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Transfer of Training: A Meta-Analytic Review

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Although transfer of learning was among the very first issues addressed by early psychologists, the extant literature remains characterized by inconsistent measurement of transfer and significant variability in findings. This article presents a meta-analysis of 89 empirical studies that explore the impact of predictive factors (e.g., trainee characteristics, work environment, training interventions) on the transfer of training to different tasks and contexts. We also examine moderator effects of the relationships between these predictors and transfer. Results confirmed positive relationships between transfer and predictors such as cognitive ability, conscientiousness, motivation, and a supportive work environment. Several moderators had significant effects on transfer relationships, including the nature of the training objectives. Specifically, most predictor variables examined (e.g., motivation, work environment) had stronger relationships to transfer when the focus of training was on open (e.g., leadership development) as opposed to closed (e.g., computer software) skills. Other moderators related to the measurement of transfer also influenced transfer relationships, including situations in which transfer outcomes were obtained by the same source in the same measurement context—which consistently inflated transfer relationships. Findings are discussed in terms of their relevance for future research and training practice.

Keywords: *training transfer; meta-analysis; trainee characteristics; work environment; training interventions*

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Introduction

Today's most progressive organizations have moved from treating some select human resource management practices (e.g., incentive compensation, employee participation, flexible work arrangements, training) as obligatory cost factors to regarding them as strategic weapons in the battle for competitive advantage. Consistently included in any discussion of such high-performance human resource practices is employee training (Combs, Liu, Hall, & Ketchen, 2006; Huselid, 1995; Pfeffer, 1998). Effective training certainly has the potential to increase knowledge, skills, and abilities (KSAs) and to enable employees to leverage their KSAs for organizational benefit (Becker & Huselid, 1998; Combs et al., 2006).

According to a recent American Society for Training and Development study, U.S. organizations spend more than $125 billion annually on employee training and development (Paradise, 2007). At the same time, organizations continue to question the true yield of their training expenditures. Despite the large investments in and potential benefits of training, organizational decision makers are often not sure to what extent employees perform differently once back on the job.

In organizational contexts, original learning in a training experience is rarely enough to render that training effective. Rather it is the positive transfer of training—the extent to which the learning that results from a training experience transfers to the job and leads to meaningful changes in work performance—that is the paramount concern of organizational training efforts (Goldstein & Ford, 2002). For example, leadership training programs often present a model of leadership and include some case studies. While this training may be beloved by participants, the extent to which such programs positively affect the leadership behavior of managers while on the job is at the crux of the transfer issue. Concerns raised about investing in training often revolve around these training transfer issues and the return the organization can expect. This so-called *transfer problem* has led to a body of studies that explore factors that can affect transfer and to a search for strategies that enhance the likelihood that acquired knowledge and skills will be applied to different tasks and contexts (Ford & Kraiger, 1995).

The purpose of the current study is to provide a comprehensive meta-analysis of predictors of transfer of training. Given the clarion call for more evidence-based practice within the management discipline (Pfeffer & Sutton, 2006; Rousseau, 2006), we believe such a meta-analytic synthesis is timely and important for several reasons. First, and most generally, there is a need to know which predictors actually make a difference in facilitating transfer—not just intuitively or anecdotally, but with support from the extant evidence. Second, in the past 20 years, there has been a burgeoning volume of studies on transfer, and there is significant variability in findings across those studies (Cheng & Hampson, 2008). Third, scholars have operationalized transfer in various ways, and it is important to quantitatively examine how these different operationalizations influence predictor–transfer relationships. Therefore, we identify and test a set of theory-based and methodological moderators of transfer relationships. Before developing our research questions below, we first define *transfer* and its most fundamental dimensions, note limitations of the current state of transfer research findings, and highlight the contributions of our meta-analytic review.

The Training Transfer Concept

The transfer of learning has been an enduring problem in psychology and education (Grose & Briney, 1963). The history of transfer research goes back more than 100 years, with researchers debating the nature, contexts, and prevalence of transfer (Barnett & Ceci, 2002). What has emerged from this research stream is a view of transfer as a complex and dynamic process.

Transfer was originally defined as the extent to which learning of a response in one task or situation influences the response in another task or situation (e.g., see Adams, 1987). For example, Thorndike and Woodworth (1901) predicted that transfer would occur as long as the aims, method, and approaches used for the learning task were similar to the transfer task. They found support for the generalization of responses when there was similarity in the stimuli and responses in the learning and transfer environments. Research has supported a generalization gradient in which transfer is more likely with *near transfer tasks*, which are highly similar to the learning tasks (e.g., working on a small jet engine in training and a larger one in the field), and less likely as one moves to *far transfer*, in which the tasks and situations in the learning situation are quite different from the transfer setting (e.g., applying principles of electricity from training to troubleshooting complex mechanical problems under extreme time pressures; Royer, 1979). This generalization process allows people to react appropriately to new situations because of similarities with familiar ones (Bass & Vaughan, 1966).

Gagne (1965) distinguished between two types of generalization processes—*lateral* and *vertical transfer*. Lateral transfer occurs when a skill spreads over a broad set of situations at the same level of complexity or difficulty (i.e., applying trained rules and procedures to situations similar to that trained). In contrast, vertical transfer occurs when an acquired skill affects the acquisition of a more complex or superordinate skill (e.g., a pilot gaining knowledge and skills related to flying a plane and then having to learn the appropriate team interrole behaviors required for effective flight cockpit performance). Barnett and Ceci (2002) developed a framework of transfer that categorizes studies based on the training content (what is transferred) and the training context (when and where something is transferred). In their framework, they noted how the field has expanded the notion of near and far transfer. For example, in terms of the physical context, near transfer has been studied in cases in which the transfer context is in the same location as the acquisition context. Far transfer has been studied in cases in which the transfer context is much different in location from the learning context, such as when conflict management material learned in a classroom would be applied in workplace settings. Near and far transfer can also be discussed in terms of a temporal dimension. For example, near transfer can occur and be studied during the same session as the learning, and far transfer can be studied months or years later. These frameworks demonstrate that transfer can be examined in many different ways.

While much of the initial interest in transfer focused on understanding educational issues, such as how learning in one domain might affect learning in another (Thorndike, 1933), researchers subsequently adapted the study of transfer to improve the application of workplace training (Goldstein, 1974). For our review, and consistent with historical perspectives, we define *transfer* as consisting of two major dimensions: (a) *generalization*—the extent to which the knowledge and skill acquired in a learning setting are applied to different settings, people, and/or situations from those trained, and (b) *maintenance*—the extent to which

changes that result from a learning experience persist over time. Researchers have studied generalization and maintenance issues across a variety of research settings (laboratory, simulations, field studies, and field experiments) and time intervals. We examine studies that have attempted to better understand the factors that can affect transfer regardless of research setting and time interval. In this way we can better understand transfer as a dynamic and complex process (Ford & Kraiger, 1995; Royer, 1979).

Transfer Research

As noted by Brown and Sitzmann (in press), the most frequently cited model of training transfer is one presented by Baldwin and Ford (1988). They organized their qualitative review around a model of training inputs (trainee characteristics, training design, and work environment), training outputs (acquisition of knowledge and skills during training), and conditions of transfer (generalization of knowledge and skills acquired in training to the job and the maintenance of that learning over time on the job). Trainee characteristics consist of factors such as ability, skill, motivation, and personality. Training design factors include the training objectives and methods and the incorporation of learning principles such as multiple training techniques and opportunities for practice. Work environment factors include transfer climate, social support from supervisors and peers, and the constraints on or opportunities for performing learned behaviors on the job. A good example of these work environment factors is provided by Rouillier and Goldstein (1993), who defined transfer climate as consisting of two categories: *situational cues* and *consequences*. Situational cues consist of things such as manager goals, peer support, equipment availability, and opportunity to practice trained skills. Consequences consist of punishment, as well as positive and negative feedback from both managers and peers when trainees attempt to apply the skills they learned in training.

The goal of Baldwin and Ford (1988) was to "provide a critique of the existing transfer research and to suggest directions for future research" (p. 64). They analyzed 63 empirical studies spanning the period from 1907 to 1987 and summarized key findings related to the linkage of training input factors and transfer. The review also noted key limitations relevant to the way transfer had been operationalized. They closed their review by noting, "Conclusions from the existing research are problematic, given the relatively short-term, single source, perceptual database that has been created" (p. 100). Since then, the transfer literature has expanded to address a number of the issues raised in that review (Ford & Weissbein, 1997). A wider array of individual differences and motivational variables have been studied for their impact on transfer. In addition, a number of studies have examined the transfer environment for its impact on transfer. Other studies have created interventions to facilitate transfer.

A number of authors have recently attempted to qualitatively summarize what we know about transfer from this expanding research base (Alvarez, Salas, & Garofano, 2004; Baldwin, Ford, & Blume, 2009; Burke & Hutchins, 2007; Cheng & Hampson, 2008; Cheng & Ho, 2001; Kopp, 2006; Merriam & Leahy, 2005; Yamnill & McLean, 2001). These reviews have typically focused on trainee and work environment characteristics and their impact on transfer. They have highlighted several inconsistent and conflicting findings in the transfer literature. For example, Cheng and Hampson (2008) concluded, "The studies examining the relationships between general dispositions and training transfer have shown

incoherent findings" (p. 334). Similarly, Burke and Hutchins (2007) concluded that there was mixed support for conscientiousness and that other Big Five personality variables were said to have minimal or no empirical evidence supporting their relationship with transfer.

Cheng and Hampson (2008) further noted that "similar reasoning applies to such variables as transfer climate, social support (e.g., supervisors, peers and subordinates) and opportunity to transfer. . . counterintuitive results were reported" (p. 334). Cheng and Ho (2001) also reported conflicting findings related to organizational support. They noted that while 10 studies found positive relationships between organizational support and transfer outcomes, 2 studies found negative relationships, and 5 studies found that the link was nonsignificant. Burke and Hutchins further described the mixed findings for the impact of trainee interventions on training transfer.

Contributions of Our Quantitative Review

Existing qualitative reviews have provided some evidence of the factors that can affect transfer. Nevertheless, a demand for the "best evidence" to drive future research and practice requires meta-analytic estimates of transfer relationships. Meta-analytic estimates allow us to resolve inconsistent findings in the literature by including confidence intervals, corrected estimates, and measures of variability in correlations across studies, permitting more accurate inferences of the strength and consistency of relationships. We discuss key meta-analyses related to transfer below, highlighting the unique contributions of our meta-analysis.

