Development of a Causal Model of Processes Determining Job Performance

Article *in* Current Directions in Psychological Science · June 1992

DOI: 10.1111/1467-8721.ep10768758

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247 PUBLICATIONS **41,528** CITATIONS

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Development of a Causal Model of Processes Determining Job Performance

Frank L. Schmidt and John E. Hunter

Perhaps the most important dependent variable in industrial-organizational psychology is job performance. Until recently, the focus of research was almost exclusively on predicting job performance (and using weighted combinations of different predictors to maximize prediction), with little attention given to theory development. In recent years, this focus has changed; research has turned to understanding the psychological processes underlying and determining job performance. This change of emphasis has occurred in part because application of meta-analysis to research literatures has provided fairly precise and generalizable estimates of the validity of different measured constructs for predicting job performance and more precise estimates than previously available of correlations among predictors, such as general mental ability, job knowledge, and personality traits.[1] These advances have led to the demise of the older notion that population relations among variables were unique to each sample or study, thus limiting the development of general knowledge. The meta-analytic results have made possible the increasing application of path analysis and latent variable analysis (statistical methods for testing causal theories or models) to correlation (and covariance) matrices believed to be widely representative of those existing in the real world.

Much of the data for these studies has come from military research. For some time, time, money, and subjects have been available in the military for careful measurement of many variables on large samples or large numbers of smaller samples. As research has progressed, additional variables have been included in these causal models, further expanding our understanding. The emerging picture of the causal processes underlying job performance differs in noteworthy ways from older thinking and has important theoretical and applied implications.

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INITIAL STUDIES

The first study in this research tradition[2] examined a causal model that included general mental ability, job knowledge, job performance capability, and composite supervisory ratings of job performance. General mental ability was measured using standardized group intelligence tests; job knowledge was assessed by content-valid written measures of knowledge of facts, principles, and methods needed for job performance; and job performance capability was measured using work samples that simulated or reproduced important tasks from the job, as revealed by job analysis. Specific aptitudes (such as verbal, quantitative, and spatial ability) were not measured; meta-analytic research has shown that including such narrow aptitudes rarely results in better prediction of job performance than pre-

diction based on general mental ability alone.[3] The correlations among these constructs used in the path analyses were the result of meta-analysis of all available studies in the cumulative literature and were corrected for the attenuating effects of measurement error. Total sample size varied from 1,474 to 3,264. Separate analyses were conducted for military and civilian studies.

Personnel psychologists and employers had been using mental ability measures to predict future job performance of job applicants since the early part of this century, and many studies, including numerous meta-analyses in recent years, had shown substantial predictive validity for general mental ability. An important finding in this study (which held for both military and civilian data) was that the major causal impact of mental ability was *not* on performance capability (work sample performance), but rather on the acquisition of job knowledge. What appears to happen is this: People with higher mental ability acquire more job knowledge, and job knowledge, in turn, is the major determinant of work sample performance. The indirect effect (through increased job knowledge) of mental ability on work sample performance was quite large in this study—more than twice as large as its direct effect. These findings shed light not only on the mechanism by which ability affects performance, but also on the important role of job knowledge. Job knowledge was found to be the most important direct determinant of performance capability.

Another important question concerns the determinants of supervisory ratings of job performance. In both the military and the civilian data sets, the major determinant was found to be not work sample performance, but job knowledge. The impact of job knowledge on ratings was 1.5 times and 3 times as great as that of work sample performance in the civilian and military data sets, respectively. Such a pattern might be expected if supervisors have greater opportunities to assess subordinates' job knowledge (e.g., in conversations) than to observe actual job performance, and if this discrepancy is greater in the military than in the civilian sector.

