

# A Review and Meta-Analysis of the Nomological Network of Trainee Reactions

Traci Sitzmann

Advanced Distributed Learning Co-Laboratory

Kenneth G. Brown

University of Iowa

Wendy J. Casper

University of Texas at Arlington

Katherine Ely

George Mason University

Ryan D. Zimmerman

Texas A&M University

A review and meta-analysis of studies assessing trainee reactions are presented. Results suggest reactions primarily capture characteristics of the training course, but trainee characteristics (e.g., anxiety and pretraining motivation) and organizational support also have a moderate effect on reactions. Instructional style ( $\rho = .66$ ) followed by human interaction ( $\rho = .56$ ) were the best predictors of reactions. Reactions predicted pre-to-post changes in motivation ( $\beta = .51$ ) and self-efficacy ( $\beta = .24$ ) and were more sensitive than affective and cognitive learning outcomes to trainees' perceptions of characteristics of the training course. Moderator analyses revealed reactions–outcomes correlations tended to be stronger in courses that utilized a high level rather than a low level of technology, and affective and utility reactions did not differ in their relationships with learning outcomes. The current study clarifies the nomological network of reactions and specifies outcomes that are theoretically related to reactions.

*Keywords:* trainee reactions, meta-analysis, training evaluation, course design, course satisfaction

Trainee reactions are the primary means by which organizations evaluate training programs (Twitchell, Holton, & Trott, 2001). Firms participating in the American Society of Training and Development's benchmarking forum reported evaluating 91% of training programs with satisfaction surveys (Sugrue & Rivera, 2005). In the same sample, other training outcomes were assessed far less often (learning for 54% and transfer for 23% of programs). In some cases, trainee reactions may be the only form of evaluation data collected (Morgan & Casper, 2000).

While trainee reactions are frequently assessed in practice, they are poorly understood. Trainee reactions refer to subjective evaluations learners make about their training experiences and are typically measured with post-training surveys (Kirkpatrick, 1996). Researchers have not reached a consensus on the nomological network of reactions, leading to confusion over how to interpret them and questions as to whether they have value for decision making. For example, some researchers have asserted that trainee reactions are unrelated to learning and overused in practice (e.g., Holton, 1996; Hook & Bunce, 2001). Others have suggested reactions can influence learning (e.g., Brown, 2005; Noe, 1986) and other outcomes of interest to organizations, such as training reputation and course enrollment rates (e.g., Brown, 2005; Kraiger, 2002). These contrasting perspectives suggest that a conceptual and quantitative review of the nomological network of reactions is warranted.

The current study addresses the limitations in our understanding of trainee reactions by reviewing the literature, proposing hypotheses, and testing the hypotheses with meta-analysis whenever possible. Five research questions regarding trainee reactions are addressed: (a) To what degree do *trainee characteristics* predict reactions to training programs? (b) To what degree do *situational characteristics*, including course characteristics, predict reactions? (c) To what degree are reactions related to *learning outcomes*? (d) To what degree are reactions related to *organizational outcomes*, such as training reputation and enrollment rates? (e) Are there *moderators* of these relationships? In the following sections, we

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Traci Sitzmann, Advanced Distributed Learning Co-Laboratory, Alexandria, VA; Kenneth G. Brown, Henry B. Tippie College of Business, University of Iowa; Wendy J. Casper, Department of Management, University of Texas at Arlington; Katherine Ely, Department of Psychology, George Mason University; Ryan D. Zimmerman, Department of Management, Texas A&M University.

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Correspondence concerning this article should be addressed to Traci Sitzmann, Advanced Distributed Learning Co-Laboratory, 1901 North Beauregard Street, Suite 600, Alexandria, VA 22311-1721. E-mail: traci.sitzmann.ctr@adlnet.gov

review the literature on antecedents and outcomes of reactions and propose theory-driven moderators of the reactions–antecedents and reactions–outcomes relationships.

