

Technical Report 418

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**A COMPARISON OF EXPERT RATINGS OF
TASK DIFFICULTY WITH AN INDEPENDENT
CRITERION**

David L. Ryan-Jones

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U. S. Army

Research Institute for the Behavioral and Social Sciences

November 1979

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Technical Report 418	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A COMPARISON OF EXPERT RATINGS OF TASK DIFFICULTY WITH AN INDEPENDENT CRITERION.		5. TYPE OF REPORT & PERIOD COVERED -----
		6. PERFORMING ORG. REPORT NUMBER -----
7. AUTHOR(s) David L. Ryan-Jones		8. CONTRACT OR GRANT NUMBER(s) -----
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue, Alexandria, VA 22333		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 20762722A764
11. CONTROLLING OFFICE NAME AND ADDRESS Deputy Chief of Staff for Personnel Washington, DC 20310		12. REPORT DATE November 1979
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) -----		13. NUMBER OF PAGES 10
		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) -----		
18. SUPPLEMENTARY NOTES -----		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Subjective judgement Ratings Training Management Task Difficulty Criterion-referenced testing		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report evaluates the possibility of utilizing 'expert' ratings of task difficulty as a substitute for actual measurement or determination of task difficulty. Task difficulty information exists for only a small number of tasks in the US Army inventory of tasks. Accurate ratings of task difficulty would reduce the logistical problem of actually measuring difficulty for each task in the inventory. Expert ratings of task difficulty were compared with the results of a		

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✓ criterion-referenced test of the same tasks. There was a non-significant correlation between the expert ratings and the independent measure of difficulty. There is a need for further research into methods of improving expert ratings of task difficulty.

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A COMPARISON OF EXPERT RATINGS OF TASK DIFFICULTY WITH AN INDEPENDENT CRITERION

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**Office, Deputy Chief of Staff for Personnel
Department of the Army**

November 1979

**Army Project Number
2Q762722A764**

Training and Education

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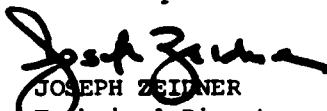
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FOREWORD

The Army Research Institute for the Behavioral and Social Sciences (ARI) maintains a field unit with the U.S. Army, Europe (USAREUR) to conduct research to meet the special needs of USAREUR and to evaluate other research projects and products under front-line operational readiness requirements, with feedback leading to modification and refinements.

Sustainment training is receiving increasing emphasis by the Army as the only viable approach to maintenance of performance of critical combat unit tasks. One of the requirements of the sustainment approach to training management is a detailed knowledge of both the rates of degradation of performance over time and the time required to train an individual on critical tasks. This information is ultimately related to some measure of task difficulty.

This report evaluates the possibility of using expert ratings of task difficulty to provide the data base on task difficulty required by the sustainment model. The research was conducted under Army Project 2Q762722A764, "Training and Education".


JOSEPH ZEINER
Technical Director

A COMPARISON OF EXPERT RATINGS OF TASK DIFFICULTY WITH AN INDEPENDENT CRITERION

BRIEF

Requirement:

To evaluate the possibility of using "expert" ratings of task difficulty to assess actual task difficulty.

Procedure:

Expert ratings of task difficulty, obtained from squad leaders and platoon leaders, were compared with Skill Qualification Test (SQT) results for soldiers at Skill Level One (SQT 2) and Skill Level Three (SQT 4). Additionally, SQT 2 results were compared with SQT 4 results as well as SQT 2 results for the SQT given five quarters later. The percent of soldiers missing the written component of a particular SQT task was used as the independent measure of task difficulty.

Findings:

There was no significant correlation between the expert ratings of difficulty and difficulty as indicated by SQT results. There was a high correlation between SQT 2 and SQT 4 results and between results for successive administrations of the SQT. The conclusion was that expert ratings of difficulty may not be representative of actual task difficulty.

Utilization of Findings:

The findings suggest that it may be necessary to investigate methods of improving expert ratings of task difficulty in order to derive ratings representative of actual task difficulty.