Of the three training inputs identified by Baldwin and Ford (1988), training design has received the most significant research attention to quantify results across studies. Existing meta-analytic studies have focused on design characteristics such as overlearning (Driskell, Willis, & Copper, 1992), practice (Arthur, Bennett, Stanush, & McNelly, 1998), and training delivery methods (Arthur, Bennett, Edens, & Bell, 2003; Sitzmann, Kraiger, Stewart, & Wisher, 2006). In addition, there are two quantitative reviews of specific training methods of behavioral modeling (Taylor, Russ-Eft, & Chan, 2005) and error management training (Keith & Frese, 2008). One element that is missing from current meta-analytic studies on training design and transfer is consideration of the training objectives or goals of the training program on transfer. Training objectives are the intended outcomes of training, and they should dictate the selection of evaluation criteria (Goldstein & Ford, 2002).

As noted by Brown and Sitzmann (in press), research studies need to provide information on training objectives so that research can examine the extent to which training is effective when certain types of objectives are the focus of training. Baldwin and Ford (1988) stated that one objective of a training program can be to teach motor skills where the steps to be learned are clearly prescribed. In these training situations, it is desirable for trainees to adopt the modeled behaviors in essentially the same form as they are presented in training. For example, there is little leeway permitted in the proper way to safely operate a power tool. Consequently, the objective is to have the trainee mimic trained behavior as closely as possible. In the case of interpersonal or leadership training, however, the objective is more to inculcate generalizable rules, concepts, and principles. Trainees are to formulate their own plan for how to apply those rules and customize the training to fit their needs (Baldwin et al., 2009). Yelon and Ford (1999) characterized this important distinction as closed versus open skills. In this meta-analysis, we

distinguish between the goal of training for open versus closed skills and subsequently examine the extent to which the type of skills being trained might moderate the relationship between trainee and work environment characteristics and training transfer.

Colquitt, Lepine, and Noe (2000) quantitatively reviewed trainee characteristics and work environment factors and tangentially considered transfer. The central focus of their review was on understanding factors affecting the motivation to learn. In addition, they examined impacts on learning and transfer. They found that self-efficacy, valence, anxiety, and climate had the largest impact on motivation to learn, and they did not find support for conscientiousness or job involvement. Motivation to learn was found to be significantly related to learning measures and transfer measures. Some evidence was found for the impact of conscientiousness and climate on transfer. Unfortunately, the number of studies in their review that included measures of transfer was quite small (i.e., relationships often were based on only two or three studies), and thus it is tenuous to reach conclusions regarding transfer on those data alone. On the other hand, our study represents the first full-scale quantitative review examining the influence of trainee characteristics and work environment on transfer.

We also examine the relationship between transfer and training interventions (pre- and posttraining), learning outcomes (i.e., trainee knowledge or learning, self-efficacy), and reactions. Our examination of the learning-transfer and reaction-transfer relationships is an update of a meta-analysis by Alliger, Tannenbaum, Bennett, Traver, and Shotland (1997), which focused on the relationships between training criteria.

Finally, we consider how transfer has been operationalized and how research design decisions affect reported relationships between training input factors and training transfer. Although the distinction has rarely been made explicit, transfer has typically been measured as either the use of a trained skill or the effectiveness in performing the trained skill. These two ways of measuring transfer are clearly different from one another, and it is unknown to what extent the way transfer has been measured could affect the relationships. In addition, training researchers have too rarely considered how common method variance and the type of transfer measure (ratings, objective measures) will affect observed relationships between predictor variables of interest and training transfer. Taylor, Russ-Eft, and Taylor's (2009) meta-analysis found that ratings of the impact of behavioral modeling training were related in part to the source (self, supervisor) of the transfer measure. Therefore, it is critical that we understand the extent to which transfer relationships differ depending on how transfer is measured. We empirically examine these issues and others (e.g., lab vs. field studies, time between end of training and the measurement of transfer) by looking at moderators of meta-analytic estimates.

Research Questions

A wide variety of empirical studies have emerged since Baldwin and Ford's (1988) review. The result has been a more extensive nomological network for transfer and a considerably greater amount of empirical data, but at the cost of convergence and clarity regarding which factors relate most significantly with transfer and what can be leveraged to improve transfer. Our review of the extant transfer literature prompts several questions that meta-analysis is uniquely suited to address. Our seven research questions below concern both direct effects on transfer and moderators of transfer relationships.

The first research question concerns the influence of the most frequently identified and investigated predictor variables (trainee characteristics, work environment, training interventions, learning outcomes, and reactions) on transfer. With respect to the variables proposed to influence transfer, a few central questions are of both conceptual and pragmatic interest to the transfer community. For example, which of many investigated individual differences have the strongest or weakest relationship to transfer? How do situational predictors vary in the strength of their effects? Are there some interventions that have shown consistently significant relationships with transfer? How do various training outcomes (reactions to training, declarative knowledge) relate to transfer?

Research Question 1a: What is the size of the relationship between transfer and trainee characteristics (e.g., cognitive ability, experience, personality, motivation), work environment factors (i.e., support, climate, constraints/opportunity), training interventions, learning outcomes (i.e., knowledge, self-efficacy), and trainee reactions.

Directly related to obtaining these estimates, we found a subset of studies that are likely to inflate transfer relationships and, if included in the meta-analytic estimates, would provide inaccurate results. These studies are those in which same-source and same-measurement-context (SS/SMC) effects are present. For example, in some studies exploring effects of work environment on transfer outcomes, the measurements of both the input factor (i.e., support) and the outcome factor of transfer were gathered from self-report measures at the same time (e.g., Chiaburu & Marinova, 2005; Facteau, Dobbins, Russell, Ladd, & Kudisch, 1995).

There is a growing body of research examining the extent to which method variance influences relationships between measures. Podsakoff, MacKenzie, Lee, and Podsakoff (2003) reviewed several meta-analytic studies (e.g., Gerstner & Day, 1997; Podsakoff, MacKenzie, Paine, & Bachrach, 2000) that contrasted the strength of the relationship between two variables when common method variance was controlled versus when it was not. They concluded that, on average, the amount of variance accounted for when common method variance was present was approximately 35%, versus approximately 11% when it was not present. Given such compelling evidence of the impact of common method variance in other research contexts, it is likely that SS/SMC bias is operative in many reported transfer relationships. As one example, Colquitt et al. (2000) reported a mean corrected correlation of .84 between peer support and transfer, so it seems likely that this reported relationship is inflated to some extent because of SS/SMC. We think it is important to document the extent of such inflation and to seek estimates of predictor–transfer relationships that do *not* reflect this inflation.

Research Question 1b: What are the predictor–transfer relationships after removing SS/SMC bias?

Moderators Directly Related to Transfer Measures

Another set of unaddressed questions concerns how the operationalization of transfer or measurement context affects the relationship between predictor variables and transfer. We

contend that three specific distinctions of transfer measurement are particularly important. First, transfer measures can be taken immediately after training or after some time lag. We would expect that predictor and transfer relationships will be stronger when transfer measures are taken immediately after training, without a time lag. Barnett and Ceci (2002) refer to this as near transfer in both the physical and the temporal context.

Second, the source of transfer ratings (e.g., self vs. other) may also affect transfer correlations. Self-reports may be distorted in the presence of high social desirability (Podsakoff et al., 2003). In cases in which trainees want to impress a supervisor by affirming that they have applied the training they received (i.e., indicating that the training was worthwhile and not a waste of time), social desirability could influence trainees' ratings of transfer. Taylor et al. (2009) found that effect size estimates for the transfer of managerial training were largest when based on trainees' self-ratings (compared with supervisor, peer, and subordinate ratings). We would therefore expect self-ratings of transfer to yield stronger relationships with predictors than other ratings would.

Third, transfer has been measured as both the *use* of a trained knowledge or skill and the *effectiveness of the trainee* in applying the knowledge or skill. An example of a use measure of transfer is found in Tracey, Tannenbaum, and Kavanagh (1995), who examined the influence of the work environment on the transfer of newly trained supervisory skills. Their items reflect a broad range of supervisory behaviors, including problem solving and decision making. An example item is, "At the present time, the associate to be trained meets regularly with other associates to discuss problems and identify ways to solve them." One example of an effectiveness measure of transfer is illustrated in a study by Xiao (1996), who assessed transfer of circuit board production workers 9 months after training. Two of the six items used were, "Using the new KSA has helped me improve my work" and "I have accomplished my job tasks faster than before training." In general, since using the knowledge or skill is necessary, but not sufficient, to effective transfer, we would expect stronger predictor–transfer relationships when transfer is measured as use than when it is measured as effectiveness. Our second research question is therefore an aggregation of the three transfer measurement issues.

Research Question 2. To what extent does the way that transfer is measured, including (a) whether a time lag exists between training and the transfer measure, (b) self versus non-self (i.e., peer or objective) measures, and (c) use versus effectiveness, influence predictor–transfer relationships?

Open Versus Closed Skills

As discussed above, among the most conspicuous gaps in the transfer literature is a neglect of how the open or closed nature of the skills being trained (i.e., training objectives) affects subsequent transfer. Training objectives tied to learning specific skills that are to be produced identically in the transfer environment as in the learning context are labeled *closed skills*, whereas training objectives tied to learning principles are labeled *open skills* (Yelon & Ford, 1999). Yelon and Ford (1999) noted that with closed skills, trainees are to respond in one particular way on the job according to a set of rules implemented in a precise fashion. With highly variable open skills, there is not a single correct way to act but rather freedom to perform.

Salas, Milham, and Bowers (2003) noted the evolution of many military jobs from primarily physical roles to roles based more on rapid actions linked to changing situations. They argued that not only are such open skills more difficult to train, but they also require higher-level cognitive components, are subject to greater and more rapid decay than are simpler motor skills, and likely demand a more supportive context for transfer to occur. That is, with closed skills, a trainee is often given the opportunity to apply learned skills immediately on the job, and the rewards and reinforcement for transfer are usually self-evident (e.g., the employee can now use a production machine he or she previously could not use). The prevalence of opportunities to apply open skills, however, is less straightforward and may be a function of the trainee's seeing the potential to use trained principles and guidelines on the job, as well as the supervisor's taking an active role in offering such opportunities. Therefore, a predictor of transfer, such as supervisor support, may differ in its relationship to transfer depending on whether the skill being trained is an open or a closed skill.

