job. In the process, subject matter experts identify the cutoff scores for the skills included in the analysis and produce a rank ordering of the importance of these skills. The ranking information is used as one consideration for

deciding which assessments to include in the selection system.

The skill requirements and cutoff scores for many jobs are available in the ACT Work Keys archive. However, we chose the job of retail salespersons to focus on because it had a high vacancy rate at the time of the study. For example, in the county in which the investigators reside (population 100,003), there was an annual average of 317 openings for this job (according to the data provided by the Department of Labor in the state; Dralle, personal communication, September 11, 1997).

Having identified the retail salespersons job, the investigators searched the ACT Work Keys archive for the job analysis data from 1993 to date, and found 13 cases for this job. The average profile for the job of retail salesperson is as follows:

Skills	Skill Levels
Applied Mathematics	4
Applied Technology	4
Listening	4
Locating Information	4
Observation	4
Reading for Information	4
Teamwork	3
Writing	4

Since the database does not track the ranking information, the investigators asked six former retail salespersons to rank the skills in terms of their importance to their jobs. The most important skill was accorded rank 1, the second most important skill, rank 2, and so on. Skills that were deemed "not applicable" to the job were given a rank of 9. The ranks indicated by all six subject matter experts for every skill were totalled, and the total rank was used as the basis for the order of

the skills as shown below. The most important skill to the job of retail salesperson was found to be Observation and the least important was Applied Technology.

Skills	Rank
Applied Mathematics	3
Applied Technology	8
Listening	5
Locating Information	2
Observation	1
Reading for Information	6
Teamwork	4
Writing	7

Using the cutoff scores and ranking information, we then started building selection models, first using the compensatory approach and then the conjunctive approach. Regardless of the approach taken, these models had one thing in common; that is, the first one included only one assessment, the second one two assessments, the third one three assessments, and so on, as shown below.

Model	Number of Instruments	Components
1	1	Observation
2	2	Observation & Locating Information
3	3	Observation, Locating Information, & Applied Mathematics
4	4	Observation, Locating Information, Applied Mathematics, & Teamwork
5	5	Observation, Locating Information, Applied Mathematics, Teamwork, & Listening
6	6	Observation, Locating Information, Applied Mathematics, Teamwork, Listening, & Reading for Information
7	7	Observation, Locating Information, Applied Mathematics, Teamwork, Listening, Reading for Information, & Writing
8	8	Observation, Locating Information, Applied Mathematics, Teamwork, Listening, Reading for Information, Writing, & Applied Technology

The various compensatory models created for this study were different with respect to the number and type of assessments included in the calculation of the composite score for each applicant. Similarly, the conjunctive models varied with respect to the number and type of assessments included. However, note that the cutoff scores of the selection instruments included in both the compensatory and conjunctive models were not changed.

To reiterate, in this study, we first explored the difference between the compensatory and conjunctive strategies. Next, we examined the impact of various selection models on selection ratio.

Method

Sample

A convenience sample of examinees who took all eight assessments was selected from the Work Keys archive for this study. This sample consisted of 3,236 examinees, approximately 42% female. Because the archival data came from various test administrations, most of which did not require examinees to complete all the demographic fields on the answer documents, a more detailed description of the sample was not obtainable.

Instruments

The instruments in this study were criterion-referenced assessments:

- ! Applied Mathematics measures skill in applying mathematical reasoning to work-related problems (40 minutes, scores range from 3 to 7);
- ! Applied Technology measures the skill in solving problems of a technological nature using the basic principles of mechanics, electricity, fluid dynamics, and thermodynamics (45 minutes, scores range from 3 to 6);
- ! Listening measures the skill in listening to and understanding work-related messages (40 minutes, scores range from 1 to 5);
- ! Locating Information measures the skill in using information presented in workplace graphics such as diagrams, floor plans, tables, forms, graphs, charts, and instrument gauges (35 minutes, scores range from 3 to 6);
- ! Observation is a video-based assessment measuring the skill in paying attention to instructions and demonstrations, and in noticing details (60 minutes, scores range from 3 to 6);
- ! Reading for Information measures the skill in reading and understanding work-related instructions and policies (40 minutes, scores range from 3 to 7);

- ! Teamwork measures the skill in choosing behaviors and/or actions that simultaneously support relationships within the team and lead toward accomplishment of work tasks (80 minutes, scores range from 3 to 6); and
- ! Writing measures the skill in writing work-related messages (40 minutes, scores range from 1 to 5).