A COMPARISON OF EXPERT RATINGS OF TASK DIFFICULTY WITH AN INDEPENDENT CRITERION

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A COMPARISON OF EXPERT RATINGS OF TASK DIFFICULTY WITH AN INDEPENDENT CRITERION

INTRODUCTION

Training management in the US Army requires the training manager to possess detailed information regarding individual tasks for planning and scheduling purposes. This information must include task difficulty, which serves as a guide for setting priorities when planning training and as an indicator of the training time needed when scheduling training. The most common method of determining task difficulty is to ask for "expert" opinion regarding the difficulty of training an individual on a particular individual task. The expert is usually someone, such as a first line supervisor, who is thought to have an insight into the training process.

In the absence of empirical information, these experts must be considered to be making judgements about task difficulty under conditions of uncertainty. This may lead to systematic errors of judgements resulting from erroneous intuitions about the nature of the factor being judged. This means that the judges may have personal conceptions about what constitutes a difficult task, which may or may not be representative of actual difficulty (Kahneman and Tversky, 1977; Tversky and Kahneman, 1977). Expert opinion is rarely tested against an unrelated criterion measure of the factor being judged. This must be done to insure that there is an empirical foundation for such judgements of task difficulty.

PURPOSE

The research reported here was conducted to evaluate expert ratings of task difficulty. Ratings of task difficulty represent a potential data base for developing predictive models of retention for specific tasks. Such a model is needed if a sustainment approach to training is to be eventually adopted by Army battalions. The sustainment approach requires that the training manager have access to the degradation rates for all tasks on which the battalion must train. From this information the training manager can determine the training frequency on each task required to produce an acceptable level of sustainment.

Ratings of task difficulty, obtained from squad leaders and platoon leaders, were compared with Skill Qualification Test (SQT) results for soldiers in grades E1-E4. The SQT is a performance-based measure of job proficiency consisting of a number of tests of tasks which are constructed using behaviorally derived scoring standards. The SQT may have a hands-on component, a performance certification component, and a written component. The written component consists of a number of tests of tasks, each represented by a set of items designed to measure essential behaviors or steps in performing the task. The exact nature of the SQT varies with the responsibilities of the military grade, and thus skill level, of the subpopulation being tested. Research has shown that performance on written tests

correlates highly with the level of performance on actual performance tests if the written tests are criterion referenced to the same set of criteria as the actual performance test (Osborn and Ford, 1978). The SQT is criterion referenced and each task on the written component is validated against actual performance on the task (Maier and Hershfield, 1978; Osborn et al., 1977).

The results of the written component of the SQT should relate to task difficulty, with more difficult tasks being missed more frequently than less difficult tasks. This is indirectly implied in that the percent of individuals missing a question on the written component of the SQT is a direct measure of item difficulty of the particular question (Steinheiser et. al, 1978). If the item is validated as discriminating between performers and non-performers, then the item difficulty is related to task difficulty, with performance on a set of items being a relative measure of the actual difficulty of any particular task. The assertion that SQT results are representative of difficulty might not hold if soldiers were trained to a high level of performance on difficult tasks and a low level of performance on easy tasks. This would normally not be the case, since one trial performance is the US Army criterion. Additionally, there is such a variety of training methods and training priorities within the US Army that the likelihood of a systematic bias in training would be small. This would mean that in the best case all tasks would be trained to criterion, and in the worst case there would be random training of tasks to criterion (Yates, 1979). With this in mind, the written component of SQT2 was selected as the independent criterion against which the expert ratings of task difficulty were evaluated. SQT2 was selected because of the large number of soldiers and organizations represented, limiting the introduction of a systematic training bias. Also, SQT2 is for low ranking soldiers who have been in the service for a relatively short period of time. This helps to insure that over-learning on any set of tasks has not occurred, and that most soldiers do not pass most tasks.

