Journal of Applied Psychology
1999, Vol. 84, No. 2, 260–270

0021-9010/99/$3.00

Meta-Analysis, Level of Analysis, and Best Estimates of Population Correlations: Cautions for Interpreting Meta-Analytic Results in Organizational Behavior

Cheri Ostroff
Arizona State University

David A. Harrison
University of Texas at Arlington

Meta-analytic procedures allow for determining best estimates of the individual-level, the within-organization, and the organizational-level population correlations. In most validity generalization work, meta-analytic procedures have been used to provide best estimates of the within-organization correlation. However, in many other organizational domains, researchers often do not clearly specify which population parameter is of interest. Further, researchers often combine studies in which data were collected at different levels of analysis or with mixed (single- and multiple-organization) sampling schemes, making it difficult to interpret unambiguously the meta-analytic $\hat{\rho}$. The authors focus on how to make appropriate inferences from meta-analytic studies by integrating a levels-of-analysis framework with meta-analytic techniques, highlighting how meta-analytic procedures can aid researchers in better understanding multilevel relationships among organizational constructs. The authors provide recommendations for clearer specifications of populations and levels issues in future meta-analytic studies.

Since the late 1970s, two prominent trends in organizational research have been the advancement of meta-analytic procedures and the understanding of levels-of-analysis issues (Katzell & Austin, 1992). Following Hunter and Schmidt's approach of cumulating correlations (e.g., Hunter & Schmidt, 1990), researchers using meta-analytic techniques have begun to answer long-standing substantive questions in applied psychology. Applications of meta-analyses have expanded from the initial focus on selection test validity (e.g., Schmidt & Hunter, 1977) to a broader variety of domains (Hunter & Schmidt, 1990). For example, meta-analytic estimates have been used in court cases (e.g., *Pegues v. Mississippi State Employment Service,* 1980), utility analyses (e.g., Hunter & Hunter, 1984; Schmidt, Mack, & Hunter, 1984), path analyses (e.g., Hom, Caranikas-Walker, Prussia, & Griffeth, 1992), and for estimating bivariate relationships between industrial–organizational (I/O), organization behavior (OB), and human resource (HR) constructs (e.g., Iaffaldano & Muchinsky, 1985). Given the wide-reaching financial, practical, and scientific consequences that arise from interpretations of meta-analytic results, it is critical that researchers use these procedures appropriately and draw correct inferences from their results.

At the same time that meta-analytic procedures were being refined and applied, researchers began to shift their attention from focusing almost exclusively on characteristics of individuals and their immediate job requirements to understanding interdependencies among characteristics of individuals, groups, and organizations (Katzell & Austin, 1992; Roberts, Hulin, & Rousseau, 1978). Increasing effort was directed at exploring how organizational characteristics influence individual responses and how relationships among variables operate at the individual, group, and organizational levels of analysis (e.g., Dansereau, Alluto, & Yammarino, 1984; Klein, Dansereau, & Hall, 1994; House, Rousseau, & Thomas-Hunt, 1995; Rousseau, 1977, 1985). The "levels" framework has highlighted a need to examine the (in)consistency of connections within and between different levels. Cross-level and multilevel empirical research has been surging (House et al., 1995). Different relationships at different levels have been demonstrated by a number of researchers working in a variety of content areas (e.g., Angle & Perry, 1981; George & James, 1993; Schneider & Bowen, 1985; Vancouver & Schmitt, 1991). Further, researchers have shown that the relationship between variables is often not the same when individuals are examined within the same organization compared with when

Cheri Ostroff, Department of Management, Arizona State University; David A. Harrison, Department of Management, University of Texas at Arlington.

We are grateful for the helpful comments provided by Paul Sackett and Frank Schmidt on an earlier version of this article.

Correspondence concerning this article should be addressed to Cheri Ostroff, Department of Management, Arizona State University, P.O. Box 874006, Tempe, Arizona 85287-4006. Electronic mail may be sent to cheri.ostroff@asu.edu.

individuals are examined across different organizations (e.g., Dansereau et al., 1984; Ostroff, 1992; Ryan, Schmit, & Johnson, 1996; Yammarino & Markham, 1992).

The overarching purposes of this article are to establish the basic elements of an integration of meta-analysis and levels of analysis and to show how misinterpretations of accumulated effect sizes can occur when levels are not considered. To illustrate, suppose one is interested in the correlation at the individual level between task autonomy (Hackman & Oldham, 1976) and organizational citizenship behavior (OCB; Bateman & Organ, 1983). Independent researchers could examine the relationship between autonomy and OCB by (a) correlating individual-level measures of the two constructs in a sample drawn from within a single organization, (b) correlating individual-level measures of the two constructs in a broader sample drawn from multiple organizations, or (c) correlating organization-level aggregates of the two constructs (e.g., organizational means) in a sample of individuals drawn from multiple organizations.

Each of these different data collection strategies has implications for the conclusions one could draw from a meta-analytic application. For example, if a researcher conducting a meta-analysis combined findings of studies that had used only the first strategy (a), would he or she draw the same conclusions if the studies collected had used the second strategy (b)? In the presence of 100% of the variance in correlations accounted for by artifacts, is the meta-analytic $\hat{\rho}$ an estimate of some universal parameter—*the* population correlation—or does the interpretation of the estimate depend on levels-of-analysis issues? Is it possible to correctly interpret a meta-analytic $\hat{\rho}$ obtained from combining studies that have used different sampling strategies (e.g., combining studies conducted within single organizations with studies conducted across organizations) or that have collected data at different levels of analysis (e.g., combining studies in which data were collected at the individual level with studies in which data were collected at the organizational level)? Each of these questions is addressed below.

Before turning to these issues, it is important to note that we are not claiming meta-analytic techniques per se are problematic. Rather, we focus on the application and interpretation of these techniques and how their use can lead to erroneous conclusions unless both the level of the estimated population correlation is carefully specified and original studies are identified that contain the appropriate levels-based components of variance to estimate that population correlation. For example, we note that meta-analytic researchers in the validity generalization area have generally attended to levels of analysis in their investigation of the situational specificity hypothesis (e.g., Schmidt & Hunter, 1984; Schmidt, Hunter & Caplan, 1981). Yet researchers conducting meta-analyses in many OB areas have not attended to levels when aggregating studies in which data were collected at different levels or with different sampling schemes, thereby making it difficult to interpret the ensuing meta-analytic $\hat{\rho}$ as an estimate of any population parameter. Given the importance placed on meta-analytic results as the basis of cumulative knowledge, it is critical that any meta-analysis be conducted so that the results do indeed provide the best estimate of a level-specific correlation in the population, and that conclusions appropriately reflect such levels.