In the case of open skills, the trainee has more choice regarding whether, how, and when to transfer. For example, those more motivated to learn an open skill will more likely seek opportunities in the work place to apply the training and perhaps also seek out coworker support for applying trained skills (Ford, Quinones, Sego, & Sorra, 1992). Therefore, we expect that the relationship of some predictor variables (e.g., self-efficacy, motivation to learn) might have a stronger impact on training transfer for open rather than for closed skills (Baldwin et al., 2009).

Research Question 3. To what extent are predictor–transfer relationships stronger for open than for closed skills?

Additional Moderators

Lab versus field context. The transfer literature is characterized by a volume of both laboratory and field studies. Laboratory studies typically include a student sample, whereas field studies have nonstudent samples. Laboratory studies often allow for more control over key variables and thus provide the potential for greater in-depth examination of transfer processes and outcomes (Evans & Rooney, 2008). At the same time, laboratory studies tend to have a shorter time frame between training and the transfer measurement. Given these differences, the effect sizes found in a lab setting might not be consistent, for the same predictor–transfer relationships, with the effect sizes found in field research. We therefore were interested in documenting any systematic differences between lab and field studies.

Research Question 4: To what extent does the laboratory or field context moderate predictor–transfer relationships?

Publication source. The next research question explores the impact on transfer relationships of whether the data analyzed were from a published or unpublished source. This phenomenon has traditionally been labeled the *file drawer* effect (Rosenthal, 1979). A recent review and evaluation of meta-analytic practices (Geyskens, Krishnan, Steenkamp, &

Cunha, 2009) stressed the importance of examining this phenomenon. Some prior meta-analyses on training effectiveness have found differences related to whether the source of data was published or not (e.g., Arthur et al., 2003). Therefore, our fifth research question is designed to explore whether a file drawer effect exists in the transfer literature.

> Research Question 5: What is the impact on predictor–transfer relationships related to whether the data were from a published or unpublished source?

Time between the end of training and the transfer measure. In addition to issues related to the source and type of measurement discussed above, the timing of the measurement is important to consider. More specifically, it seems likely that the length of time between the end of training and a measure of transfer can affect the relationship between predictor variables and transfer. From the standpoint of the temporal context (Barnett & Ceci, 2002), it may be that some predictors would have a larger impact on transfer when there is less time between training and when the transfer measure is obtained. For example, would the relationship between trainee motivation and transfer be stronger if transfer was measured a few weeks after training rather than a few months after training? While it may seem logical to predict that shorter time frames would lead to stronger predictor–transfer relationships, Taylor et al. (2009) made the following point:

> On one hand, longer time lags might be expected to result in smaller effect sizes as a result of learning decay, but on the other hand, too little time between training and posttest could result in trainees not having had opportunities to use newly learned skills or raters not having had sufficient observational opportunities. (p. 106)

Therefore, our sixth research question relates to the impact of transfer measurement timing on observed relationships.

> Research Question 6: To what extent does the length of time between training and the transfer measure influence predictor–transfer relationships?

Relationships Between Transfer Measures

Our final research question examines the relationship of multiple measures of transfer for a subset of longitudinal studies in which transfer is assessed by multiple sources or at multiple times. First, we examined the relationship between trainees' versus others' (e.g., supervisor or peers) assessment of transfer when these measures are obtained at the same time. Although we are not aware of a meta-analysis on transfer that has reported such relationships, we might expect correlations to be similar to those found between self–other ratings of job performance. For example, Heidemeier and Moser (2009) found an overall meta-analytical estimate of the correlation between self- and supervisory ratings of .22 (r = .34 when corrected for measurement error). Second, we examined the correlation of repeated measures of transfer by the same source at different times. This relates to

maintenance of transfer in that we are examining how transfer changes over time. In other words, how consistent are perceptions of transfer over time?

Research Question 7a: What is the correlation between trainees' versus others' (e.g., supervisor's or peers') assessment of transfer when these measures are obtained at the same time?

Research Question 7b: What is the correlation between repeated measures of transfer by the same source at different times?

Method

Literature Search

We conducted an extensive search for primary empirical studies reporting a correlation between training transfer and at least one of the following variables: age, gender, education, experience, cognitive ability, the Big Five personality traits, locus of control, goal orientation, job involvement, voluntary participation, pretraining self-efficacy, motivation to learn or transfer, work environment, learning outcomes of knowledge or self-efficacy, reactions, and pre- or posttransfer intervention. We defined a measure as transfer if the skill being trained was assessed (a) through different or more complex tasks than the tasks in the training session or (b) in an environment different from the training environment. We excluded studies that looked only at learning outcomes (e.g., declarative or procedural knowledge). We limited the search results to articles that were published in English and based on healthy adult samples (i.e., we excluded studies of children or of adults with a medical condition).

Studies included in our meta-analysis were identified by a variety of methods. First, we conducted a search of the PsycINFO and ERIC databases using the keywords *training transfer*, *transfer of training*, *training effectiveness*, and *learning transfer* for the years 1988 through 2008. In addition to the above four keywords, we conducted an expanded search using the additional keywords *training outcome* and *training performance* from several key academic journals[1] to obtain as many published articles as possible that might contain training transfer measures. We also identified studies published prior to 1988 by examining all studies reviewed in Baldwin and Ford (1988). Second, we searched the ProQuest dissertation abstracts database from 1988 through 2008 using the terms *training transfer*, *transfer of training*, *training effectiveness*, and *learning transfer* to identify unpublished dissertations. Third, we conducted a search of the Academy of Management (AOM) and the Society for Industrial and Organizational Psychology (SIOP) conference programs for 2005 through 2008 and contacted authors of articles that might report relationships involving training transfer. Fourth, we contacted prominent authors in the field to request working papers.

For a study to be included in the meta-analysis, it had to either report or allow the computation of a correlation coefficient between any of the predictor variables and a measure of training transfer.[2] On the basis of our literature search, we identified 93 independent samples ($N = 24{,}493$), including 60 published articles, 5 unpublished conference papers, 26 dissertations, and 2 unpublished articles.

Coding for Meta-Analysis

After developing guidelines for coding, two of the authors coded an initial set of 13 articles. Three of the authors then discussed problems encountered and revised the guidelines. The first two then coded and discussed five additional articles. Any discrepancies were resolved by using a consensus discussion among all of us. One of us subsequently coded the remainder of the articles included in the meta-analysis. Another of us also coded 36 of these articles to allow for an examination of interrater agreement.

Each of the studies identified was coded as follows: (a) type of transfer (use vs. effectiveness), (b) time between the predictor variable and transfer measures, (c) time between the end of training and the transfer measure, (d) type of skill trained (open vs. closed), (e) source of predictor variable measure (objective, self, other), (f) source of transfer measure (objective, self, other), (g) setting (field vs. lab), (h) sample size (*N*), (i) measure reliabilities, and (j) effect sizes. For coding of effect sizes, we obtained Pearson's correlation coefficient directly from the majority of studies or computed *r* from existing statistics such as *d*. The level of coding agreement was generally high, with a mean overall agreement of 94.5% (*SD* = 4.2). Cases in which the initial codings of the two raters differed were resolved by discussion and recoded as needed.

When coding a transfer measure, we focused on whether transfer was measured as the use of a trained skill or the effectiveness of the performance on the trained skill. The majority of use measures were from the trainees on the frequency of or extent to which they apply the trained skills on the job. The effectiveness measures consisted of approximately equal proportions of objective measures, others' ratings, and self-report measures that generally focused on the outcome of applying the trained skills. For type of skill trained, we coded a study as closed skills training if the trainee was taught to respond in a particular way according to a set of rules or procedures. A study was coded as open skills training if the trainee had considerable latitude in deciding a course of action. Typical closed skills training programs included various technical training and computer software training, and typical open skills training included leadership and interpersonal skills training.

Independence Assumption

When a study reported multiple indicators of a focal construct, we followed the recommendation by Geyskens et al. (2009) and created a single composite variable for that construct in order to avoid violating the independence assumption by including multiple correlations from the same study. There were three exceptions to the use of linear composites. We chose not to create composites when the correlations among the indicators were so low as to indicate that they did not measure the same construct. We also decided not to create composites for transfer measures across different times, as time was one of the important moderator variables of interest, and a composite correlation would obscure the effect of time and prohibit further moderator analysis. In some rare cases, we could not create a composite because all necessary correlations were not reported. When any of these situations occurred for transfer measures within the same study, we selected one of the possible effect sizes based on the following

order of preference: (a) effectiveness over use; (b) others' report or objective measures over self-report; and (c) longer over shorter time lag after training. When these situations did not concern transfer measures, we randomly selected one of the possible effect sizes for inclusion (Lipsey & Wilson, 2001; Rosenthal & Rubin, 1986).

Outliers

A primary study coefficient may be an outlier in a meta-analytic study because of unique features of the study's design or sample or because of errors in analyses or reporting (Huffcutt & Arthur, 1995). With that in mind, we first removed Oakes, Ferris, Martocchio, Buckley, and Broach (2001) because of its extremely large sample size of 9,721. To detect outliers, we calculated the sample-adjusted meta-analytic deviancy (SAMD) statistic (Huffcutt & Arthur, 1995; cf. Beal, Corey, & Dunlap, 2002), which approximates a *t* distribution. We used a cutoff of SAMD > 4 (e.g., Steel, 2007) to determine outliers for the effect of each predictor variable on transfer. This analysis identified 24 effect sizes as outliers out of the total of 349 effect sizes between various predictor variables and transfer. A review of these effect sizes identified reasons for caution, such as very large sample size (i.e., two effect sizes from Dierdorff & Surface, 2008, were based on $N = 2{,}105$), unlikely high effect sizes (e.g., Ameel, 1992, with $r = .77$ between posttraining self-efficacy and transfer, Mohammed, 1994, with $r = .75$ between social support and transfer), and one-time, self-report data (e.g., Chiaburu & Marinova, 2005; Velada & Caetano, 2007). The removal of outlier effect sizes resulted in a final data set of 325 independent correlations from 89 sources ($N = 12{,}496$).