All the assessments use hierarchical score scales such that the higher scores are founded on lower scores and are more difficult to obtain (ACT, 1997). For example, a score of Level 4 on Applied Mathematics means that the examinee has demonstrated the skills set at Level 3 and Level 4. Table 1 shows the correlations of the assessments and Table 2, a frequency table, shows the number of and the selection ratio by assessment by possible cutoff score.

Data Analysis

The proportion of individuals meeting each model's criteria was computed. These proportions were then used to examine the effect of the selection strategy and model using the ANOVA procedure.

Results

Table 3 shows the number and percentage of applicants who were selected by using both the compensatory and conjunctive strategies using the eight models shown on page 4. (These models were built by varying the number and type of selection instruments.) When we used the compensatory strategy, the various models retained 46% to 77% of the applicants. On the other hand, as shown in Figure 1, when we used the conjunctive strategy, the same models were consistently more selective (with the exception of the baseline model which included only one selection instrument). That is, as more instruments and different types of instruments were added to the conjunctive models, the selection ratio became steeper.

In contrast to the conjunctive model, when we used the compensatory models, this steep decline was not observed. Rather, the selection ratios bounced up and down. This pattern could be, in part, attributed to the compensatory nature of the models. That is because some instruments were simply more difficult than others and good performance on certain instruments made up for poor performance on other instruments. For example, 24% of the examinees obtained Level 5 of Applied Technology in contrast to 69% for Locating Information (see Table 2).

An ANOVA analysis was performed to further examine the effect of selection strategy (conjunctive vs. compensatory strategy) and model. Table 4 shows the results of the ANOVA analysis. The conjunctive strategy did screen out more applicants than the compensatory strategy ($F = 7.12, p < .05, \eta^2 = 0.27$). Given the results presented in Table 3, this finding is not surprising.

On the other hand, selection model did not produce a significant effect on selection ratio ($F = 1.40, p > .05$). However, when re-examining Figure 1 and the trend after averaging the impact of the two selection strategies, one can see that a sharp decline separates the first four selection models from the last four selection models.

Discussion

This study shows that when the selection system must focus on finding the applicant that best matches a particular position with respect to Work Keys skills, the conjunctive strategy appears to be more stringent than the compensatory strategy. Holding the selection model constant, the conjunctive strategy always screens out more applicants than the compensatory strategy (with the exception of the baseline, Model 1). Therefore, when building a selection system, one concern should be the selection strategy. When deciding whether to use a compensatory or conjunctive strategy, one should bear in mind several factors. One factor is the rate of unemployment. If unemployment is generally low, it is important to remember that a conjunctive model can be more restrictive than a compensatory model. A second question is whether compensation is appropriate

for the job. If one believes that having more of one skill or knowledge in one area compensates for the lack of skill or knowledge in another area, then a compensatory model makes good sense. However, many jobs may not allow for this compensation. For example, because a pilot with excellent factual knowledge of flight dynamics may not overcome or compensate for the lack of perceptual skills needed in the landing and take off phases of flight, pilots are probably best selected with a conjunctive model.

Although the study did not find an effect of selection model on selection ratio, the sharp decline separating Models 4 and 5 indicates that the first four models were more similar to each other than they are to the last four models. Since the selection models in this study were built by varying both the number and type of selection instruments, the effect of the type of instrument is confounded with the effect of the number of instruments. These two factors, along with cutoff scores, and order of administration will be the subjects of further investigation in this series of research studies on selection ratio.