We initially explore these issues by comparing components of a population correlation formula in the context of current meta-analytic techniques. We then demonstrate the importance of recognizing levels-of-analysis issues by reanalyzing data from a published meta-analysis. Finally, we provide suggestions for conducting both primary studies and meta-analyses, and we establish some of the boundary conditions for being able to integrate meta-analytic and levels-of-analysis conclusions within a research domain.

Levels of Analysis and Algebraic Relations Among Correlations

The levels-of-analysis literature (Dansereau et al., 1984; Klein et al., 1994; Ostroff, 1993) has clearly demonstrated that within-organization correlations can differ substantially from the total correlation of individuals across organizations and from the correlation of aggregated individual scores across organizations. To illustrate, consider again the correlation between measures of autonomy and OCB involving individual employees from different organizations. Individual scores within each organization can be aggregated to represent the bivariate organizational mean or centroid for autonomy (x) and OCB (y). Three interrelated "levels" of correlations can then be examined: (a) the *individual correlation,* between all individual x and y scores, (b) the *correlation-within,* between x and y across individuals within an organization, and, (c) the *organizational correlation,* between the aggregated x and y scores across organizations.[1] Each of these is assumed to be a single parameter, not a statistical average of several parameters (i.e., $\rho_{xy|uv}$ is a single value, not the mean of k different values for different firms).

Expanding on the work of Robinson (1950), Ostroff (1993) detailed the nature of the relationship between correlations at different levels of analysis. The components of the individual-level population correlation can be expressed as:

$$\rho_{xy} = \rho_{xu}\rho_{yv}\rho_{uv} + \sqrt{1-\rho^2_{xu}}\sqrt{1-\rho^2_{yv}}\rho_{xy|uv}, \quad (1)$$

where x = value of variable x for individual i in organization i; y = value of variable y for individual i in organization i; u =

[1] Klein et al. (1994) used the terms *individual* and *group* to refer to any two adjacent levels of analysis. Earlier methodological articles (e.g., Ostroff, 1993) used the terms *individual* and *organizational.* We use *individual* and *organizational.*

aggregated or mean value of x for all individuals in organization i; v = aggregated or mean value of y for all individuals in organization i; ρ_{uv} = organizational correlation between aggregated x and y (u and v); $\rho_{xy|uv}$ = correlation-within, the correlation between x and y, controlling for u and v.

$$\rho_{xu}=\frac{\sigma_u}{\sigma_x}=\sqrt{1-\frac{\sigma^2_{i_x}}{\sigma^2_x}} \quad (2)$$

eta for x, variance ratio of between to total variance for x

$$\rho_{yv}=\frac{\sigma_v}{\sigma_y}=\sqrt{1-\frac{\sigma^2_{i_y}}{\sigma^2_y}} \quad (3)$$

eta for y, variance ratio of between to total variance for y

where σ^2_x = total variance of x across all individuals; σ^2_y = total variance of y across all individuals; σ^2_u = variance-between for x—variance of the aggregate u scores; σ^2_v = variance-between for y—variance of the aggregate v scores; $\sigma^2_{i_x}$ = variance-within for x—variance of individual deviations from the mean of their organization on x; $\sigma^2_{i_y}$ = variance-within for y—variance of individual deviations from the mean of their organization on y.

The terms of Equation 1 can be rearranged to express population formulations for the correlation-within and organizational correlation (see Ostroff, 1993).[2] For further clarity, Figure 1 shows four potential configurations of these levels-based population correlations (see Klein et al., 1994; and Ostroff, 1993, for examples of other configurations).

Figure 1A displays a near-zero (population) correlation-within, which is clearly smaller than the (population) individual and organizational correlations. Within each organization, autonomy differences between individuals have negligible consequences for OCB. A form of organizational-level norms or policies that encourages or discourages OCB carries nearly all of the individual-level relationship, as evidenced by the organizational differences in OCB means and the stronger organizational-level correlation.

Figure 1B depicts a high correlation-within, higher than both the individual correlation and the organizational correlation. In such a case, the relationship within a single organization between individuals' task autonomy and their enactment of OCB is strong, but the relationship is weak across organizations and for all individuals across organizations. Here, individual deviations in autonomy from the organizational norm are more consequential for OCB than differences in overall levels of autonomy across organizations, although both the within and between sources of variation are important.

Figure 1C presents a special case of the scenario in Figure 1B, with a switch in the direction of relationships; the correlation-within has a different sign than the individual correlation. For individuals within a single organization there is a negative relationship, whereas for individuals across organizations (individual correlation) the relationship is positive. Here, some third variable has the effect of altering the relationship between autonomy and OCB within the organization. For example, those with more autonomy relative to their peers within an organization could be ostracized, and hence be less willing to engage in OCB. However, organizations that allow greater autonomy among their employees overall might also have policies that promote greater use of OCB (e.g., Huselid, 1995; Pfeffer, 1995).

Finally, Figure 1D shows equivalent correlations at all levels. Differences between organizations have consequences that are identical, in terms of the magnitude and direction of the relationship, to differences between individuals within the same organization. As shown in the following sections, when applied appropriately, meta-analytic applications, particularly those that incorporate a levels-based moderator, can elucidate these different types of relationships.

Meta-Analysis and Levels of Analysis

Many meta-analytic $\hat{\rho}$s in the OB literature are based on an n-weighted average of correlations taken from original studies done within single organizations. Likewise, the population correlation-within is estimated by first computing a correlation between the x and y scores within each of many organizations and then computing an n-weighted average of these within-organization correlations (assuming a single $\rho_{xy|uv}$ value; Dansereau et al., 1984; Finn, 1974). Hence, the meta-analytic $\hat{\rho}$ derived from cumulating a set of studies of within-organization samples represents the best estimate of the population correlation-within. However, as can be seen in Equation 1 and Figure 1, the population correlation-within may be quite different from the population individual-correlation (also see Ostroff, 1993).[3]

Appropriate Interpretation of Meta-Analytic Correlations

A meta-analytic $\hat{\rho}$ that reflects the correlation-within should be interpreted as the correlation that would be ex-

[2] This formulation can be likened to an analysis of variance (ANOVA) or to a linear variances components model such as generalizability theory (Brennan, 1992; Cronbach, Gleser, Narda, & Rajartnam, 1972). It is different, however, in that it deals with relations among true scores at the population level, whereas a major emphasis of generalizability treatments is on sources of measurement error. One way to consider Robinson's (1950) equation is that it represents a nested ANOVA model. Individuals are nested within organizations. Therefore, $\sigma_x^2=\sigma_u^2+\sigma_{ix}^2$ and $\sigma_y^2=\sigma_v^2+\sigma_{iy}^2$, where individuals ($i$) are nested within and represent deviations from their respective organizational means (u on x, and v on y). In the overall equation, not only can the individual deviations covary, i_x can covary with i_y, and the organizational means can covary as well (u can covary with v).