Meta-Analytic Procedures

We used Hunter and Schmidt's (2004) meta-analytic procedure to conduct the overall analysis on the relationship between each predictor variable and transfer. We calculated a sample-weighted average correlation ($\bar{r}$) and derived the mean of population correlation (ρ) by correcting for unreliability in both the predictor and dependent variables. Consistent with the suggestion by Geyskens et al. (2009), we corrected for unreliability at the individual level when information was available. When reliability information was reported sporadically, we corrected for measurement error with artifact distribution (formulas provided in Hunter & Schmidt, 2004), which used all reliability coefficients coded for a particular variable for its analysis. We also calculated the percentage of observed variance explained by artifacts (i.e., sampling error and unreliability), as well as the standard deviation of the corrected correlation (SD_r).

Moderator Analyses

We used two heterogeneity tests to aid the detection of moderating effects: the 75% rule proposed by Hunter and Schmidt (2004) in conjunction with the credibility interval.

Specifically, when variance from sampling and measurement error accounts for less than 75% of the observed variance, the 75% rule suggests that there is a potential moderator in effect. A wide credibility interval also indicates the presence of moderators.

To examine the effect of categorical moderators, we used Hunter and Schmidt's (2004) subgroup analysis. When the subsequent subgroups displayed different mean corrected correlations and had lower average corrected variance than the whole group did, we concluded the categorical moderator was in effect. When moderators are not orthogonal to each other, hierarchical subgroup analysis can separate effects of different moderators (Geyskens et al., 2009). We adopted a partial hierarchical approach and examined the effects of categorical moderators in the following sequence: (a) SS/SMC bias, (b) transfer operationalization, and (c) other moderators not related to the measurement of transfer (i.e., open vs. closed, lab vs. field). When examining open skills as a moderator, when possible we divided our analysis by interpersonal/leadership versus other skills.

To examine the effect of continuous moderators, we employed weighted least squares (WLS) regression with inverse sampling error weighting suggested by Steel and Kammeyer-Mueller (2002). We conducted WLS regression only when there were more than 10 studies for the analysis. Moderator variables with severe positive skewness were first log transformed or power transformed to approximate normal distribution before WLS regression analysis.

Results

Study Characteristics

The final 89 studies that contributed at least one effect size to the meta-analyses included 58 journal articles, 5 conference papers, 24 dissertations, and 2 unpublished manuscripts. The majority of the samples (85%) were from the United States and Canada. The trainees included undergraduate students (24 studies, 27%), MBA or graduate students (12 studies, 13%), managers and supervisors (21 studies, 24%), and other nonmanagerial personnel (32 studies, 36%).

The sample included 61 field studies and 28 lab experiments. All of the lab studies had student samples, whereas 90% of field studies had nonstudent samples. The time between training and the transfer measures ranged from immediately after training to 163 weeks after training and was shorter for lab studies (i.e., $M = 1.6$ weeks; median = 1 day) than for field studies (i.e., $M = 15$ weeks; median = 7.5 weeks). The median length of training was 6 hours.

The field studies contained more open skills training (44 open, 15 closed, and 2 not codable) whereas the lab studies had more closed skills training (12 open and 16 closed). The most common closed skills trained were computer software and those involving simulations, such as flight simulator tasks. Of the 56 studies involving open skills, 71% included interpersonal or leadership skills (e.g., teamwork, negotiation) and 29% included other open skills (e.g., problem solving, substance abuse prevention).

The main effects of the predictor variables on transfer are presented in Table 1. Where SS/SMC bias could be expected to influence the relationship between a predictor and trans-

fer, we analyzed the effects for two subgroups of studies, one with SS/SMC bias present and the other without the influence of SS/SMC. These results are also presented in Table 1. Cohen's (1988) definition of effect sizes (small effect sizes are correlations of .10, moderate are .30, and large are .50) guided our interpretation.

Main Effects Considering SS/SMC

Our results indicate that when the predictor variables and transfer were both measured by the trainee at the same time, this SS/SMC bias consistently inflated the relationships between the constructs examined. For example, in the relationship between environment and transfer, the correlation for studies with SS/SMC bias was .54, whereas the correlation for studies without SS/SMC bias was .23. When the 13 studies that had SS/SMC bias were included in the calculation of the effect size, it increased from .23 to .36. Another example is motivation, for which the correlation with transfer was .23 for those studies without SS/SMC bias versus .41 when SS/SMC bias was present. SS/SMC bias also inflated the results of the relationship with transfer for the following constructs: locus of control, goal orientation, job involvement, posttraining self-efficacy, and utility reactions. To illuminate the uninflated or true relationship between constructs, we report on and discuss below only those results that exclude SS/SMC bias.

Among the trainee characteristics examined, cognitive ability (.37), conscientiousness (.28), and voluntary participation (.34) had moderate relationships with training transfer. It should be noted that all but two of the studies that examined the relationship between transfer and cognitive ability were in the lab context, most with no time between the end of training and the transfer measure. Neuroticism (.19), pretraining self-efficacy (.22), and motivation (.23), had small to moderate relationships with transfer. Small correlations were found between training transfer and Big Five personality dimensions agreeableness (−.03), extraversion (.04), and openness to experience (.08). In addition, small correlations were found between training transfer and trainees' age (.04), education (.07), male gender (.12), experience (.09), external locus of control (−.06), and job involvement (.04). Small correlations were also found for learning goal orientation (.14), prove-performance goal orientation (.03), and avoid-performance goal orientation (−.12). Most of the studies involving goal orientation examined transfer in the lab context with little or no time between training and the transfer measure.

In addition to the effect size of .22 discussed above for a general environment construct, we were able to perform an analysis on the environment context variable based on how environment was measured. We classified these measures into three different categories: support (e.g., peer support, supervisor support), transfer climate, and reversed-scored organizational constraints (e.g., lack of autonomy, situational constraints). Results indicated that transfer climate had the highest relationship with transfer (.27), followed by support (.21) and constraints (.05; reverse scored), although constraints was based on only two studies. Subsequent analysis indicated that supervisor support (.31) may have a stronger relationship with transfer than does peer support (.14), although these relationships also are based on small sample sizes.

Table 1
Relationships Between Predictor Variables and Transfer

Predictor	*K*	*N*	$\bar{r}$	SD_r	ρ	SD_ρ	% Variance	95% CI		80% CV	
Trainee characteristics											
Age	10	1,049	.04	.13	.04	.02	97	–.04	.12	.01	.07
Gender (male)	5	366	.11	.28	.12	.15	42	–.13	.36	–.12	.37
Education[a]	8	1,219	.06	.11	.07	.06	73	–.01	.14	–.02	.16
Experience	16	1,887	.08	.18	.09	.13	38	–.01	.17	–.13	.30
Cognitive ability	10	1,452	.31	.20	.37	.18	23	.19	.43	.08	.66
Conscientiousness	5	433	.23	.12	.28	.07	77	.13	.34	.17	.38
Neuroticism	5	653	–.16	.10	–.19	.04	88	–.25	–.07	–.25	–.13
Agreeableness	3	218	–.02	.07	–.03	.00	100	–.10	.06	–.03	–.03
Extraversion	3	218	.03	.08	.04	.00	100	–.06	.12	.04	.04
Openness	4	303	.06	.19	.08	.16	47	–.12	.25	–.18	.35
Locus of control (external)	6	744	–.08	.13	–.12	.08	73	–.19	.02	–.24	.01
SS/SMC	2	386	–.12	.10	–.17	.00	100	–.26	.01	–.17	–.17
Not SS/SMC	4	358	–.04	.14	–.06	.09	73	–.18	.10	–.20	.08
Learning goal orientation	12	1,718	.13	.14	.16	.10	51	.06	.21	.00	.33
SS/SMC	1	186	.32	.00	.39	.00					
Not SS/SMC	11	1,532	.11	.13	.14	.07	69	.03	.19	.02	.25
Prove–performance goal orientation	13	1,728	.06	.16	.07	.13	39	–.03	.14	–.15	.29
SS/SMC	1	186	.30	.00	.36	.00					
Not SS/SMC	12	1,542	.03	.15	.03	.09	57	–.06	.11	–.12	.19
Avoid–performance goal orientation	5	904	–.10	.09	–.12	.00	100	–.17	–.02	–.12	–.12
Pretraining self–efficacy	22	1,968	.19	.18	.22	.18	32	.11	.26	–.07	.52
Motivation	29	3,844	.24	.17	.29	.15	29	.18	.30	.03	.54
SS/SMC	5	1,270	.35	.04	.41	.00	100	.31	.38	.41	.41
Not SS/SMC	24	2,574	.19	.16	.23	.16	33	.13	.25	–.04	.49
Voluntary participation[a]	5	1,413	.22	.14	.34	.12	34	.10	.34	.14	.54
Job involvement[a]	4	546	.29	.21	.38	.20	21	.09	.50	.05	.71
SS/SMC	2	386	.41	.06	.52	.00	100	.33	.48	.52	.52
Not SS/SMC	2	160	.03	.06	.04	.00	100	–.06	.12	.04	.04
Environmental factors											
Work environment[a]	35	5,017	.30	.19	.36	.18	22	.23	.36	.06	.66
SS/SMC	13	3,623	.43	.20	.54	.12	25	.32	.54	.35	.73

(continued)

Table 1 (continued)

Predictor	*K*	*N*	$\bar{r}$	SD_r	ρ	SD_ρ	% Variance	95% CI		80% CV	
Not SS/SMC	22	2,085	.19	.16	.23	.14	43	.12	.26	.00	.46
Constraints (reverse–scored)	2	140	.05	.07	.05	.00	100	–.05	.14	.05	.05
Support	12	1,075	.18	.14	.21	.07	75	.10	.26	.10	.33
Climate	8	870	.23	.20	.27	.20	26	.09	.36	–.05	.60
Learning outcome variables											
Posttraining knowledge	34	3,825	.20	.20	.24	.17	30	.13	.26	–.04	.52
Posttraining self–efficacy	17	1,927	.19	.18	.22	.15	35	.10	.27	–.02	.46
SS/SMC	2	87	.40	.03	.46	.00	100	.36	.44	.46	.46
Not SS/SMC	15	1,840	.18	.18	.20	.14	35	.09	.27	–.03	.44
Reactions											
Utility reactions	9	987	.39	.29	.46	.28	11	.20	.58	.00	.92
SS/SMC	3	528	.60	.13	.69	.07	47	.45	.75	.58	.80
Not SS/SMC	6	459	.14	.13	.17	.04	92	.04	.24	.10	.23
Affective reactions	8	768	.07	.09	.08	.00	100	.01	.13	.08	.08
Overall reactions	7	897	.07	.18	.08	.12	46	–.06	.20	–.11	.27
Pre– or posttraining interventions											
Pretraining optimistic preview	3	221	.17	.11	.20	.00	100	.05	.30	.20	.20
Posttraining goal–setting	6	378	.07	.23	.08	.15	46	–.11	.26	–.17	.33
Posttraining relapse prevention	5	321	–.06	.15	–.06	.00	100	–.19	.08	–.06	–.06

Note. *K* = number of studies included in each analysis; *N* = total sample size in each analysis; $\bar{r}$ = sample size weighted mean correlation; SD_ρ = standard deviation of the observed correlations; ρ = mean population correlation (corrected for unreliability in predictor and criterion); SD_ρ = standard deviation of the corrected correlation; % Variance = percentage of variance attributed to sampling error and measurement unreliability; 95% CI = 95% confidence interval around $\bar{r}$; 80% CV = 80% credibility interval around ρ

[a]All of the studies were conducted in the field setting.