### Antecedents of Trainee Reactions

#### *Trainee Characteristics*

Theory and empirical research suggest trainee characteristics will predict reactions just as employee characteristics influence other job attitudes (e.g., Staw, Bell, & Clausen, 1986). Our review reveals four characteristics that have been examined with regularity as antecedents of reactions: pretraining motivation, mastery goal orientation, agreeableness, and anxiety.

Affect research (e.g., Weiss & Cropanzano, 1996) has suggested that pretraining motivation should be related to trainee reactions. By definition, motivated trainees exhibit greater interest in learning (Noe, 1986). Accordingly, they should enjoy learning more and experience positive affect that shifts their perceptions of the training experience to be more favorable (Ainley, Hidi, & Berndorff, 2002; Weiss & Cropanzano, 1996). Supporting this argument, Colquitt, LePine, and Noe (2000) reported meta-analytic corrected correlations of .53 for the relationship between training valence and reactions ( $k = 6, N = 1,394$ ) and .45 for the relationship between motivation to learn and reactions ( $k = 12, N = 2,517$ ). Consequently, we predict the following:

*Hypothesis 1:* Trainees' pretraining motivation will be positively related to reactions.

Mastery goal orientation is the tendency to strive to learn as much as possible, to overcome challenges, and to increase one's level of competence for one's own sake. According to Dweck's (1988) social-cognitive theory of motivation, trainees are guided through learning by the goal orientation they possess, and trainees with a mastery goal orientation tend to have positive feelings toward the learning process. Research has shown that mastery goal orientation is positively associated with learning (Payne, Youngcourt, & Beaubien, 2007), with the experience of positive affect during learning (Lee, Sheldon, & Turban, 2003; Mullins, Brown, Toney, Weissbein, & Kozlowski, 1998; Steele-Johnson, Beauregard, Hoover, & Schmidt, 2000), and with motivation to learn (Wolters, 2004). Brown (2005) found mastery goal orientation had a positive effect on reactions to training ( $\beta = .39$  while controlling for basic personality traits). Consistent with prior research, we predict the following:

*Hypothesis 2:* Trainees' mastery goal orientation (MGO) will be positively related to reactions.

Costa and McCrae (1992) suggested that individuals high in agreeableness are altruistic, sympathetic, and eager to help others. Agreeable individuals are more motivated to maintain positive relations with others and have more favorable reactions to other people (Graziano, Jensen-Campbell, & Hair, 1996). Thus, trainees high in agreeableness should have more positive views of an instructor and a course and should be more sympathetic to minor training inconveniences (e.g., the instructor coming late to class) than trainees low in agreeableness. Thus, we hypothesize the following:

*Hypothesis 3:* Trainees' agreeableness will be positively related to reactions.

Weiss and Cropanzano (1996) suggested affect influences subsequent attitude formation. Anxiety experienced in training, as a particular form of negative affect, should induce more negative reactions to training. Meta-analytic evidence has indicated that trainee anxiety correlates negatively with reactions ( $\rho = -.23, k = 2, N = 174$ ; Colquitt et al., 2000). Whether assessed as a trait or state, learners experiencing anxiety should have more negative perceptions of training than do those who experience less anxiety. This suggests Hypothesis 4:

*Hypothesis 4:* Trainees' anxiety will be negatively related to reactions.

#### *Situational Characteristics*

Along with trainee characteristics, characteristics of the situation such as instructor style, human interaction during training, and organizational support may also influence trainee reactions. Considerable research suggests instructor style influences students' ratings of instruction. For example, Murray (1983) used in-class observers to tally 60 specific teacher behaviors and found behavior differed between instructors rated at different levels of overall effectiveness. Instructors who were rated as more effective were more likely to speak expressively, show interest in the subject, move about while lecturing, use humor, and show facial expressions.