[3] The formula for the sampling variance of the meta-analytic correlation is the same for the individual and within correlation. We focus on the mean effect size as the more important statistic than

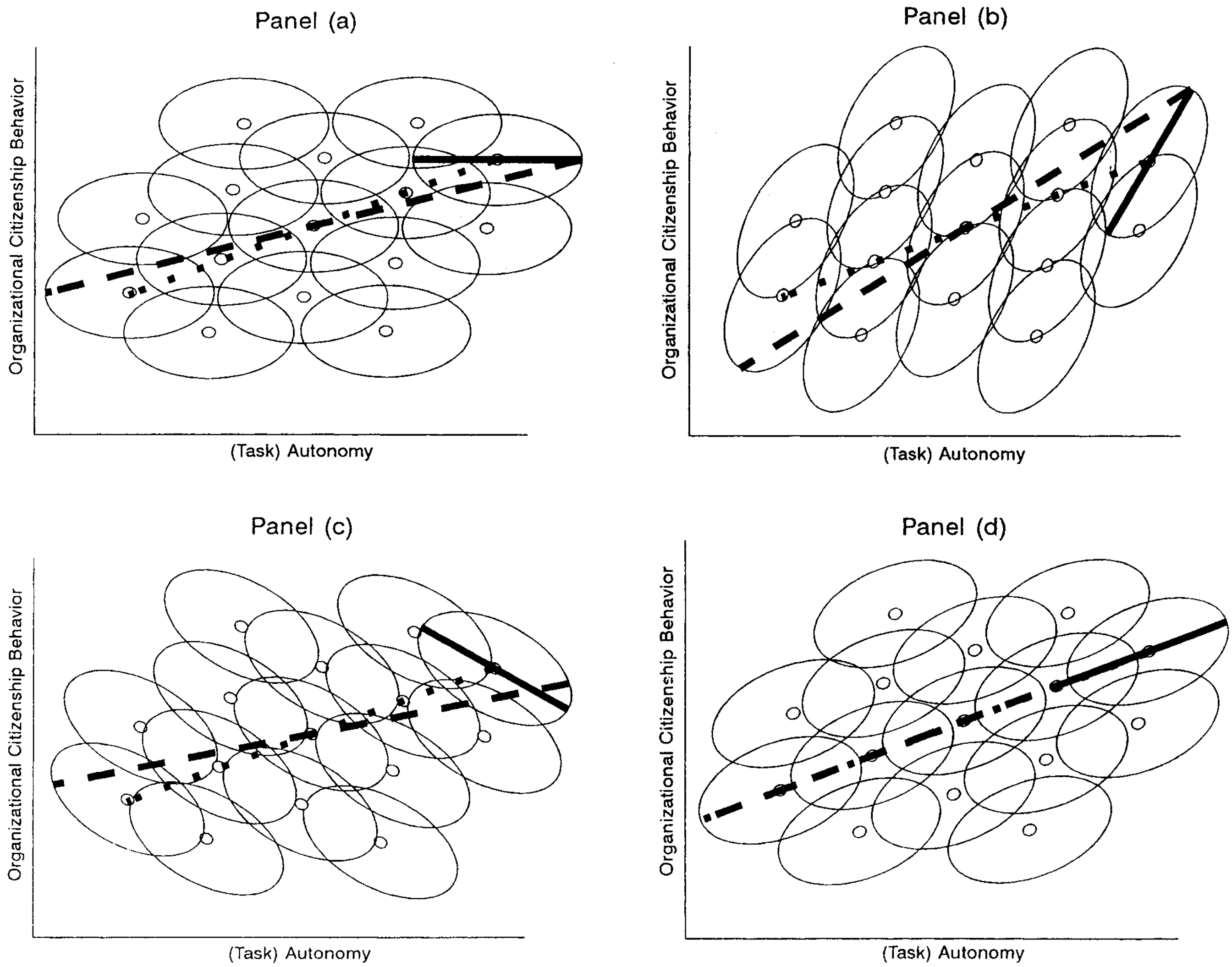

Figure 1. Panel A: Situation in which the correlation within is weaker than the individual correlation and organizational correlation. Ovals represent scores for individuals within one organization; dots within ovals represent aggregate organizational scores (organizational centroids). Solid line represents the population correlation within; dashed line represents the population individual correlation; dotted line represents the population organizational correlation. Panel B: Situation in which the correlation within is stronger than the individual correlation and the organizational correlation; the organizational correlation is stronger than the individual correlation. Panel C: Situation in which the correlation within is negative; the individual correlation and organizational correlation are positive. Panel D: Situation in which the correlation within, individual correlation, and organizational correlation are equal.

pected in another single organization, rather than the degree of relationship between the two constructs for an overarching or larger population of employees. Meta-analytic studies in the validity generalization area have generally interpreted such meta-analytic $\hat{\rho}$s appropriately. Schmidt, Hunter, and their colleagues demonstrated that variations in observed validity coefficients were due primarily to sampling error and other methodological artifacts (e.g., Hunter, 1980; Schmidt, Gast-Rosenberg, & Hunter, 1980; Schmidt & Hunter, 1977; Schmidt, Hunter, Pearlman, & Shane, 1979). These studies and subsequent investigations in validity generalization (e.g., Schmidt & Hunter, 1984; Schmidt, Hunter, & Caplan, 1981) indicated that meta-analytic correlations could be generalized to an entire set of tests, jobs, organizations, or test–job–organization combinations. In these

variability in effect sizes when comparing estimates for different levels. Regardless, meta-analytic researchers should attend to the determining the most appropriate analytic methods that are best suited for handling different sorts of correlations at different levels.

meta-analyses, nearly all studies were conducted within a single organization; the results of the analysis indicated that the meta-analytic $\hat{\rho}$ could be used as an appropriate estimate of the validity to be expected in a different organization or context.

Mitra, Jenkins, and Gupta's (1992) meta-analysis of absenteeism and turnover provides a second example of correct interpretation. The authors noted that conclusions cannot be drawn about relationships at organizational, industrial, or other levels because their database focused on individual-level studies. However, these researchers did not evaluate whether within-organization and total individual-effects differ.

Mixed Levels and Inappropriate Interpretations

Researchers conducting meta-analyses in many OB domains often cumulate studies in which the data have been collected at different levels or with mixed (within-organization and between-organization) samples. Some studies have cumulated data from the individual-level and organizational level (cf., Fried, 1991; Saunders, Driskell, Johnston, & Salas, 1996; Steel & Ovalle, 1984). Others have cumulated studies in which data for some studies were drawn from within-organization samples and data from other studies were drawn from across-organization samples (cf. Brown, 1996; Carsten & Spector, 1987; Cohen, 1993; Cotton & Tuttle, 1986; Farrell & Stamm, 1988; Fried & Ferris, 1987; Hackett & Guion, 1985; Iaffaldano & Muchinsky, 1985; Jackson & Schuler, 1985; Johns, 1994; Loher, Noe, Moeller, & Fitzgerald, 1985; Mathieu & Zajac, 1990; Mitra et al., 1992; Organ & Ryan, 1995; Peters, Hartke, & Pohlmann, 1985; Randall, 1990; Scott & Taylor, 1985; Shikiar & Freudenberg, 1982; Steel & Ovalle, 1984; Tait, Padgett, & Baldwin, 1989; Tett & Meyer, 1993; Wanous, Poland, Premack, & Davis, 1992; Wanous, Reichers, & Hudy, 1997; Wofford & Liska, 1993). The resulting $\hat{\rho}$ in these cases is not a best estimate of any population parameter: the individual correlation, organizational correlation, or correlation-within. There is no accurate theoretical description for a parameter that combines correlations from different levels.