For learning outcomes, posttraining self-efficacy (.20) and posttraining knowledge (.24) both had small to moderate effects on transfer. Utility reactions had a corrected correlation of .17, while both affective reactions and reactions that included both affective and utility dimensions had small relationships (.08) with training transfer.

The effect of training interventions (i.e., optimistic preview, goal-setting, and relapse prevention) on transfer were small to moderate (.20, .08, and −.06, respectively), and the between-study variation of effect sizes for optimistic preview and relapse prevention was fully attributed to artifacts. However, these results should be interpreted with caution as they are based on a fairly small number of studies (i.e., 3 to 6). In addition, the 80% credibility interval for the correlation between transfer and goal-setting interventions ranged from −.17 to .33, indicating the presence of moderators on how effective these interventions were on improving transfer. An important moderator for goal-setting interventions discussed below is the lab-versus-field context.

Moderator Analyses

Given our finding that SS/SMC bias consistently inflates the observed relationships between predictors and transfer, the presence of SS/SMC bias could confound any further moderator analysis if SS/SMC bias is not orthogonal to the moderator variable. Therefore, we used only the studies without SS/SMC bias when further examining effects of other moderators.[3] Table 2 includes the moderating effects of transfer operationalization specified in Research Question 2.

Time lag versus no time lag between end of training and transfer measure. Pretraining self-efficacy is influenced by when transfer is measured, that is, $\rho = .32$ when taken immediately after training, versus $\rho = .21$ when there is a time lag between training and the transfer measure. For the four studies in which transfer was measured immediately after training, the correlation of posttraining self-efficacy was .38, which was significantly higher than the correlation of .11 for the 11 studies in which there was at least some time between training and the transfer measure. As compared with studies that didn't have a time lag, when there was a time lag between training and the transfer measure, our results also indicate a decrease in ρ for posttraining knowledge (i.e., from .48 to .18) and for experience (i.e., from .30 to .03).

Self versus other measure of transfer. The source of the transfer measure influenced the effect sizes between transfer and both pretraining self-efficacy and motivation. Pretraining self-efficacy had ρ of .29 for self versus .14 for others/objective. With motivation, when transfer was measured by the trainee (self), the ρ was .33, compared with .11 when transfer was measured objectively or by others. Although the difference in effect sizes was not as pronounced as for motivation, the correlation between environment and transfer also increased when measured by self versus other (i.e., .28 vs. .20).

Use versus effectiveness measure of transfer. We were also able to examine the moderator of use versus effectiveness for motivation, environment, and posttraining knowledge. When transfer was measured objectively or by others, the relationship between motivation and

Table 2
Moderating Effect of Transfer Operationalization on Predictor–Transfer Relationship

Predictor	*K*	*N*	$\bar{r}$	SD_r	ρ	SD_ρ	% Variance	95% CI		80% CV	
Experience	16	1,887	.08	.18	.09	.13	38	−.01	.17	−.13	.30
No Time Lag	4	423	.28	.09	.30	.00	100	.19	.37	.30	.30
Time Lag	12	1,464	.02	.17	.03	.07	64	−.07	.12	−.10	.15
Pretraining Self–Efficacy	22	1,968	.19	.18	.22	.18	32	.11	.26	−.07	.52
No Time Lag	4	305	.28	.16	.32	.09	64	.12	.43	.17	.47
Time Lag	18	1,663	.17	.18	.21	.19	30	.09	.25	−.10	.52
Other/Objective	10	910	.12	.19	.14	.19	29	.00	.24	−.18	.45
Self	8	753	.23	.17	.29	.15	41	.12	.35	.05	.53
Motivation[a]	24	2,574	.19	.16	.23	.16	33	.13	.25	−.04	.49
Other/Objective	13	1,236	.10	.14	.11	.05	85	.02	.17	.03	.19
Effectiveness	11	1,128	.08	.13	.10	.04	89	.01	.16	.03	.16
Use	2	108	.26	.04	.36	.00	100	.20	.31	.36	.36
Self	10	1,288	.27	.18	.33	.17	27	.16	.38	.05	.61
Effectiveness	4	319	.27	.15	.32	.11	57	.12	.42	.14	.50
Use	6	969	.27	.20	.35	.19	20	.11	.43	.03	.66
Work Environment[a]	22	2,085	.19	.16	.23	.14	43	.12	.26	.00	.46
Effectiveness	12	964	.18	.17	.21	.16	42	.08	.27	−.04	.47
Use	10	1,121	.20	.16	.24	.13	45	.10	.30	.04	.45
Other/Objective	12	1,292	.17	.20	.20	.18	28	.05	.28	−.10	.50
Self	8	709	.24	.09	.28	.00	100	.17	.30	.28	.28
Posttraining Knowledge	34	3,825	.20	.20	.24	.17	30	.13	.26	−.04	.52
No Time Lag	7	785	.38	.19	.48	.15	34	.24	.52	.23	.73
Time Lag	27	3,040	.15	.15	.18	.13	45	.09	.21	−.02	.39
Effectiveness	14	1,456	.14	.17	.17	.13	44	.05	.23	−.05	.38
Use	13	1,584	.16	.13	.20	.12	46	.09	.23	.00	.39
Post training self–efficacy[a]	15	1,840	.18	.18	.20	.14	35	.09	.27	−.03	.44
No Time Lag	4	659	.32	.08	.38	.00	100	.25	.40	.38	.38
Time Lag	11	1,181	.09	.17	.11	.09	60	−.01	.19	−.04	.26

Note. *K* = number of studies included in each analysis; *N* = total sample size in each analysis; $\bar{r}$ = sample size weighted mean correlation; SD_r = standard deviation of the observed correlations; ρ = mean population correlation (corrected for unreliability in predictor and criterion); SD_ρ = standard deviation of the corrected correlation; % Variance = percentage of variance attributed to sampling error and measurement unreliability; 95% CI = 95% confidence interval around $\bar{r}$; 80% CV = 80% credibility interval around ρ

[a]Included only studies without SS/SMC bias in the analysis.

transfer was higher for the 2 studies in which transfer was measured as use (.36) than in the 11 studies in which transfer was measured as effectiveness (.10). On the other hand, when transfer was measured by self, the relationships between motivation and transfer were similar (.35 for use vs. .32 for effectiveness). For environment, use measures have only slightly higher relationships than effectiveness measures (.24 vs. .21, respectively). There was also a slight increase in the correlation of posttraining knowledge when transfer was measured as use (.20) versus effectiveness (.17).

Open versus closed skill. Table 3 presents the results of the moderator analysis for open versus closed skills. For the relationship between cognitive ability and transfer, two studies examined open skills, and eight studies examined closed skills. Although based on only two studies, it is interesting to note that there was a small, negative relationship between cognitive ability and the transfer of open skills (−.14). This contrasts with the moderately strong, positive relationship between cognitive ability and the transfer of closed skills (.41).

For all other variables examined, predictor–transfer relationships were stronger for open than for closed skills, including trainee experience (.06 and −.02, respectively) and motivation (.19 and .11, respectively). For pretraining self-efficacy, the relationship with transfer is higher for open than for closed skills (.23 vs. .10). This finding is similar for posttraining self-efficacy (i.e., .13 for open skills vs. .06 for closed skills). When examining the environment–transfer relationship, we found a correlation of .26 for open skills and a correlation of .04 for closed skills. Finally, in studies that examined the relationship between transfer and posttraining knowledge with some time lag between the end of training and transfer, the correlation is .20 for open skills and .14 for closed skills. When we examined only studies of interpersonal/leadership skills training (as a subset of open skills), we found that post-training self-efficacy, motivation, work environment, post-training knowledge, and pre-training self efficacy all had similar correlations with transfer (i.e, .22, .20, .20, .16, and .14, respectively).

Lab versus field context. As seen in Table 4, the effect of posttraining self-efficacy is stronger in the field than in the lab context (i.e., .17 vs. .08). Similarly, cognitive ability has a negative relationship with transfer in two field studies, whereas it has a positive relationship in lab studies (i.e., .41 vs. −.14). On the other hand, other predictors demonstrate stronger relationships in the field than in the lab context, such as pretraining self-efficacy (i.e., .24 vs. .11), motivation (i.e., .24 vs. .17), and goal setting interventions (i.e., .28 vs. .00). Posttraining knowledge has similar relationships with transfer in the field and lab context (i.e., .19 vs. .16).

Publication source. Per Table 5, we found evidence that published studies reported stronger relationships with transfer than unpublished studies did for environment (.26 vs. .18), motivation (.28 vs. .15), pretraining self-efficacy (.31 vs. .10), and posttraining self-efficacy (.37 vs. .06). The relationship between posttraining knowledge and transfer was contrary to this trend, with similar relationships, $\rho = .23$ and .24, for published and unpublished studies, respectively.