These instructor behaviors overlap substantially with an instructional style labeled by communication researchers as immediacy. Immediacy refers to verbal and nonverbal communication behaviors that reduce social and psychological distance between instructors and students (Brown, Rietz, & Sugrue, 2005; Christophel, 1990). Verbal immediacy behaviors include using personal examples and humor, providing and inviting feedback, and addressing and being addressed by students by name (Gorham, 1988). Nonverbal immediacy behaviors include making eye contact, smiling, moving around the classroom, and having a relaxed posture (Andersen, 1979). Allen, Witt, and Wheelless (2006) found the meta-analytic correlation between instructor immediacy and affective learning (i.e., a combined measure of reactions, attitudes toward the behaviors recommended, and behavioral intentions) was .50 ( $k = 81, N = 24,474$ ). Instructors high in verbal and nonverbal immediacy create enjoyable learning environments, and trainees should react more favorably to training.

*Hypothesis 5:* Instructor style characterized by high levels of immediacy will be positively related to reactions.

Human interaction refers to the extent to which trainees believe they have meaningful interactions with the instructor and/or other trainees during training. Several studies have found that more interaction (instructor–learner or learner–learner) results in greater learner motivation and more positive attitudes toward learning and the instructional process (e.g., Entwistle & Entwistle, 1991; Hackman & Walker, 1990; Ritchie & Newbury, 1989; Wagner, 1994). This finding is generally consistent with theory and research on human needs, which has shown that affiliating with others often contributes to a sense of well-being and satisfaction (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000; Sheldon, Elliot, Kim, & Kasser, 2001). Thus, we hypothesize the following:

*Hypothesis 6:* Human interaction in training will be positively related to reactions.

Research also has suggested perceived organizational support for training is related to trainee reactions. According to organizational support theory (Eisenberger, Hungtington, Hutchison, & Sowa, 1986), in supportive environments employees believe supervisors will provide opportunities for them to learn and grow. Learners who perceive low support may anticipate little assistance for applying what they have learned in training on the job. In anticipation of this difficulty, trainees may have reduced motivation and interest, which would cause their reactions to be less favorable. This is consistent with Colquitt et al.'s (2000) meta-analytic results indicating both supervisor support ( $\rho = .15$ ,  $k = 4$ ,  $N = 181$ ) and positive climate ( $\rho = .40$ ,  $k = 7$ ,  $N = 1,546$ ) have a positive relationship with trainee reactions. On the basis of the aforementioned literature, we predict Hypothesis 7:

*Hypothesis 7:* Perceived organizational support for training will be positively related to reactions.

### Outcome Correlates of Trainee Reactions

#### *Affective and Cognitive Learning Outcomes*

Brown (2005) proposed trainee reactions predict changes in affective learning that occur during training. For example, frustration due to difficulty navigating in a Web-based training course may influence not only perceptions of the delivery technology but also subsequent motivational states. This suggests trainees' motivational states and post-training reactions should be related because reactions capture affective processes during training. If Brown's argument is true, reactions should predict post-training affect levels after controlling for pretraining affect.

*Hypothesis 8:* Reactions will predict changes in affective learning during training.

Reactions are hypothesized to be positively related to learning in several models of training effectiveness (Kirkpatrick, 1996; Mathieu, Tannenbaum, & Salas, 1992; Tracey, Hinkin, Tannenbaum, & Mathieu, 2001). Meta-analyses conducted in higher education settings have supported this hypothesis. P. A. Cohen (1981) found a strong relationship between learning in college courses and both satisfaction with the instructor (mean  $r = .43$ ,  $k = 67$ ) and overall course satisfaction (mean  $r = .47$ ,  $k = 22$ ). Yet there is ongoing debate in the education literature about the magnitude and nature of the relationship between students' ratings of instruction and learning outcomes (i.e., McKeachie, 1997, and others in a special issue of *American Psychologist*).