Further, some researchers have implicitly or explicitly interpreted their meta-analytic $\hat{\rho}$ (when statistical artifacts explain the observed variation across studies) as the best estimate of the true correlation between the two variables for the *entire population* of individual employees. For example, Iaffaldano and Muchinsky (1985) focused their discussion on the value of high job satisfaction and productivity for the U.S. workforce. Tait et al. (1989) discussed their results in terms of the population of male and female workers.

A demonstrable problem in such cases is the failure to explicitly consider which population parameter is of interest at the outset of the analysis. The meta-analytic $\hat{\rho}$ would indeed be the best estimate of the individual-level population correlation if studies used in the meta-analysis contained samples that had been selected so that they were representative of the entire population of individuals. However, most investigations include a sample from within a single organization, industry, region, and culture. For example, more than half of the empirical field studies published in the *Journal of Applied Psychology* from 1992 to 1997 were conducted within a single organization. In such cases, organizational, industrial, regional, and cultural sources of variance and covariance in x and y are missing (see Steel & Griffeth, 1989 for an exploration of this higher-level variance issue in turnover research).

To illustrate, assume the true correlations between task autonomy and OCB are those represented in Figure 1C. Also assume that a number of studies were conducted within organizations and observed correlations were obtained. Because of sampling error, measurement error, and other artifacts, the observed within-organization correlations will vary. Proper application of meta-analytic procedures would show that the variance in observed corrected validities was due to these artifacts. Further, the meta-analytic results could produce an estimate (after corrections) that is close to or identical to the population correlation-within presented in Figure 1C. Yet, this best estimate of the $\rho_{xy|uv}$ (correlation-within) would not be the best estimate of the individual-level population correlation, ρ_{xy}. The true correlation-within is negative and the true individual-level correlation is positive. In such a case, a typical search for moderators using meta-analytic techniques would not pick up the effect as the same degree of relationship holds for each organization. The correct and valuable interpretation is that little change in the relationship between the two variables would be expected within another organization.

However, there is an important distinction between lack of situational specificity and lack of an organizational-level effect. To illustrate, first consider Figure 1A. Here, a meta-analysis composed or based on studies conducted within single organizations would result in a very low meta-analytic $\hat{\rho}$ and no situational moderator would be found. It would be inappropriate to interpret this meta-analytic $\hat{\rho}$ as indicating that the relationship between the variables is unimportant for organizations. Because there are meaningful differences between organizations on both variables, and there is meaningful covariance at the organizational level, some other effect or a third organizational-level variable is operating that causes the correlation-within to be muted. Such an effect does not mean that the degree of relationship will vary from one organization to another, but rather that at the organizational and overall individual levels, there are meaningful relationships between the variables. Conventional moderator analysis, when applied to within-organization samples, can only detect situational influences that have the effect of altering the relationship within organizations such that some subsets of organizations have the same correlations and others have different correlations. This is depicted in Figure 2 in which there is a positive relationship between autonomy and OCB in half of the organizations, and there is no relationship in the other half.

We argue that it is inappropriate to pool studies from multiple levels of analysis in a meta-analysis. Yet an important question that arises is whether these organizational or higher-level sources of covariance are indeed an issue (e.g., Figures 1A–1C) or whether most individual, within, and organizational correlations will be the same (e.g., Figure 1D). If the former is true, then levels become critical in applications of meta-analysis. If the latter is true, then meta-analysis need not consider levels issues.

The Correlation-Within Relative to the Individual Correlation

From the set of equations above, it is clear that the population values of the correlation-within and the individual correlation can vary substantially. By focusing on the components that constitute the correlations, Ostroff (1993) demonstrated the conditions under which different values would be obtained for the correlation-within and individual correlation. There are only two cases when the correlation-within will equal the individual correlation. First, when $\rho_{xu} = \rho_{yv} = 0$, the variance ratio (within to total) is 1, indicating that variance within any organization is the same as total variance for the variables of interest. In this situation there are no differences between organizations in mean scores for the variables, and the organizational correlation is zero. Equation 1 reduces to $\rho xy = 0 + 1(1)(\rho_{xy|uv})$ and the individual correlation equals the correlation-within.

The second situation that produces a correlation-within identical to the individual correlation is when the organizational correlation equals the individual correlation, regardless of the variance-within ratio. Here, the individual correlation, organizational correlation and correlation-within will all be the same regardless of whether or not the variance within organizations is smaller or "constrained" relative to the total variance (see Figure 1D). This situation is one in which the same processes are operating at the same strength for individuals within a firm and for all social aggregates up to the organizational level.

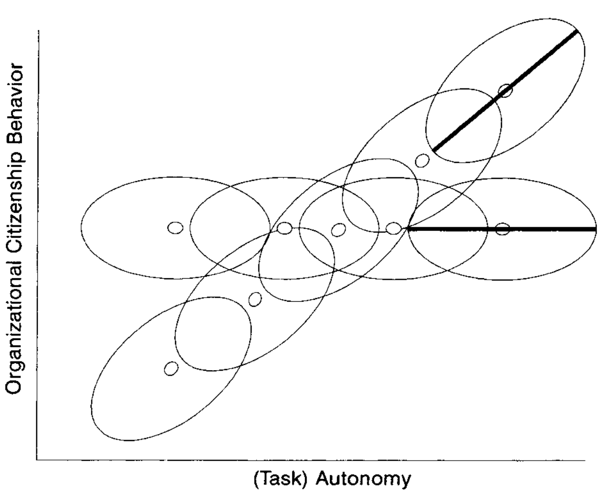

Figure 2. Situation in which the correlation within differs over a third moderator variable.

On the basis of the results of mathematical analyses (Ostroff, 1993), cases in which the population correlation-within will be equivalent to the population individual-correlation are somewhat limited. Hence, meta-analytic researchers should not assume that a meta-analytic $\hat{\rho}$ based on within-organization samples will be the best estimate of the overall individual correlation. Nevertheless, one still might question if the scenarios depicting differences at different levels are relevant for the types of issues studied in our field.