THE ROLE OF EXPERIENCE ON THE JOB

Ever since the early days of scientific psychology, learning has been an important focus of research. In the work setting, opportunity to learn is measured by amount of experience on the job; that is, time on the job is taken as a measure of practice. Psychologists have generally found that learning curves are nonlinear: Gains in proficiency are more rapid early in practice, with the rate of gain decreasing with increasing practice (negatively accelerated monotonic curves). The same general relation has been found between experience on the job and (a) work sample performance, (b) job knowledge, and (c) supervisory ratings of job performance. However, the relationship appears to be linear out to at least 5 years,[4] thus allowing the use of linear statistical methods and models up to that point.

Job experience was the next major variable to be introduced into the causal model. Based on a sample of nearly 1,500 people from four different military jobs, this next study[5] replicated the findings already described. It also found that job experience operates in a manner similar to mental ability. That is, the major causal impact of job experience is not on work sample performance, but rather on the acquisition of job knowledge. Increases in job experience lead to rapid increases in job knowledge, which in turn lead to improvements in work sample performance. The direct effect of job experience on work sample performance (.18) was only about half as large as its indirect effect through increased job knowledge (.38). These findings suggest that learning (as assessed by job experience) plays an important role in determining individual differences in job performance in the early years on the job. It is important to remember that the effects of learning were assessed in a way that controlled for the effects of ability.

If a group of individuals were to begin a job new to them at the same time, then there would be no experience differences and experience could not have an effect on individual differences. This situation was simulated statistically by partialing job experience out of all the correlations and then applying path analysis to the resulting partial correlations. Under these circumstances, the impact of ability differences on the acquisition of job knowledge and (to a lesser extent) on work sample performance increased (a 22% increase for job knowledge and a 13% increase for work sample performance). When individuals do not differ in experience, ability differences become more important in determining individual differences in performance. Students in elementary and high school, for example, may be in essentially this situation. We hypothesize that this same pattern of heightened causal impact for ability differences will apply in situations in which individuals initially unequal in job experience (as in this study) become relatively less unequal as job experience increases for all. For example, we would expect this pattern to hold for the subjects in this study if all remained on the job an additional 10 to 20 years.

RECENT STUDIES

The subjects in this study were incumbents in nonsupervisory jobs in the U.S. Army (e.g., armor repair-

men, supply specialists). A second study tested this process model in a group of 570 first-line supervisors in nine Army jobs,[6] with the data again being integrated across jobs using meta-analysis. The same general pattern of causal relationships was found, but with some differences. The most important was that the direct impact of ability on work sample performance was relatively larger among the supervisors. Supervisory jobs are usually less well defined and require more direct problem solving and improvisation than nonsupervisory jobs; these job characteristics may increase the direct causal impact of ability on performance. Nevertheless, the impact of ability on supervisory job knowledge was still twice as large as the impact of ability on work sample performance (vs. over 5 times as large for the nonsupervisors in the earlier study). Also, among supervisors, job experience appeared to have a smaller impact on job knowledge than for nonsupervisors, meaning that the *relative* causal impact of ability on job knowledge was greater for supervisors. As in the earlier study, managers based their ratings of job performance more heavily on job knowledge than on task proficiency as measured by job sample performance. These findings might be used to argue that greater emphasis should be placed on ability in hiring supervisors than in hiring subordinates.

Up to this point, ability was the only psychological trait incorporated into the causal model. Although personality and temperament measures have traditionally done a poor job of predicting job performance, recent meta-analytic research has shown these earlier findings to be artifactual in part and has presented substantial evidence that the personality trait of Conscientiousness (also called Dependability and Will to Achieve) correlates substantially with job performance.[7] Employees scoring high on Conscientiousness are described as careful, thorough, dependable, responsible, hardworking, organized, and planful. There is some emerging evidence that integrity and "honesty" tests, used by numerous employers today (especially for entry-level hiring), may measure the low end of what may be a very broad trait of Conscientiousness.[8] Further, there is now substantial evidence supporting the validity of some integrity tests as predictors of both job performance ratings and counterproductive job behaviors, such as excessive absences, tardiness, malingering, deliberate equipment damage, drug abuse, disciplinary infractions, and theft.[9]