Meta-analyses of workplace training programs have offered mixed support for the hypothesized reactions-learning relationship. Alliger, Tannenbaum, Bennett, Traver, and Shotland (1997) found near zero correlations between affective reactions and both immediate learning (mean weighted  $r = .02$ ,  $k = 11$ ) and transfer (mean weighted  $r = .07$ ,  $k = 6$ ) but found a stronger relationship between utility reactions and both immediate learning (mean weighted  $r = .26$ ,  $k = 6$ ) and transfer (mean weighted  $r = .18$ ,  $k = 3$ ). As a result, some researchers have concluded that affective reactions are unrelated to learning (e.g., Holton, 1996; Hook & Bunce, 2001).

However, affect theory and research suggest reactions should have a positive relationship with both declarative and procedural

knowledge, and the relationship between reactions and cognitive learning outcomes should occur as a result of motivational states created during training (Brown, 2005). This argument suggests that some, but not all, of the association between reactions and cognitive learning will be captured with affective learning outcomes due to the distinct foci of affective learning and reactions measures. The two most commonly assessed affective learning outcomes are post-training self-efficacy and motivation. Post-training self-efficacy captures the confidence trainees have that they can successfully use the knowledge and skills obtained in training on the job, while post-training motivation captures the degree to which trainees will strive to apply knowledge gained during training back on the job. Reactions, in contrast, capture the degree to which the training provided a satisfying, meaningful learning experience. These three constructs should not be completely redundant because they reflect different aspects of trainees' affect, and each construct should account for unique variability in cognitive learning outcomes. Specific to the focus of this study, we hypothesize the following:

*Hypothesis 9:* Reactions will provide incremental prediction of declarative and procedural learning outcomes over affective learning outcomes.

#### *Organizational Outcomes*

Brown (2005) and Kraiger (2002) argued that trainee reactions may predict organizational outcomes such as training reputation, enrollment rates, and success in marketing training. Fecteau, Dobbins, Russell, Ladd, and Kudisch (1995) found training reputation influenced trainees' pretraining motivation ( $r = .61$ ,  $\beta = .32$ , controlling for other influences on motivation), suggesting that reputation may influence subsequent trainee motivation. Similarly, Switzer, Nagy, and Mullins (2005) found trainees' perceptions of the quality of managerial training in their organization was related to managers' subsequent perceived training transfer ( $r = .46$ ). To our knowledge, no research has examined the antecedents of a training course's reputation and its relationship with trainee reactions, nor has research explored the impact of reactions on subsequent course reputation and enrollment rates. As such, we could not examine the extent to which trainee reactions predict organizational outcomes in the current meta-analysis.

### Moderators

In the following section, we propose theoretical explanations for why antecedents-reactions and reactions-outcomes relationships may vary across training courses.

#### *Technology*

Technology captures the extent to which training was delivered via face-to-face classroom instruction versus computer-based or other technology-based instruction. Technology-delivered instruction generally provides trainees with more control over their learning experience than does classroom instruction (Sitzmann, Kraiger, Stewart, & Wisher, 2006), and it permits trainees to skip material that does not interest them (Brown & Ford, 2002). Thus, if trainees do not enjoy the material, they spend less time learning (e.g., Ainley et al., 2002), and reactions should predict learning. In

contrast, during classroom instruction the instructor typically guides trainees' instructional experience, providing little control to trainees and attenuating the effect of trainee reactions (and associated motivational processes) on learning outcomes. This suggests trainee reactions should exhibit a stronger relationship with learning outcomes when a course is delivered in a technology-based format.

*Hypothesis 10:* The reactions–outcomes relationships will be stronger when a high level rather than a low level of technology is used to deliver instruction.

### *Length of Training*

Brown (2005) argued that the longer a training program lasts, the weaker the relationship between end-of-training reactions assessments and both affective and motivational states experienced during training. When reactions are collected on the same day that a brief training program is completed, affect experienced during training should be captured. However, if a training program lasts several weeks or months, reactions collected on the last day will not capture trainees' psychological states experienced each day of the program.

*Hypothesis 11a:* The reactions–outcomes relationships will be stronger in shorter rather than longer training programs.