Relevant Content Domains

For different relationships to be found at different levels of analysis, two conditions must exist: (a) between-organization differences, and (b) a third (unmeasured) effect operating that alters either the correlation-within relative to the individual correlation, or that alters the variance-within ratio for one variable more than another (Ostroff, 1993). With respect to the first condition, both theory and evidence support the notion that systematically different subgroups of individuals are attracted to, selected for, and leave from different jobs and organizations (e.g., Lindsley, Brass, & Thomas, 1998; Sackett & Ostgaard, 1994; Schneider, 1987). Mean differences between organizations or groups have been demonstrated in a wide variety of areas such as abilities (e.g., Sackett & Ostgaard, 1994), attitudes (e.g., Angle & Perry, 1981), climate (e.g., Schneider & Bowen, 1985), affect and personality (e.g., George, 1990; Schneider, Smith, Taylor, & Fleenor, 1998), goals (e.g., Vancouver & Schmitt, 1991), and role stresses (Peterson et al., 1995). Differences in means, and lower standard deviations within (versus across) organizations are substantive phenomena, not artifacts or errors (Klein et al., 1994; George & James, 1993).[4] With respect to the second condition, differences in relationships among variables at different levels of analysis have been demonstrated in many OB areas (e.g., Angle & Perry, 1981; Burke, Rupinski, Dunlap, & Davison, 1996; Dansereau et al., 1984; George & James, 1993; Hofmann & Stetzer, 1996; House et al., 1995; Klein et al., 1994; Ostroff, 1992; Vancouver & Schmitt, 1991).

[4] Given a set of studies in which data are collected from individuals within organizations, there are only two situations in which

We argue that different relationships at different levels are most likely to occur when there is a dominant social or normative component operating within the organization, such as a strong culture, climate, or normative expectation. It is less likely that one would detect different relationships at different levels of analysis in studies focusing on abilities or on broad skills and competencies, as social and normative components might be less likely to influence such persistent characteristics of individuals. Organizations with powerful norms and roles can magnify and blunt individual-level processes (Staw & Sutton, 1992), and the aggregate of individual beliefs, emotions, behaviors, and other psychological attributes of employees may influence organization-level operations and processes (e.g., Harrison & Shaffer, 1994; Nicholson & Johns, 1985). Further, the attraction–selection–attrition process results in an organization that will be comprised of people with similar personal characteristics such as goals, values, needs and personality dimensions, but will create variance in such personal characteristics between organizations (Schneider, 1987). Hence, in research on the beliefs and cognitive, emotional, social, and behavioral processes of employees, different processes are likely to operate at different levels of analysis. In meta-analyses of relationships involving such variables, the organizational, individual, and within-organization correlations cannot all be assumed to be equal. However, meta-analysis can help to locate if and when levels-based differences are operating, as we outline in the next section.

An Illustration of Addressing Levels Issues Through Meta-Analysis

There are several requirements for applying Equation 1 to estimate the individual-level population correlation. The correlation-within must be obtained for each organization (study) that is being cumulated. The mean and standard deviation for each organization (study) must be obtained so that the organizational correlation and ρ_{xu} and ρ_{yv} terms can be computed. Further, the means must be comparable (which may not be the case if different measures of the construct are used in different studies). As an alternative procedure, the studies that serve as the basis for the meta-analysis can be divided into groups—those involving single-organization samples, those involving multiple-organization samples, and those conducted at the organizational level. Meta-analytic estimates can then be derived for population parameters at different levels.

Gully, Devine, and Whitney's (1995) meta-analysis examining the relationship between group cohesion and performance checked for "level" as a moderator. Dividing the studies by group- and individual-level of analysis resulted in a sizable difference in the average *r*s. The mean corrected *r*s were .32 and .23 for the group and individual levels, respectively. These authors did not, however, distinguish between within-organization and between-organization samples. We do so below.

We reanalyzed the Wanous et al. (1992) meta-analysis of the effects of met expectations on responses of organizational newcomers. The analysis included 17,241 individuals from 31 samples. We gathered summary data from the studies, divided them into two sets—within-organization samples and across-organization samples—and computed average *r*s for each set. Table 1 contains the results for all studies combined (as reported by Wanous et al., 1992) and our split-level sample results.

As we pointed out, the average (adjusted) *r* across all

range restriction corrections (using an SD_x and SD_y from the entire population of individuals) would result in accurate estimates of the individual-level correlation in the population: (a) when there is no between-organization variance, and sample standard deviations are restricted artifactually and (b) when there is a lucky coincidence that the correction produces the same adjustment to the correlation-within as would have been obtained if the organization correlation and variance ratios were known. If a range restriction correction were applied in Figure 1A, only by the lucky coincidence described above (b) would a researcher possibly obtain the individual-level correlation. In the configuration shown in Figure 1B, when the correlation-within is stronger than the individual correlation, the effect would be to accentuate the bias of the original, incorrect interpretation of the meta-analytic *r* as an estimate of the individual correlation. In Figure 1C, a range restriction correction would produce a more extreme estimate of the individual correlation with the wrong sign. Finally, in the situation in Figure 1D in which population correlations at all three levels are identical, application of a range restriction correction would create a new bias that was not present in the original meta-analytic estimate.

Table 1
Reanalysis of Wanous et al. (1992) Meta-Analysis

Dependent variable	All studies	Single-organization studies	Multiple-organization studies
Commitment			
$\bar{r}$	.33	.34	.32
n	2991	1699	1292
No. of studies	15	10	5
Intent to remain			
$\bar{r}$	.24	.28	.19
n	2851	1559	1292
No. of studies	14	9	5
Satisfaction			
$\bar{r}$	.33	.35	.30
n	3960	2093	2017
No. of studies	19	11	8
Performance			
$\bar{r}$	.09	.12	.06
n	2130	984	1146
No. of studies	10	5	5

Note. All studies are reported in Wanous et al. (1992). Single-organization studies represent correlation-within estimates. Multiple-organization studies represent individual-level correlation estimates.

studies is not readily interpretable as an estimate of any population parameter. However, the average r for single-organization studies can be viewed as the best estimate for the correlation-within. The average r for the multiple-organization studies can be viewed as the best estimate for the individual-level population correlation (keeping in mind that this r reflects the true individual correlation only if the across-organization samples were randomly drawn from the population of organizations). Nevertheless, it is interesting to note that in this set of studies, the correlation-within is consistently stronger than the individual-level correlation.[5] These results indicate that some factor might be operating to change the relationship between the two variables within an organization relative to the organizational-level and total individual-level correlations. Although the differences between the meta-analytic correlation (correlation-within) and the individual-level correlation may not appear overly dramatic, given the importance placed on meta-analytic estimates and the authority they convey in utility analyses, court cases, and research, the differences are meaningful.