Time between the end of training and the transfer measure. Table 6 indicates the moderator analysis of the length of time between the end of training and the time the transfer measure was

Table 3
Moderating Effect of Type of Skill on Predictor–Transfer Relationship

Predictor	*K*	*N*	$\bar{r}$	SD_r	ρ	SD_ρ	% Variance	95% CI		80% CV	
Cognitive ability	10	1,452	.31	.20	.37	.18	23	.19	.43	.08	.66
Closed	8	1,338	.34	.12	.41	.10	40	.26	.42	.24	.58
Open	2	114	–.12	.06	–.14	.00	100	–.21	–.03	–.14	–.14
Experience[b]	12	1,464	.02	.17	.03	.07	64	–.07	.12	–.10	.15
Closed	4	619	–.02	.15	–.02	.04	85	–.17	.13	–.08	.04
Open	8	845	.06	.16	.06	.08	67	–.05	.16	–.06	.18
Pretraining self–efficacy[b]	18	1,663	.17	.18	.21	.19	30	.09	.25	–.10	.52
Closed	3	350	.08	.14	.10	.09	63	–.08	.24	–.05	.25
Open	15	1,313	.19	.19	.23	.20	29	.10	.29	–.09	.55
Interpersonal/leadership	11	908	.11	.15	.14	.12	56	.03	.20	–.06	.33
Other open skills	4	405	.37	.25	.44	.17	28	.13	.62	.17	.72
Motivation[a]	24	2,574	.19	.16	.23	.16	33	.13	.25	–.04	.49
Closed	6	589	.09	.13	.11	.00	100	–.01	.19	.11	.11
Open	17	1,490	.16	.16	.19	.13	47	.08	.24	–.03	.41
Interpersonal/leadership	12	951	.17	.15	.20	.11	58	.08	.26	.02	.39
Other open skills	5	539	.14	.21	.17	.17	33	–.05	.32	–.11	.45
Work environment[a]	22	2,085	.19	.16	.23	.14	43	.12	.26	.00	.46
Closed	4	337	.03	.11	.04	.00	100	–.07	.13	.04	.04
Open	18	1,748	.22	.16	.26	.13	46	.15	.29	.05	.48
Interpersonal/leadership	7	545	.17	.14	.20	.00	100	.06	.27	.20	.20
Other open skills	5	579	.27	.19	.34	.15	34	.11	.44	.09	.59

(continued)

Table 3 (continued)

Predictor	*K*	*N*	$\bar{r}$	SD_r	ρ	SD_ρ	% Variance	95% CI		80% CV	
Posttraining knowledge[b]	27	3,040	.15	.15	.18	.13	45	.09	.21	−.02	.39
Closed	8	959	.13	.14	.14	.09	56	.02	.23	−.01	.29
Open	19	2,081	.16	.15	.20	.13	42	.09	.23	−.02	.42
Interpersonal/leadership	13	1,217	.13	.17	.16	.12	51	.04	.22	−.04	.36
Other open skills	6	864	.21	.11	.25	.13	36	.12	.30	.04	.46
Posttraining self-efficacy[b]	11	1,181	.09	.17	.11	.09	60	−.01	.19	−.04	.26
Closed	4	462	.05	.05	.06	.00	100	.00	.11	.06	.06
Open	7	719	.12	.19	.13	.13	43	−.02	.26	−.08	.34
Interpersonal/leadership	5	494	.19	.16	.22	.09	61	.05	.33	.07	.36
Other open skills	2	225	−.04	.04	−.04	.00	100	−.09	.01	−.04	−.04

Note. *K* = number of studies included in each analysis; *N* = total sample size in each analysis; $\bar{r}$ = sample size weighted mean correlation; SD_r = standard deviation of the observed correlations; ρ = mean population correlation (corrected for unreliability in predictor and criterion); SD_ρ = standard deviation of the corrected correlation; % Variance = percentage of variance attributed to sampling error and measurement unreliability; 95% CI = 95% confidence interval around $\bar{r}$; 80% CV = 80% credibility interval around ρ

[a]Included only studies without SS/SMC bias in the analysis.

[b]Included only studies that operationalized transfer at least 1 day after training.

Table 4
Moderating Effect of Lab versus Field Context on Predictor–Transfer Relationship

Predictor	*K*	*N*	$\bar{r}$	SD_r	ρ	SD_ρ	% Variance	95% CI		80% CV	
Cognitive ability	10	1,452	.31	.20	.37	.18	23	.19	.43	.08	.66
Field	2	114	−.12	.06	−.14	.00	100	−.21	−.03	−.14	−.14
Lab	8	1,338	.34	.12	.41	.10	40	.26	.42	.24	.58
Pretraining self–efficacy[b]	18	1,663	.17	.18	.21	.19	30	.09	.25	−.10	.52
Field	12	1,226	.20	.19	.24	.20	25	.09	.31	−.09	.57
Lab	6	437	.09	.16	.11	.10	68	−.04	.22	−.05	.26
Motivation[a]	24	2,574	.19	.16	.23	.16	33	.13	.25	−.04	.49
Field	18	2,128	.20	.17	.24	.17	27	.12	.28	−.05	.52
Lab	6	446	.14	.13	.17	.00	100	.04	.25	.17	.17
Posttraining knowledge[b]	27	3,040	.15	.15	.18	.13	45	.09	.21	−.02	.39
Field	19	2,131	.16	.16	.19	.14	37	.09	.23	−.05	.43
Lab	8	909	.13	.12	.16	.01	99	.04	.21	.14	.18
Posttraining self–efficacy [b]	11	1,181	.09	.17	.11	.09	60	−.01	.19	−.04	.26
Field	7	816	.07	.10	.08	.00	100	.00	.15	.08	.08
Lab	4	365	.15	.22	.17	.16	34	−.07	.37	−.10	.44
Goal–setting intervention	6	378	.07	.23	.08	.15	46	−.11	.26	−.17	.33
Field	3	104	.25	.34	.28	.22	39	−.13	.63	−.09	.64
Lab	3	274	.00	.09	.00	.00	100	−.10	.10	.00	.00

Note. *K* = number of studies included in each analysis; *N* = total sample size in each analysis; $\bar{r}$ = sample size weighted mean correlation; SD_r = standard deviation of the observed correlations; ρ = mean population correlation (corrected for unreliability in predictor and criterion); SD_ρ = standard deviation of the corrected correlation; % Variance = percentage of variance attributed to sampling error and measurement unreliability; 95% CI = 95% confidence interval around $\bar{r}$; 80% CV = 80% credibility interval around ρ

[a]Included only studies without SS/SMC bias in the analysis.

[b]Included only studies that operationalized transfer at least 1 day after training.

Table 5
Investigation of Publication Bias on Predictor–Transfer Relationship

Predictor	*K*	*N*	$\bar{r}$	SD_r	ρ	SD_ρ	% Variance	95% CI		80% CV	
Pretraining self–efficacy											
Published data	14	1,109	.26	.18	.31	.16	39	.17	.36	.05	.58
Unpublished data	8	859	.09	.16	.10	.13	44	–.02	.19	–.11	.32
Motivation[a]											
Published data	14	1,504	.24	.16	.28	.16	33	.15	.32	.02	.55
Unpublished data	10	1,070	.13	.17	.15	.12	45	.02	.23	–.06	.35
Work environment[a]											
Published data	13	1,244	.22	.19	.26	.17	32	.12	.32	–.02	.54
Unpublished data	9	841	.15	.13	.18	.00	100	.06	.23	.18	.18
Posttraining knowledge											
Published data	21	2,099	.18	.21	.23	.17	35	.09	.27	–.05	.50
Unpublished data	13	1,726	.22	.19	.24	.16	25	.11	.32	–.03	.51
Posttraining self–efficacy[a]											
Published data	7	841	.32	.12	.37	.00	100	.23	.40	.37	.37
Unpublished data	8	999	.06	.08	.06	.00	100	.00	.11	.06	.06

Note. *K* = number of studies included in each analysis; *N* = total sample size in each analysis; $\bar{r}$ = sample size weighted mean correlation; SD_r = standard deviation of the observed correlations; ρ = mean population correlation (corrected for unreliability in predictor and criterion); SD_ρ = standard deviation of the corrected correlation; % Variance = percentage of variance attributed to sampling error and measurement unreliability; 95% CI = 95% confidence interval around $\bar{r}$; 80% CV = 80% credibility interval around ρ

[a]Included only studies without SS/SMC bias in the analysis.

taken. The length of time entered in the analysis differed across predictors, with a smaller range for both pretraining self-efficacy and posttraining self-efficacy (ranging from immediately after training to 19 weeks, medians = 4) and a larger range for both posttraining knowledge and environment (from immediately after training to 163 weeks, median = 4 and 9, respectively).

The relationship between transfer and knowledge is moderated by the amount of time between training and the transfer measure. The significant, negative beta ($\beta = -.25$, $p < .05$) indicates that as the amount of time increased, the strength of the relationship between posttraining knowledge and transfer decreased. Our regression results ($\beta = -.64$, $p < .01$) indicate that the strength of the relationship between posttraining self-efficacy and transfer also decreased as the amount of time between training and transfer increased. On the other hand, nonsignificant regression results demonstrate that the relationships between transfer and the following constructs are not moderated by the amount of time between the end of the training and transfer: environment, pretraining self-efficacy, and motivation.

Relationships Between Transfer Measures

Table 7 presents the results of those studies in which two different sources (i.e., self and other) obtained a similar transfer measure (i.e., both sources rated use, or both sources rated effectiveness) at the same time. This analysis demonstrates the association between ratings provided by the trainee and either their peers, supervisor, or a trained rater on the trainee's transfer of training. Results indicate that a moderate correlation exists regardless of whether the other rater is a supervisor (.28) or peer(s) (.26).

In addition, we found a large relationship (.57) between measures of transfer over time for studies that obtained similar measures (e.g., both measures of effectiveness or both measures of use) by the same source (e.g., both trained raters). Four of the six studies included in this analysis used trained raters to measure transfer in a lab context. The Time 1 and Time 2 measures for these four studies were separated by 1 to 7 weeks. We identified only two field studies (i.e., Axtell et al. 1997; Martineau, 1995) that obtained multiple measures of transfer over time from the same source, and both had strong correlations over time (.58 and .55, respectively).