References

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Guion, R.M. (1991). Personnel Assessments, Selection, and Placement. In M.D. Dunnette and L.M. Hough (eds.), *Handbook of Industrial/Organizational Psychology*, Vol. 2. Palo Alto, CA: Consulting Psychologists Press, Inc.

Table 1

Correlations of Selection Instruments

	Mean	S.D.	AM	AT	L	LI	OB	RI	TW
Applied Mathematics (AM)	5	1.3							
Applied Technology (AT)	3	1.0	.57						
Listening (L)	3	0.6	.38	.20					
Locating Information (LI)	4	0.8	.63	.46	.39				
Observation (OB)	4	0.9	.47	.40	.29	.44			
Reading for Information (RI)	5	1.2	.62	.52	.39	.60	.43		
Teamwork (TW)	4	1.0	.46	.33	.32	.46	.40	.49	
Writing (W)	3	0.8	.42	.19	.54	.43	.28	.44	.36

Note. All correlations were significant at .05 using a one-tailed test.

Table 2

Frequency and Ratios by Selection Instrument and Cutoff Scores

	Below 3	Level 3	Level 4	Level 5	Level 6	Level 7
Applied Mathematics	195	535	794	865	647	200
Number passing	3,236	3,041	2,506	1,712	847	200
Percent passing	100%	94.0%	77.4%	52.9%	26.2%	6.2%
Applied Technology	1,486	975	483	269	23	N/M
Number passing	3,236	1,750	775	292	23	N/M
Percent passing	100%	54.1%	23.9%	9.0%	0.7%	N/M
Locating Information	331	674	1,681	547	3	N/M
Number passing	3,236	2,905	2,231	550	3	N/M
Percent passing	100%	89.8%	68.9%	17.0%	0.1%	N/M
Observation	151	579	1,316	1,023	167	N/M
Number passing	3,236	3,085	2,506	1,190	167	N/M
Percent passing	100%	95.3%	77.4%	36.8%	5.2%	N/M
Reading for Information	206	241	1,106	890	635	158
Number passing	3,236	3,030	2,789	1,683	793	158
Percent passing	100%	93.6%	86.2%	52.0%	24.5%	4.9%
Teamwork	299	906	991	955	85	N/M
Number passing	3,236	2,937	2,031	1,040	85	N/M
Percent passing	100%	90.8%	62.8%	32.1%	2.6%	N/M
	Below 1	Level 1	Level 2	Level 3	Level 4	Level 5
Listening	24	55	783	2,195	179	0
Number passing	3,236	3,212	3,157	2,374	179	0
Percent passing	100%	99.3%	97.6%	73.4%	5.5%	0.0%
Writing	25	91	992	1,678	450	0
Number passing	3,236	3,211	3,120	2,128	45	0
Percent passing	100%	99.2%	96.4%	65.8%	13.9%	0.0%

Note: N/M indicates skills are not measured at these levels by the assessment.

Table 3

Number and Percentage of Applicants Selected by Strategy and by Model

<u>Selection models</u>	<u>Strategy</u>			
	<u>Conjunctive</u>		<u>Compensatory</u>	
1	2506	(77%)	2506	(77%)
2	1947	(60%)	2102	(65%)
3	1787	(55%)	2152	(66%)
4	1751	(54%)	2341	(72%)
5	155	(5%)	1934	(60%)
6	154	(5%)	2254	(70%)
7	71	(2%)	1839	(57%)
8	23	(1%)	1484	(46%)

Table 4

Results from ANOVA Analysis of Selection Strategy and Model

Source of variance	SS	df	MS	F	p
Strategy	.40	1	.40	7.12	<.05
Model	.55	7	.08	1.40	>.05
Error	.79	14	.06		
Total	1.19	15			

Figure 1. Percentage of applicants selected by selection strategy by selection model