Implications and Conclusions

The preceding discussion illustrated that systematic discrepancies can occur between the population individual-level correlation and interpretations of a meta-analytic $\hat{\rho}$. Meta-analyses can provide best estimates of different population correlations when such correlations are properly specified beforehand. We also documented many published studies in which the obtained meta-analytic $\hat{\rho}$ may not be interpretable as an estimate of any population parameter because authors have cumulated studies in which samples were drawn from different levels or with different sampling schemes (within-organization versus between-organizations). The extent to which erroneous conclusions have been drawn in these cases is not known. However, given the expanding literature documenting different relationships at different levels, meta-analytic researchers should routinely check for differences by level. Additional conclusions and recommendations are offered below.

First, finding a relationship at an organizational or a higher level of analysis and assuming it applies at lower levels, as well as finding a relationship at a lower level and assuming it applies to higher levels, are well-known ecological fallacies (e.g., Roberts, et al., 1978; Rousseau, 1985). Researchers must determine what type of population parameter is of interest when conducting and reporting a meta-analysis. For example, for validity generalization purposes the within-correlation may be most appropriate, and meta-analytic researchers should focus on single-organization studies. If the purpose is to ascertain the relationship between scientific constructs in the population of jobholders, across-organization samples are appropriate so that the results from meta-analysis can provide the best estimate of the population correlation for individuals. Meta-analysis should not combine mixed sets of studies or a set of studies conducted at different levels of analysis because doing so produces a meta-analytic $\hat{\rho}$ that is not interpretable as an estimate of any population parameter.

Second, if a meta-analytic researcher is interested in whether there are differences in within-organization versus across-organization relationships, studies can be divided into two groups (single-organization versus across- or multiple-organization). The level of analysis at which the studies were conducted can be treated as a moderator in a traditional meta-analytic study, as can the single- versus multiple-organization sampling scheme. Researchers should at least address the likelihood of whether differences between correlations at multiple levels are possible, adding an important contribution to the body of knowledge about levels-based influences (e.g., George, 1990; Jones & James, 1979; Jordon, Herriot & Chalmers, 1991; Klein et al., 1994; Mathieu & Kohler, 1990; Ostroff, 1992, 1993; Roberts et al., 1978; Schneider, 1987; Vancouver & Schmitt, 1991).

Third, as noted by Hunter and Schmidt (1990), it is important to distinguish between additive and moderator effects. Following their example, it is quite possible that there are strong organizational constraints or effects (e.g., the technology of an organization) that will "limit" some within-organization constructs (e.g., decision style). A large manufacturing organization with an assembly line operation can require rigid work structure and coordination, and hence may provide fewer opportunities for sharing decision making with subordinates. This may lead to the prediction that there are lower levels of participative decision making with subordinates in such organizations. However, even if this is true, it may still be true that those managers within the organization who engage in participative decision making show higher productivity. Thus, even though means may differ or be lower in some organizations, the technology–decision style correlation does not have to be lower. A conventional meta-analysis of a set of within-organization studies can determine whether (a) correlations within organizations are similar even if means differ (e.g., Figure 1D) or (b) there is some moderator, such as organizational size or some other variable that causes the within-organization correlations to differ by this variable (e.g., Figure 2). However, it is also important to recognize that even when the correlations-within are similar and the means are different,

[5] Is a larger correlation at the organizational level merely a result of improved measurement properties (a lower proportion of error) relative to the individual level? Our theoretical examples were created and described at the population true-score level, as if measures of x and y had no measurement error. Ostroff (1993) provides a more in-depth discussion of this question, as does Brennan (1995).

the traditional meta-analysis of the set of within-organization correlations will not allow one to determine if there is some organizational-level effect such that the organizational correlation or the individual correlation differs from the correlation-within (e.g., Figure 1A). That is, this type of meta-analysis still may not provide the best estimate of the individual-level population correlation, even if the "situational specificity" hypothesis, as traditionally applied, is rejected.

Fourth, some difficulties may arise in estimating the individual-level and organizational-level correlations because of the type of data typically reported in studies. It can be difficult to use the equations presented above to cumulate findings across studies because means and standard deviations for all variables are not reported in many investigations (although moderator analysis, as suggested in the third point above, is still appropriate). A further limitation is that different measures are used in different studies to assess the same construct, making means and standard deviations incomparable, which means the equations presented cannot be used. One possible way to address this problem is to begin developing linear equations for transforming different measures of the same construct into nearly identical metrics. Of course, such equations should be based on broad, multi-organization samples that capture as many sources of variance as possible. Similarly, developers of new instruments should attempt to obtain a broad sampling of individuals across organizations as well as within-organization samples. Estimates of the variance-between and variance-within should be provided for researchers who may need them in future meta-analyses when incomplete data are reported in original studies, or when the nature of the samples is ambiguous.

Fifth, more work is needed. Future treatments could focus on expanding the equations to include effects at multiple levels. Equation 1 can be thought of as an additive formula, whereby the individual-level correlation is a weighted function of the organizational correlation and correlation-within. The weights for the correlations are the etas (based on variance ratios). Equation 1 could be generalized to be an additive function of correlations at each of three or four or more different levels (e.g., industry level, national or cultural level). The correlations at each level could be weighted by the proportion of variance attributed to that level in both x and y (under the constraint that the variance proportions sum to 1.0).

Finally, our analysis treated organizational-level influences as a main effect. Person × Situation, or Individual × Organizational interactions were not addressed. To incorporate such effects, a different set of statistical models is needed (see Erez, Bloom, & Wells, 1996 for a model of that treats differences in correlations-within as random effects). Several multi-level modeling procedures have recently been developed and refined to address using complex individual-level and aggregated data (e.g., Bryk & Raudenbush, 1992; Goldstein, 1995; Goldstein & McDonald, 1988). Future efforts could focus on the incorporation of more sophisticated, interactive models into the framework presented here. Additional work by methodologists and theorists which integrates meta-analytic choices and levels-based procedures could greatly enhance our understanding of the interplay of individuals and organizations.

References

Angle, H. L., & Perry, J. L. (1981). An empirical assessment of organizational commitment and organizational effectiveness. *Administrative Science Quarterly, 26,* 1–13.

Bateman, T. S., & Organ, D. W. (1983). Job satisfaction and the good soldier: The relationship between affect and employee "citizenship." *Academy of Management Journal, 26,* 587–595.

Brennan, R. L. (1992). Generalizability theory. *Educational Measurement: Issues and Practices, 11,* 27–34.

Brennan, R. L. (1995). The conventional wisdom about group mean scores. *Journal of Educational Measurement, 32,* 385–396.

Brown, S. P. (1996). A meta-analysis and review of organizational research on job involvement. *Psychological Bulletin, 120,* 235–255.

Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models: Applications and data analysis methods.* Newbury Park, CA: Sage.

Burke, M. J., Rupinski, M. T., Dunlap, W. P., & Davison, H. K. (1996). Do situational variables act as substantive causes of the relationships between individual difference variables? Two large-scale tests of the "common-cause" models. *Personnel Psychology, 49,* 573–598.