The real advantages of using ratings of difficulty as opposed to actually measuring difficulty or obtaining SQT results are numerous. There are hundreds of tasks in the US Army inventory of tasks and the logistics of collecting data on each task is enormous. Obtaining ratings from experts is a relatively simple and low-cost process. The SQT results could provide part of the answer, but there are no SQTs yet for many Military Occupational Specialities (MOSs). Additionally, many of the tasks for any particular MOS having an SQT are never tested, leaving the data base incomplete for the MOS.

METHOD

Judgements were obtained, during a previous research effort, from sixty-eight (68) randomly selected squad leaders and platoon leaders in mechanized infantry units regarding the difficulty of eighteen (18) Skill Level One (SL1) individual tasks for E1-E4 soldiers in MOS 11B. The judges were asked to rate the difficulty of each task in terms of easy, moderately difficult and extremely difficult (Bonner, 1978). These data were transposed into a form more amenable to analysis. Using the values of easy=0, moderately difficult=50, and extremely difficult=100, the rated task difficulty was

converted into a scale of 0-100, with the category frequency serving as the weight for each value.

Each major command receives a quarterly SQT report listing the percent of men failing to pass each task on the SQT. This SQT report was obtained and data extracted for the same eighteen (18) tasks of interest for MOS 11B soldiers in grades E1-E4, and from the same population of mechanized infantry units as the squad leaders and platoon leaders. For each of the individual tasks of interest, the percent of men missing the written component task was taken as a direct measure of task difficulty. The assumption of this report is that the less the task was missed, the less difficult the task. The SQT data were derived from the written component results for 2,003 E1-E4s. Table 1 shows the category frequencies and weighted difficulty for the expert judgements, and the percent missing for the SQT data.

TABLE 1

Percent of Soldiers Missing SQT2 Task, Percent of Judgements in Each Category, and Weighted Difficulty

Task	SQT2* %Soldiers Missing	Easy	JUDGEMENTS**		Weighted Difficulty
			Moderately Difficult	Very Difficult	
071-11A-0001	51	66	30	4	19
071-11A-0150	41	66	28	6	20
071-11A-0502	26	49	41	10	31
071-11A-0511	42	66	24	10	22
071-11A-0704	25	38	43	19	41
071-11A-0705	63	44	43	13	35
071-11A-0703	47	51	40	9	29
071-11A-0801	49	81	13	6	13
071-11A-0960	53	54	28	18	32
071-11A-2003	52	82	18	0	9
071-11A-2004	52	63	33	4	21
071-11B-2006	30	69	28	3	17
071-11A-2104	46	50	43	7	29
071-11A-2401	58	57	33	10	27
071-11A-1501	73	65	29	6	21
071-11A-4402	69	71	23	6	18
071-11A-4502	37	65	28	7	21
071-11A-4503	25	37	40	23	43

*N=2,003

**N=68

r = -.375, df=16, p > .10

Since it is possible that the judges rated task difficulty in terms of their own ability and personal experience with the task, SQT written component results were obtained for SQT4 (N=349). This is the SQT that a squad leader would be expected to take. Although these data are for squad leaders, similar results could be expected from platoon leaders since they have a similar degree of competence on the tasks as squad leaders. This similar competence is due to the nature of the branch training platoon leaders receive as they complete their basic officer training. Therefore, SQT4 results should be representative of task difficulty for both squad leaders and platoon leaders. There were nine (9) written component tasks in common between SQT2 and SQT4, and seven (7) written component tasks in common between SQT4 and the difficulty ratings. These tasks, with the percent of soldiers missing the tasks, and the weighted difficulty, are shown in Table 2.