Discussion

Despite a long research history and several qualitative reviews, the literature on transfer of training has remained characterized by mixed findings and the lack of an empirical synthesis. Overall, our study brings some clarity to this literature and demonstrates that the transfer of training is influenced by a variety of predictor variables (e.g., motivation of trainee, learning outcomes, supportive transfer climate).

A key objective of our meta-analysis was to bring a more precise quantitative lens to a literature with a wide variety of studied variables and inconsistent criteria measurement. The findings that stand out most are that (a) once SS/SMC is controlled for, there are a surprisingly limited number of strong predictor relationships with transfer; (b) the relationships to transfer of several variables are contingent on whether the trained skills were open or closed; and (c) reported relationships are significantly affected by the source and timing of transfer

Table 6
Moderating Effect of the Length of Time Between End of Training and Transfer Measure

Predictor	*K*	b	*p*
Pretraining self–efficacy	22	–.08[a]	.49
Motivation	22	–.29[a]	.11
Work environment	21	.07[b]	.62
Posttraining knowledge	33	–.25[b]	.01
Posttraining self–efficacy	15	–.64[a]	.00

Note. *K* = number of effect size included in each analysis; β = beta weight from weighted least square regression.
[a]Time lag measured in weeks, power transformed to reduce skewness and influence of extreme time lag; specifically, 1/3 power transformation was used.
[b]Time lag measured in weeks, power transformed to reduce skewness and influence of extreme time lag; specifically, 1/5 power transformation was used

measurement. Below we elaborate on each of these findings and discuss their implications for future research and practice.

Discussion of Meta-Analytic Relationships

Our first question concerned the main effects of predictor variables on transfer. An important qualifier to our findings is that when predictor variables and transfer measures were both self-assessed by the trainee at the same time, there was a *consistent inflation* of the relationships examined. This effect of SS/SMC ranged from approximately .10 to .50, with correlations typically being inflated by around .20 to .30. For example, our data indicate that studies examining the relationship between work environment and transfer have a correlation that is .31 higher when SS/SMC is present (i.e., .54 vs. .23). Based on that finding, we suspect that many reported relationships have likely been overstated because of SS/SMC. This pattern of findings is consistent with the documented effects of common method variance in many research areas (Podsakoff et al, 2003). Controlling for SS/SMC effects gives us more confidence in the results that we report, as we believe those relationships *not* characterized by this effect provide the most accurate estimates. The discussion below therefore synthesizes results *only from studies not subject to SS/SMC*.

The search for the "transfer-ready" trainee has been ubiquitous in the literature, and our findings indicate that, although there are some significant relationships across studies, there are surprisingly few consistently strong individual predictors of transfer. The single largest relationship to transfer we found was for cognitive ability. Transfer is not solely dependent on trainees' cognitive ability, however, as other moderately strong relationships were observed for other trainee characteristics, such as conscientiousness and voluntary participation. Neuroticism, pretraining self-efficacy, motivation to learn, and a learning goal orientation also had moderate relationships with transfer. Most other individual difference variables had negligible corrected relationships. We conclude that a select number of trainee characteristics relate positively to transfer, and the relationships found are at roughly the same level

Table 7
Correlations Between Self Versus Other Measures of Transfer at Same Time and Repeated Measures of Transfer by Same Rater at Different Times

Predictor	*K*	*N*	$\bar{r}$	SD_r	ρ	SD_ρ	% Variance	95% CI		80% CV	
Different raters at same time	9	938	.23	.22	.28	.12	45	.09	.38	.08	.48
Self & peer	4	644	.23	.16	.26	.10	41	.07	.39	.09	.43
Self & supervisor	4	201	.23	.30	.28	.19	42	−.07	.53	−.04	.60
Self & trained rater	1	93	.30	0	.36						
Same raters at different time	6	319	.50	.21	.57	.18	32	.33	.67	.27	.87

Note. *K* = number of studies included in each analysis; *N* = total sample size in each analysis; $\bar{r}$ = sample size weighted mean correlation; SD_r = standard deviation of the observed correlations; ρ = mean population correlation (corrected for unreliability in predictor and criterion); SD_ρ = standard deviation of the corrected correlation; % Variance = percentage of variance attributed to sampling error and measurement unreliability; 95% CI = 95% confidence interval around $\bar{r}$; 80% CV = 80% credibility interval around ρ

as the most predictive situational variables. That is, there is no clear superiority of individual variables over situational variables, or the reverse. Nevertheless, the results go beyond qualitative reviews that report mixed support for the relationship of characteristics with transfer (e.g., Burke & Hutchins, 2007) to provide more precise information about these predictor–transfer relationships.

In addition, although previous qualitative reviews have indicated mixed support for the relationship between work environment and transfer (e.g., Cheng & Hampson, 2008), we found meaningful, nonzero correlation between work environment and transfer. Subsequent analysis that subdivided the general measure of support into three different categories, (a) support (e.g., peer and supervisor support), (b) transfer climate, and (c) organizational constraints (e.g., level of autonomy, situational constraints), indicated that transfer climate had the highest relative relationship with transfer, followed closely by support. However, the confidence and credibility intervals indicate that support has a more consistent relationship with transfer than climate does. Constraints had a negligible relationship to transfer—although that finding is based on few investigations. Further analysis revealed that supervisor support had a stronger relationship with transfer than did peer support, although those correlations are also based on small sample sizes.

One appeal of work environment factors is the sense that they are directly subject to influence and control in organizational learning environments. That is, there are often logistic and political constraints to preselecting a certain group of trainees on the basis of individual characteristics. Situational variables, on the other hand, can potentially be actively managed to create environments most conducive to transfer. Therefore, the finding in support of positive transfer climates is encouraging in that it supports a proactive approach to leveraging transfer.

Consistent with prior research comparing different levels of training evaluation (Alliger et al., 1997; Colquitt et al., 2000), posttraining self-efficacy and posttraining knowledge both had small to moderate mean corrected correlations with transfer. Posttraining utility reactions had a small to moderate correlation with transfer; both affective reactions and overall reactions (which included both affective and utility dimensions) had small correlations.

In their 1988 review, Baldwin and Ford noted a paucity of investigations of interventions designed to leverage transfer and advocated for an increase in such research. That call has been modestly heeded in the succeeding two decades with explorations of transfer interventions that include goal setting, relapse prevention, and program framing (i.e., optimistic previews). Although some studies reported successful interventions (e.g., Brown, 2005), the overall meta-analytic effect sizes of existing transfer interventions on transfer were only small to moderate.

Therefore, our data lead to a less optimistic conclusion than a recent summary statement by Burke and Hutchins, (2007), "Indeed, using goals (both assigned and participative goal setting) to increase training transfer has received much support in the extant literature" (p. 273). In contrast, we found a relatively small effect of goal setting on transfer, with very wide confidence and credibility intervals. Put simply, the evidence in support of transfer interventions was not as compelling as either our intuition or prior transfer commentaries would suggest. One possible explanation is the small amount of *time spent* on typical interventions investigated. More specifically, the amount of training time spent on interventions ranged from just a half hour to 4 hours, with most interventions lasting just 2 hours or less. It is likely wishful thinking that such minimal interventions will significantly enhance an outcome as complex and challenging as transfer.

Impact of Open Versus Closed Skills on Transfer Relationships

A general pattern in the present results is that the predictor constructs tended to have stronger relationships to transfer with open skills than with closed skills. For example, based on our data, pretraining self-efficacy, motivation, and the environmental context become *more* important when training open skills. With open skills, trainees have more choice as to what and how to apply trained principles and concepts to the job. Closed skills, in contrast, have much more prescribed transfer behaviors, and thus the impact of environmental factors may be considerably less.

One intriguing exception to the generally greater influence of predictor variables with open skills was cognitive ability, which had a stronger relationship with closed skills. Based on eight lab studies, there was a moderately high relationship between cognitive ability and transfer of closed skills, but we found only two field studies that examined the transfer of open skills and included cognitive ability as a predictor. Both of these field studies indicated that there is a small *negative* relationship between cognitive ability and transfer. While we are not suggesting that this is a robust finding, or that having lower cognitive ability will improve transfer, it may be that closed skills are more dependent on cognitive ability than are open skills. In any case, this is one interesting example of how the open-versus-closed distinction alters reported transfer relationships.

Impact of Transfer Measurement and Other Moderators on Transfer Relationships

Another set of our research questions concerned the influence on reported relationships of the way in which transfer has been operationalized and measured. One consistent finding was that transfer measured immediately following training yielded consistently stronger relationships with predictor variables than transfer measured after a time lag. This issue was primarily relevant to lab studies. Similar to our findings related to SS/SMC, we believe lab studies that include a time lag are of much higher quality than are those that do not. Our results also revealed that self-reports had consistently stronger relationships with transfer criteria of interest than did data collected from other sources.

Perhaps most interesting, although we were able to examine the effectiveness-versus-use moderator for only a few predictor–transfer relationships, use measures of transfer generally had slightly stronger relationships than did effectiveness measures. For example, trainee motivation has a stronger relationship with transfer measures of use than with measures of effectiveness. This is consistent with the reality that trainees with higher levels of motivation attempt to utilize trained skills more often. However, how effective the trainee is in transferring training is affected by additional factors that may not be under the direct control of the trainee. In addition, motivation is just one factor that affects trainees' ability to effectively transfer training. These results point to the importance of transfer researchers' becoming more cognizant of distinctions among different types of transfer measurement.

Our remaining research questions dealt with isolating any influence on reported relationships related to whether studies were lab or field based, published or unpublished, and the timing and source of transfer measurement. Although the lab-versus-field moderator did help explain variance across studies for most predictor variables, the primary observation is

that there was not a consistent effect. In other words, predictor–transfer relationships weren't consistently larger or smaller in lab or field settings. While there is some indication that context could make a difference, it is not clear which theoretical mechanisms might explain these differences or that they are operating on a consistent basis.

With respect to the file drawer issue (Rosenthal, 1979), we did, in fact, find some limited evidence that published studies demonstrate higher correlations than unpublished studies. This could be because published studies have more construct-valid measures than unpublished studies do. In any case, a similar result has been found in other meta-analytic studies (e.g., Judge & Ilies, 2002; Judge, Thoresen, Bono, & Patton, 2001).

As Baldwin and Ford (1988) noted more than 20 years ago, a critical condition for transfer is maintenance. We found that the relationship between posttraining knowledge and transfer did decline when the time between training and transfer was greater. This was also the case for posttraining self-efficacy. Therefore, we found some evidence that the effects of learning outcomes may decay over time.