Carsten, J. M., & Spector, P. E. (1987). Unemployment, job satisfaction, and employee turnover: A meta-analytic test of the Muchinsky Model. *Journal of Applied Psychology, 72,* 374–381.

Cohen, A. (1993). Organizational commitment and turnover: A meta-analysis. *Academy of Management Journal, 36,* 1140–1157.

Cotton, J. L., & Tuttle, J. M. (1986). Employee turnover; A meta-analysis and review with implications for research. *Academy of Management Review, 11,* 55–70.

Cronbach, L. J., Gleser, G. C., Narda, H., & Rajaratnam, N. (1972). *The dependability of behavioral measurement: Theory of generalizability for scores and profiles.* New York: Wiley.

Dansereau, F., Alluto, J. A., & Yammarino, F. J. (1984). *Theory testing in organizational behavior: The varient approach.* Englewood Cliffs, NJ: Prentice Hall.

Erez, A., Bloom, M. C., & Wells, M. T. (1996). Using random rather than fixed effects models in meta-analysis: Implications for situational specificity and validity generalization. *Personnel Psychology, 49,* 275–306.

Farrell, D., & Stamm, C. L. (1988). Meta-analysis of the correlates of employee absence. *Human Relations, 41,* 211–227.

Finn, J. D. (1974). *A general model for multivariate analysis.* New York: Holt, Rinehart & Winston.

Fried, Y. (1991). Meta-analytic comparison of the Job Diagnostic

Survey and Job Characteristics Inventory as correlates of work satisfaction and performance. *Journal of Applied Psychology, 76,* 690–697.

Fried, Y., & Ferris, G. R. (1987). The validity of the Job Characteristics Model: A review and meta-analysis. *Personnel Psychology, 40,* 287–322.

George, J. M. (1990). Personality, affect, and behavior in groups. *Journal of Applied Psychology, 75,* 107–116.

George, J. M., & James, L. R. (1993). Personality, affect, and behavior in groups revisited: Comment on aggregation, levels of analysis, and a recent application of within and between analysis. *Journal of Applied Psychology, 78,* 798–804.

Goldstein, H. (1995). *Multilevel statistical models.* New York: Halstead Press.

Goldstein, H., & McDonald, R. P. (1988). A general model for the analysis of multilevel data. *Psychometrika, 53,* 455–467.

Gully, S. M., Devine, D. J., & Whitney, D. J. (1995). A meta-analysis of cohesion and performance: Effects of level of analysis and task interdependence. *Small Group Research, 26,* 497–520.

Hackett, R. D., & Guion, R. M. (1985). A re-evaluation of the absenteeism–job satisfaction relationship. *Organizational Behavior and Human Decision Processes, 35,* 340–381.

Hackman, J. R., & Oldham, G. R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance, 16,* 250–279.

Harrison, D. A., & Shaffer, M. A. (1994). Comparative examinations of self-reports and perceived absenteeism norms: Wading through Lake Wobegon. *Journal of Applied Psychology, 79,* 240–251.

Hofmann, D. A., & Stetzer, A. (1996). A cross-level investigation of factors influencing unsafe behaviors and accidents. *Personnel Psychology, 49,* 307–328.

Hom, P. W., Caranikas-Walker, F., Prussia, G. E., & Griffeth, R. W. (1992). A meta-analytic structural equations analysis of a model of employee turnover. *Journal of Applied Psychology, 77,* 890–909.

House, R., Rousseau, D. M., & Thomas-Hunt, M. (1995). The meso paradigm: A framework for the integration of micro and macro organizational behavior. *Research in Organizational Behavior, 17,* 71–114.

Hunter, J. E. (1980). *Validity generalization for 12,000 jobs: An application of synthetic validity and validity generalization to the General Aptitude Test Battery (GATB).* Washington, DC: U.S. Employment Service, U.S. Department of Labor.

Hunter, J. E., & Hunter, R. F. (1984). Validity and utility of alternative predictors of job performance. *Psychological Bulletin, 96,* 72–98.

Hunter, J. E., & Schmidt, F. L. (1990). *Methods of meta-analysis.* Beverly Hills, CA: Sage.

Huselid, M. A. (1995). The impact of human resource management practices on turnover, productivity, and corporate financial performance. *Academy of Management Journal, 38,* 635–670.

Iaffaldano, M. T., & Muchinsky, P. M. (1985). Job satisfaction and job performance: A meta-analysis. *Psychological Bulletin, 97,* 251–273.

Jackson, S. E., & Schuler, R. (1985). A meta-analysis and conceptual critique of research on role ambiguity and role conflict in work settings. *Organizational Behavior and Human Decision Processes, 35,* 16–78.

Johns, G. (1994). How often were you absent? A review of the use of self-reported absence data. *Journal of Applied Psychology, 79,* 574–591.

Jones, A. P., & James, L. R. (1979). Psychological climate: Dimensions and relationships of individual and aggregated work environment perceptions. *Organizational Behavior and Human Decision Processes, 23,* 201–250.

Jordan, M., Herriott, P., & Chalmers, C. (1991). Testing Schneider's ASA theory. *Applied Psychology: An International Review, 40,* 47–54.

Katzell, R. A., & Austin, J. T. (1992). From then to now; The development of industrial–organizational psychology in the United States. *Journal of Applied Psychology, 77,* 803–835.

Klein, K. J., Dansereau, F., & Hall, R. J. (1994). Levels issues in theory development, data collection, and analysis. *Academy of Management Review, 19,* 195–229.

Lindsley, D. H., Brass, D. J., & Thomas, J. B. (1998). Efficacy–performance spirals; A multi-level perspective. *Academy of Management Review, 20,* 645–678.

Loher, B. T., Noe, R. A., Moeller, N. L., & Fitzgerald, M. P. (1985). A meta-analysis of the relation of job characteristics to job satisfaction. *Journal of Applied Psychology, 70,* 280–289.

Mathieu, J. E., & Kohler, S. S. (1990). A cross-level examination of group absence influence on individual absence. *Journal of Applied Psychology, 75,* 217–220.

Mathieu, J. E., & Zajac, D. M. (1990). A review and meta-analysis of the antecedents, correlates, and consequences of organizational commitment. *Psychological Bulletin, 108,* 171–194.

Mitra, A., Jenkins, G. D., & Gupta, N. (1992). A meta-analytic review of the relationship between absence and turnover. *Journal of Applied Psychology, 77,* 879–889.

Nicholson, N., & Johns, G. (1985). The absence culture and the psychological contract; Who's in control of absence? *Academy of Management Review, 10,* 397–407.

Organ, D. W., & Ryan, K. (1995). A meta-analytic review of attitudinal and dispositional predictors of organizational citizenship behavior. *Personnel Psychology, 48,* 775–802.

Ostroff, C. (1992). The relationship between satisfaction, attitudes, and performance: An organizational level analysis. *Journal of Applied Psychology, 77,* 963–974.