TABLE 2

Percent of Soldiers Missing Task on SQT2 and SQT4, and Weighted Difficulty

Task	SQT2* % Soldiers Missing	SQT4* % Soldiers Missing	Weighted *** Difficulty
071-11A-0001	51	41	19
071-11A-0705	62	47	35
071-11A-0960	53	51	32
071-11A-2003	52	52	9
071-11A-2104	46	38	29
071-11A-2304	88	77	no data
071-11A-2401	58	30	27
071-11A-1501	73	57	21
071-11A-4505	74	51	no data

*N=2,003

**N=349

***N=68

$r=+.774$, $df=7$, $p < .02$ (between SQT2 and SQT4)

$r=-.264$, $df=5$, $p > .10$ (between SQT4 and Weighted Difficulty)

There is also a possibility that SQT results are not stable in terms of relative task difficulty. This could result from differences in the nature or wording of particular questions on successive forms of the written component of the SQT. As a check on this stability, the SQT2 results (SQT2A) which were correlated with the ratings of task difficulty were compared with the SQT2 results for the SQT (SQT2B) given to the same population of mechanized infantry battalions five quarters later. The fourteen (14) tasks in common between the two SQTs and the percent of soldiers missing the tasks are shown in Table 3.

TABLE 3

Percent of Soldiers Missing Task on Successive Administrations of SQT2

TASK	SQT2A % Soldiers Missing	SQT2B** % Soldiers Missing
071-11A-0150	41	34
071-11A-0502	26	25
071-11A-0511	42	36
071-11A-0704	25	29
071-11A-0705	63	60
071-11A-0703	47	41
071-11A-0801	49	48
071-11A-2003	52	49
071-11A-2004	52	75
071-11B-2006	30	33
071-11A-2104	46	52
071-11A-2401	58	48
071-11A-1501	73	69
071-11A-4503	25	29

*N=2,003

**N=1,337

$r=+.854$, $df=12$, $p < .001$

RESULTS

The percent of soldiers missing the task on SQT2 and the weighted task difficulty, for each of the eighteen (18) tasks in Table 1, were correlated by the Pearson method. The correlation was found to be non-significant ($r = -.375$, $df = 16$, $p > .10$).

The percent of soldiers missing a task on SQT2 was correlated by the same method with the percent of soldiers missing the same task on SQT4 for each of the nine (9) tasks in Table 2. The correlation was significant ($r = +.774$, $df = 7$, $p < .02$).

The percent of soldiers missing an SQT4 was correlated by the same method with the weighted task difficulty for each of the seven (7) tasks in Table 2. The correlation was nonsignificant ($r = -.264$, $df = 5$, $p > .10$).

The percent of soldiers missing a task on the earlier SQT2 (SQT2A) was correlated by the same method with the percent of soldiers missing the same task on the later SQT2 (SQT2B) for the fourteen (14) tasks in Table 3. The correlation was highly significant ($r = +.854$, $df = 12$, $p < .001$).

DISCUSSION

The results indicate that the expert ratings of task difficulty may not be representative of the actual task difficulty. The low correlation ($r = -.375$, $p > .10$) between the weighted ratings of difficulty and the SQT2 results suggests that the squad leaders and platoon leaders may have been guessing at the task difficulty without relying on some common conception of just what constitutes task difficulty. This is, of course, dependent upon whether or not the written component of the SQT is representative of actual task performance. The SQT is criterion referenced and validated against actual performance, as previously mentioned. The high correlation ($r = +.854$, $p < .001$) between two administrations of the SQT, as well as the high correlation ($r = +.774$, $p < .02$) between SQT2 and SQT4, lends support to this idea and indicates that it is unlikely that the earlier SQT was unrepresentative of SQTs in general.

The possibility exists that the criteria for task difficulty utilized by the squad leaders and platoon leaders does not apply to or is not represented by the SQT2. The weighted rating of task difficulty might then be expected not to correlate with the SQT2 results, but to be representative of difficulty with respect to SQT4 only. The low correlation ($r = -.264$, $p > .10$) between SQT4 and weighted rating of difficulty suggests that this is not the case.

The negative, though insignificant, correlation between the ratings of task difficulty and SQT results for both inexperienced soldiers (SQT2, $r = -.375$) and experienced soldiers (SQT4, $r = -.264$) is interesting, and is suggestive

of a trend. This apparent trend should only be attributed to a random variance due to the nonsignificant r , but there may actually be a bias in the ratings that result in the negative correlation. The most likely reason for a trend, if such a trend exists, is that the raters tended to rate all tasks as easy regardless of the relative difficulty. The fact that many of the difficult tasks were rated as being easy suggests a lack of familiarity with difficult tasks.