Our final question dealt with the relationships between the same measures of transfer taken by different raters or taken at different times. We found only modest correlations of others' reports of trainees' transfer with trainees' perceptions of their transfer. These correlations are very similar in magnitude to research estimates of self and supervisory ratings of job performance (Heidemeier & Moser, 2009). In other words, it appears that a trainee's level of agreement with his or her manager is similar when evaluating both training transfer and job performance. This also supports the notion that the source of the transfer measure is likely to influence predictor–transfer relationships. When measures of transfer were obtained by the same source at different times, the correlations between these measures were quite high. This is an initial indicator that transfer (or at least the perceptions of trainees' transfer) may be consistent over time.

Implications for Future Research

After carefully considering 89 empirical studies of transfer we have some targeted views with respect to the direction of future research. First, our meta-analytic review found that the issue of SS/SMC is so pronounced in inflating relationships, and so problematic in interpreting relationships, that we call for a moratorium on such studies. That is, it is impossible to draw strong conclusions about transfer relationships from studies that have both SS/SMC issues because we cannot disentangle the true relationship from the measurement issues. The strongest field studies will not collect both the independent and transfer variables at the same time from the trainee (same source). The strongest lab studies will include a time-lag between training and the transfer measure.

Beyond recognition of these measurement issues, we would encourage transfer researchers to increase precision in their selection and reporting of transfer outcomes. That is, how transfer is conceptualized, and how and when it is measured, *really does matter*. Although others are beginning to recognize this reality (Baldwin et al., 2009; Barnett & Ceci, 2002; Ford & Weissbein, 1997; Taylor et al., 2009), the present meta-analytic results conclusively demonstrate that the way in which transfer is operationalized and measured has significant effects on relationships ultimately reported. Indeed, we suspect that several reported and conventionally accepted findings might be subject to some reinterpretation if more precise delineation of transfer measures was considered.

A pressing need for future research, therefore, is an overt focus on the effects of different types and forms of transfer measurement (Holton & Baldwin, 2003). For example, we could envision studies in which both use and effectiveness measures were obtained from trainees and others (e.g., their supervisors or peers). If multiple measures could be obtained over time, this type of study would enable researchers to directly examine how the relationship between predictors (such as motivation or environment) may differ depending on how transfer is operationalized or when the transfer measure is obtained. Moreover, we believe studies that measure the effectiveness of training are better than those that measure use. This is because we are ultimately interested in having trainees effectively apply training (which ultimately will lead to positive results). While the use of training is necessary and certainly a goal of training, if the training is applied ineffectively, then the training ultimately will not lead to positive organizational outcomes.

A final understudied area for future research concerns the nature and objectives of the training in question. The present finding of significant moderating relationships for open versus closed skills is one manifestation of this point. With open skills, trainees have more choice as to what and how to apply trained principles and concepts to the job. Training research could benefit from examining transfer as a conscious choice that individuals make (Baldwin et al., 2009; Yelon, Sheppard, Sleight, & Ford, 2004). One could study why transfer is attempted, how choices are made to personalize or customize the training received, or why a choice is made not to attempt to transfer an open skill to the job. For example, Anderson (2003) made a convincing case as to why *not* making a choice is a likely outcome in many situations. He cites decision-making research that reveals that, in many situations, people prefer no change, nonaction, or choice deferral. Similarly, Steel (2007) argued that nonaction often has value, especially when it is uncertain what the outcome will be if a choice to act is made. This uncertainty can be heightened in the case when individuals are trained in open skills. It is the investigation of theory-driven substantive issues such as these that will most advance the field in the years ahead.

Indeed, we find it curious that such limited information about training content and training objectives is typically reported in training transfer studies. It is difficult to contemplate a cumulative body of evidence that can provide practical guidance to training professionals without further classification and taxonomic work on just what is being trained and what objectives are desired (Kraiger, 2002). The present findings, which indicate differences in transfer based on whether the training was concerned with open or closed skills, should be a catalyst for this type of orientation. Such an orientation would shift the focus of research from the general question, "Can training transfer?"—which has already been answered affirmatively—to a more targeted focus on common training objectives or types of skills trained, such as leadership, sales, and customer service. For example, what should be the content and preferred delivery method of a training program for leadership skills, and how should it be structured differently across different learner populations and organizational contexts? It is the investigation of theory-driven substantive issues such as these that will most advance the field.

Implications for Practice

In addressing the recurring transfer "problem," some authors have suggested that there has been far too much hope and not enough active strategizing and intervention based on the best

scientific evidence available (Holton & Baldwin, 2003). Of course, evidence-based action requires a synthesis and accessibility to the evidence that heretofore has not readily existed for training professionals. The present findings, although providing no comprehensive blueprint for effective transfer, do offer some preliminary guidance for training professionals.

Perhaps most important, the roughly equivalent predictive power of several individual and situational predictors reflects the reality that there are no magic bullets for leveraging transfer. This means that training professionals should consider multiple transfer strategies in combination. Just as personnel selection experts employ multiple selection predictors with moderate (but known) relationships to job performance (e.g., work samples, structured interviews, aptitude tests), so too should training professionals look to a set of strategies with demonstrated relationships to transfer. Based on the present results, the most promising avenues seem to be more proactive selection of training cohorts, a focus on increasing the motivation of trainees, and finding ways to induce higher levels of supervisor and peer support in the work environment. Learning outcomes are also related to transfer, suggesting that to the extent that the training program can increase posttraining knowledge and self-efficacy, the more likely trainees will be to transfer the training.

Another finding of practical importance is the lack of consistent support for any particular transfer interventions. Interventions may need to be longer and more impactful. Hutchins and Burke (2006) note that using a relapse prevention intervention at the end of training may not be successful because of trainee fatigue. They suggested that one avenue for increasing impact would be to incorporate relapse prevention principles *throughout* a particular training experience, and this is an idea worth testing across different interventions as well. Training professionals should be aware of that data and not be misled by false claims.

Despite a lack of strong support for existing interventions, we are not prepared to conclude that transfer is resistant to intervention. For example, although based on only three studies, optimistic previews (as compared to realistic previews), in which positive statements about the upcoming training are communicated to trainees, had a moderate, positive relationship with transfer. This has been a consistent finding even though two of the three existing studies predicted the opposite—that realistic previews would be more effective (e.g., Hicks & Klimoski, 1987; Ungsrithong, 1991).

The reality is that the bulk of evidence on interventions is still not very action oriented. That is, the vast majority of studies have stopped at the point of identifying, describing, or measuring factors that may influence transfer without investigating how those factors might be effectively managed or changed. So this is an arena that would be ripe for research–practice partnerships, in which many more of the transfer predictors are tested in the context of actual interventions.

We do not believe that achieving higher transfer necessarily involves substantial new processes or systems in organizations. Rather, we contend that the most significant gains in transfer will come when learning is more tightly integrated into the process and reward systems that already matter in a firm. The challenge is not how to build a bigger and more influential transfer support system; it is how to make transfer a more integral part of the existing organizational climate.

Study Limitations

Like any comprehensive attempt to aggregate data, this study has several limitations that warrant mention. First, the study focused on fairly broad transfer predictors (e.g., work environment, motivation). Although in some cases a number of sublevels within those broad factors were identified and examined, there is a need for more studies to allow the examination of other sublevels in future meta-analytic work.

Second, some of our results were based on small cell sizes or few studies and may therefore be subject to second-order sampling error (Hunter & Schmidt, 2004). In regard to this issue, Schmidt, Hunter, Pearlman, and Hirsh (1985) noted that although meta-analyses based on small numbers of studies may increase the variability in the effect sizes, they do not affect the mean estimates. Thus, estimates that are distinguishable from zero based on a small number of studies will very likely continue to be distinguishable from zero as evidence accumulates. Conceptually, even small meta-analyses are superior to the subjectivity and imprecision involved in qualitative reviews that attempt to interpret primary study results.

Third, only a few field studies have collected multiple measures of transfer over time from the same source, and this made it difficult to truly explore the "maintenance" of transfer over time. More empirical studies are sorely needed if we are to more conclusively examine transfer maintenance.

Finally, missing information was encountered in several original studies, leading to the exclusion of some data from the present analysis. More careful documentation of the context in which training is conducted, as well as basic descriptive statistics (e.g., group means and standard deviations; reliabilities of measures), would be helpful in future meta-analyses.

Conclusion

The escalating level of investment made in training and the accompanying expectations of that investment enhancing firm performance have combined to create greater urgency in the search for evidence and tools to improve the transfer of training. While there is growing evidence that investments in training lead to demonstrable results that positively affect individual and organizational performance (Arthur et al., 2003; Birdi et al., 2008; Taylor et al., 2009; Tharenou, Saks, & Moore, 2007), we need to continue to increase our understanding of the factors that influence the application and transfer of training. This quantitative review synthesizes what we know to date, and our hope is that the findings transfer to more precise and impactful transfer investigations, as well as more effective training practice.

Notes

1. These journals included *Academy of Management Journal*, *Human Performance*, *Human Resource Development International*, *Human Resource Development Quarterly*, *Human Resource Management*, *Human Resource Management Journal*, *Human Resource Management Review*, *International Journal of Human Resource Management*, *International Journal of Training and Development*, *Journal of Applied Psychology*, *Journal of Business and Psychology*, *Journal of Management*, *Journal of Organizational Behavior*, *Journal of Occupational and Organizational Psychology*, *Organizational Behavior and Human Decision Processes*, *Performance Improvement Quarterly*, and *Personnel Psychology*.

2. We eliminated studies that included nontrainees (i.e., control groups that did not receive training) in the computation of the correlation coefficients because we were interested only in examining the transfer of those participants who received training.

3. When addressing the type of skill and study context (see Tables 3 and 4), to avoid confounding the effect of type of skill or study context with transfer operationalization, we tested only the moderating effect of type of skill within subsets of studies that used similar operationalizations of transfer. For example, to test the moderating effect of type of skill on the relationship between pretraining self-efficacy and transfer, we selected only the studies that measured transfer with a time lag after training. Had we included the other four studies that measured transfer with no time lag (all of which involved closed skills), the effect of time lag would have confounded the moderating effects we were examining.

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