Ostroff, C. (1993). Comparing correlations based on individual-level and aggregated data. *Journal of Applied Psychology, 78,* 569–582.

Pegues v. Mississippi State Employment Service, (1980) 22 FEP 392.

Peters, L. H., Hartke, D. D., & Pohlmann, J. T. (1985). Fiedler's contingency theory of leadership: An application of the meta-analytic procedures of Schmidt and Hunter. *Psychological Bulletin, 97,* 274–285.

Peterson, M. F., Smith, P. B., Akande, A., Ayestaran, S., Bochner, S., Callan, V., Cho, N. G., Jesuino, J. C., D'Amorim, M., Francois, P., Hofmann, K., Koopman, P. L., Leung, K., Lim, T. K., Mortazavi, S., Munene, J., Radford, M., Ropo, A., Savage, G., Setiadi, B., Sinha, T. N., Sorenson, R., & Viedge, C. (1995). Role conflict, ambiguity, and overload: A 21-nation study. *Academy of Management Journal, 38,* 429–452.

Pfeffer, J. (1995). Producing sustainable competitive advantage through the effective management of people. *Academy of Management Executive, 9,* 55–72.

Randall, D. M. (1990). The consequences of organizational commitment: Methodological investigation. *Journal of Organizational Behavior, 11,* 465–476.

Roberts, K. H., Hulin, C. L., & Rousseau, D. M. (1978). *Developing an interdisciplinary science of organizations.* San Francisco: Jossey-Bass.

Robinson, W. S. (1950). Ecological correlations and the behavior of individuals. *American Sociological Review, 15,* 351–357.

Rousseau, D. M. (1977). Technological differences in job characteristics, employee satisfaction, and motivation: A synthesis of job design research and sociotechnical systems theory. *Organizational Behavior and Human Decision Processes, 19,* 18–42.

Rousseau, D. M. (1985). Issues of level in organizational research: Multi-level and cross-level perspectives. In L. L. Cummings & B. M. Staw (Eds.), *Research in organizational behavior* (Vol. 7, pp. 1–38). Greenwich, CT: JAI Press.

Ryan, A. M., Schmit, J. J., & Johnson, R. (1996). Attitudes and effectiveness: Examining relations at an organizational level. *Personnel Psychology, 49,* 853–882.

Sackett, P. R., & Ostgaard, D. J. (1994). Job-specific applicant pools and national norms for cognitive ability tests: Implications for range restriction corrections in validation research. *Journal of Applied Psychology, 79,* 680–684.

Saunders, T., Driskell, J. E., Johnston, J. H., & Salas, E. (1996). The effect of stress inoculation training on anxiety and performance. *Journal of Occupational Health Psychology, 1,* 170–186.

Schmidt, F. L., Gast-Rosenberg, I., & Hunter, J. E. (1980). Validity generalization results for computer programmers. *Journal of Applied Psychology, 65,* 643–661.

Schmidt, F. L., & Hunter, J. E. (1977). Development of a general solution to the problem of validity generalization. *Journal of Applied Psychology, 62,* 529–540.

Schmidt, F. L., & Hunter, J. E. (1984). A within-setting empirical test of the situational specificity hypothesis in personnel selection. *Personnel Psychology, 37,* 317–326.

Schmidt, F. L., Hunter, J. E., & Caplan, J. R. (1981). Validity generalization results for two job groups in the petroleum industry. *Journal of Applied Psychology, 66,* 261–273.

Schmidt, F. L., Hunter, J. E., Pearlman, K., & Shane, G. S. (1979). Further tests of the Schmidt–Hunter Bayesian validity generalization procedure. *Personnel Psychology, 32,* 257–381.

Schmidt, F. L., Mack, M. J., & Hunter, J. E. (1984). Selection utility in the occupation of U.S. park ranger for three modes of test use. *Journal of Applied Psychology, 69,* 490–497.

Schneider, B. (1987). E = f(P,B): The road to a radical approach to P-E fit. *Journal of Vocational Behavior, 31,* 353–361.

Schneider, B., & Bowen, D. (1985). Employee and customer perceptions of services in banks: Replication and extension. *Journal of Applied Psychology, 70,* 423–433.

Schneider, B., Smith, D. B., Taylor, S., & Fleenor, J. (1998). Personality and Organizations: A test of the homogeneity of personality hypothesis. *Journal of Applied Psychology, 83,* 462–470.

Scott, K. D., & Taylor, G. S. (1985). An examination of conflicting findings on the relationship between job satisfaction and absenteeism: A meta-analysis. *Academy of Management Journal, 28,* 599–612.

Shikiar, R., & Freudenberg, R. (1982). Unemployment rates as a moderator of the job dissatisfaction–turnover relation. *Human Relations, 35,* 845–856.

Staw, B. M., & Sutton, R. I. (1992). Macro organizational psychology. In J. K. Murnighan (Ed.), *Social psychology in organizations: Advances in theory and research* (pp. 71–114). Englewood Cliffs, NJ: Prentice Hall.

Steel, R. P., & Griffeth, R. W. (1989). The elusive relationship between perceived employment opportunity and turnover behavior: A methodological or conceptual artifact? *Journal of Applied Psychology, 74,* 846–854.

Steel, R. P., & Ovalle, N. K. II (1984). A review and meta-analysis of research on the relationship between behavioral intentions and employee turnover. *Journal of Applied Psychology, 69,* 673–686.

Tait, M., Padgett, M. Y., & Baldwin, T. T. (1989). Job and life satisfaction: A reevaluation of the strength of the relationship and gender effects as a function of the date of the study. *Journal of Applied Psychology, 74,* 502–507.

Tett, R. P., & Meyer, J. P. (1993). Job satisfaction, organizational commitment, turnover intention, and turnover: Path analyses based on meta-analytic findings. *Personnel Psychology, 46,* 259–293.

Vancouver, J., & Schmitt, N. (1991). An exploratory examination of person–organization fit: Organizational goal congruence. *Personnel Psychology, 44,* 333–352.

Wanous, J. P., Poland, T. D., Premack, S. L., & Davis, K. S. (1992). The effects of met expectations on newcomer attitudes and behaviors: A review and meta-analysis. *Journal of Applied Psychology, 77,* 288–297.

Wanous, J. P., Reichers, A. E., & Hudy, M. J. (1997). Overall job satisfaction: How good are single-item measures? *Journal of Applied Psychology, 82,* 247–252.

Wofford, J. C., & Liska, L. Z. (1993). Path–goal theories of leadership: A meta-analysis. *Journal of Management, 19,* 857–876.

Yammarino, F. J., & Markham, S. E. (1992). On the application of within and between analysis: Are absence and affect really group-based phenomena? *Journal of Applied Psychology, 77,* 168–176.

Received June 13, 1996
Revision received July 20, 1998
Accepted July 22, 1998 ■