The results do not imply that expert ratings cannot be used as estimates of task difficulty, but only that new methods must be devised to insure the use of relevant criteria for task difficulty across raters. Crocker et al. (1977) suggests that one of the major sources of judgemental uncertainty is a random and unpredictable environment which produces random and unpredictable information, making it difficult for a judge to discern an information pattern. This may be the case in the turbulent military environment. One possible approach to future ratings of task difficulty is to define for the rater just what factors or elements contribute to task difficulty. However, there is a problem in defining the components of task difficulty for the rater. Task difficulty can be described in terms of task complexity, and can be resolved into functional and process components. Functional complexity describes the number of sub-tasks comprising a task and process complexity the information processing requirements of a subtask (Teichner, 1974). The relevant components of the task described to the rater are inherently dependent upon the task taxonomy used to provide the terminology, and the level of detail required to enable the rater to discriminate between tasks along the dimension of difficulty. Judgemental biases of multidimensional complexity descriptions could possibly be reduced through the techniques of sensitivity analysis (Fischhoff et al., 1978).

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 1 Marine Corps Inst., ATTN: Dean-MCI
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 1 US Military Academy, West Point, ATTN: Ofc of Milt Ldrshp
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 1 Ofc of Naval Rsch, Arlington, ATTN: Code 452
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 1 NAVAIRSTA, Norfolk, ATTN: Safety Ctr
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 2 AFHRL (DOJZ) Brooks AFB
 1 AFHRL (DOJN) Lackland AFB
 1 HQUSAF (INYSO)
 1 HQUSAF (DPXXA)
 1 AFVTG (RD) Randolph AFB
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 2 AF Inst of Tech, WPAFB, OH, ATTN: ENE/SL
 1 ATC (XPTD) Randolph AFB
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 1 AFOSR (NL), Arlington
 1 AF Log Cmd, McClellan AFB, ATTN: ALC/DPCR8
 1 Air Force Academy, CO, ATTN: Dept of Bel Scn
 5 NavPers & Dev Ctr, San Diego
 2 Navy Med Neuropsychiatric Rsch Unit, San Diego
 1 Nav Electronic Lab, San Diego, ATTN: Res Lab
 1 Nav TrngCen, San Diego, ATTN: Code 9000-Lib
 1 NavPostGraSch, Monterey, ATTN: Code 55Aa
 1 NavPostGraSch, Monterey, ATTN: Code 2124
 1 NavTrngEquipCtr, Orlando, ATTN: Tech Lib
 1 US Dept of Labor, DC, ATTN: Manpower Admin
 1 US Dept of Justice, DC, ATTN: Drug Enforce Admin
 1 Nat Bur of Standards, DC, ATTN: Computer Info Section
 1 Nat Clearing House for MH-Info, Rockville
 1 Denver Federal Ctr, Lakewood, ATTN: BLM
 12 Defense Documentation Center
 4 Dir Psych, Army Hq, Russell Ofcs, Canberra
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 1 Centre de Recherche Des Facteurs Humaine de la Defense Nationale, Brussels
 2 Canadian Joint Staff Washington
 1 C/Air Staff, Royal Canadian AF, ATTN: Pers Std Anal Br
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 4 British Def Staff, British Embassy, Washington
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 1 AIR CRESS, Kensington, ATTN: Info Sys Br
 1 Militaerpsychologisk Tjeneste, Copenhagen
 1 Military Attache, French Embassy, ATTN: Doc Sec
 1 Medecin Chef, C.E.R.P.A.-Arsenal, Toulon/Naval France
 1 Prin Scientific Off, Appl Hum Engr Rsch Div, Ministry of Defense, New Delhi
 1 Pers Rsch Ofc Library, AKA, Israel Defense Forces
 1 Ministeris van Defensie, DOOP/KL Afd Sociaal Psychologische Zaken, The Hague, Netherlands