A recent large-scale causal analysis based on meta-analytically derived correlations from 4,362 Army personnel in nine jobs included two measures of Conscientiousness: a Dependability measure and an Achievement Orientation measure.[10] Dependability was found to have a direct effect on supervisory ratings of job performance. In addition, it had two indirect effects. First, people higher in Dependability developed higher levels of job knowledge (independent of the effects of ability), which in turn led to better performance on the work sample, which in turn caused higher supervisory ratings. Second, people higher in Dependability had fewer disciplinary actions taken against them, and this in turn led to higher supervisory ratings of performance. Achievement Orientation also had a direct impact on supervisory ratings. In addition, it had one indirect effect: People higher in achievement motivation received more awards and commendations, and this in turn led to higher supervisory ratings of job performance. (Awards were given by *earlier* supervisors, not by those assigning job performance ratings.) However, Achievement Orientation had no effect, direct or indirect, on work sample performance.

Thus, both aspects of Conscientiousness were found to have important direct and indirect process effects. Indeed, we believe that Conscientiousness may eventually come to be viewed as the most important trait motivation variable in the work domain. (*State motivation,* motivation induced by incentives, goal setting, and other motivational programs, is a separate phenomenon and is important in its own right.) The two aspects of Conscientiousness examined in this study are highly correlated, and we believe it would probably be theoretically appropriate to combine them into a single measure.

In addition to adding new variables, this study differed from those described earlier in one of its findings: Performance capability (task proficiency as measured by the job sample) was a more important determinant of supervisory ratings than was job knowledge. In the jobs studied in this case, the supervisors worked closely with the subordinates, often performing the same tasks. Thus, the supervisors had almost constant opportunities to observe actual job performance. How frequent situations of this sort are in the world of work is unknown. Finally, previous findings indicating that mental ability is a strong determinant of the acquisition of job knowledge and that job knowledge, in turn, has a major impact on task proficiency were replicated in this study.

IMPLICATIONS

The research described here moves personnel psychology beyond the blind empirical search for correlates and predictors of job performance and toward an understanding of the psychological processes and mechanisms that determine the wide variation in job performance that has long been ob-

served and measured for all jobs studied. Based on studies of workers' output in jobs of many kinds and levels, this variation has recently been formally quantified and shown to be very large.[11] On a typical lower level job (i.e., an unskilled job), a worker at the 85th percentile in performance produces about 20% more than the average worker. On the typical medium-complexity job (e.g., clerical supervisor), this figure is 32%. For professional and managerial jobs, it is about 48%. Thus, improvements in selection, placement, and training that findings from the sort of research described here may make possible could lead to large and economically significant improvements in output and economic competitiveness. From a theoretical point of view, this research suggests that the central determining variables in job performance may be general mental ability, job experience (i.e., opportunity to learn), and a broad trait of Conscientiousness. Based on the findings described here and related findings, we are currently attempting to formulate a theory of job performance that we hope will stimulate further research and understanding.

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Positron Emission Tomography in Psychiatric Illness

Susan M. Resnick

Advances in neuroimaging over the past 10 years have provided the opportunity to examine the structure and function of specific brain regions in relation to behavior. Both normal variation and brain abnormalities in a variety of psychiatric disorders have been studied.

IMAGING METHODS

Brain structure is measured by computed tomography (CT) or magnetic resonance imaging (MRI). MRI is preferable for psychiatric applications because it provides exquisite anatomic detail without radiation. Current volumetric imaging protocols achieve 1-mm resolution in less than 15 min of scanning time. Representative MRI sections illustrating selected brain regions of importance in psychiatric disorders are presented in Figure 1.

Magnetic resonance techniques have also been utilized in a limited way to obtain physiologic information in mental illness. For example, magnetic resonance spectroscopy (MRS) provides in vivo measures of tissue biochemistry, including metabolites and energy requirements, and new developments combining MRI and MRS hold much promise

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Published by Cambridge University Press