With regard to antecedents of reactions, reactions to shorter training programs should be heavily influenced by trainee characteristics because the training stimulus is less extensive and powerful than the training stimulus in longer programs. Thus, length of training should moderate the relationship between antecedents and reactions, such that correlations with reactions will be stronger in shorter rather than longer training programs.

*Hypothesis 11b:* The trainee characteristics–reactions relationships will be stronger in shorter rather than longer training programs.

### Summary

We propose that trainee reactions capture motivational processes that are related to individual and situational factors and learning outcomes (see Figure 1). Pretraining motivation (Hypothesis 1), MGO (Hypothesis 2), agreeableness (Hypothesis 3), and anxiety (Hypothesis 4) are proposed as individual characteristics that predict reactions, while instructor style (Hypothesis 5), human interaction (Hypothesis 6), and perceived organizational support (Hypothesis 7) are perceived situational characteristics that are proposed to predict reactions. Moreover, the model proposes that reactions predict affective learning outcomes primarily and, secondarily, declarative knowledge, procedural knowledge, and delayed procedural knowledge outcomes (Hypothesis 8 and Hypothesis 9). Training reputation and enrollment rates are additional hypothesized outcomes of reactions, but they are not examined in the current meta-analysis due to insufficient data. Finally, use of technology (Hypothesis 10) and length of training (Hypothesis 11) are proposed and examined as moderators of these relationships.

## Method

### *Sample of Studies*

A computer-based literature search of PsycINFO and ERIC located studies in the training and education literature from 1996 to 2005, since the publication of Alliger et al. (1997). To be included in the initial review, each abstract had to contain a term relevant to education or training and reactions. The keywords used to search PsycINFO and ERIC were *training* or *education* and *satisfaction*, *dissatisfaction*, *attitude*, or *reactions*. Initial searches resulted in 9,476 possible studies. A review of abstracts limited the list to 606 potentially relevant studies, of which 52 studies contained one or more relevant effect sizes. In addition, we manually searched reference lists from Alliger et al. (1997), Colquitt et al. (2000), Ely and Sitzmann (2007), and Sitzmann et al. (2006). Through these articles, we identified an additional 65 studies.

An extensive search for unpublished studies was also conducted. First, the Society for Industrial and Organizational Psychology and Academy of Management conference programs from 1996 to 2005 were manually searched. Second, authors of studies already included in the meta-analysis, as well as other practitioners and researchers with expertise in training, were contacted to request working studies. In all, we contacted 220 individuals directly and many more via training listservs. These efforts identified 19 unpublished studies, for a total of 136 studies.

Studies were included in the meta-analysis if (a) participants were non-disabled adults ages 18 or older; (b) the training was a structured learning experience (i.e., not on-the-job or informal); (c) training facilitated potentially job-related knowledge or skills (i.e., not coping with physical or mental health challenges); (d) the article was written in English; (e) relevant correlations were reported or could be calculated given the reported data; and (f) cognitive and skill-based learning were objectively assessed (i.e., not self-reported). The first three criteria support generalization to adults participating in workplace training.

### *Coding and Interrater Agreement*

In addition to correlations, samples sizes, reliabilities, and study measures, three moderators were coded: use of technology, length of training, and published versus unpublished. Use of technology was coded as low or high. Courses utilized low technology when less than half of training time was spent learning with technology (e.g., Web-based or computer-based instruction). Courses utilized high technology when over half of training time was spent learning with technology. Length of the training program was coded as the number of days in training. Published versus unpublished was coded and examined as a methodological moderator.

*Coder agreement.* All articles were coded independently by two raters with an absolute agreement of 95.4%. Coders then discussed discrepancies and reached a consensus.

### *Independence Assumption*

When multiple reactions dimensions were present in a study, the Hunter and Schmidt (2004, pp. 435–439) formula was used to calculate a single estimate that took into account the correlation among the measures. In addition, when a single study reported several correlations between a single reaction dimension and an



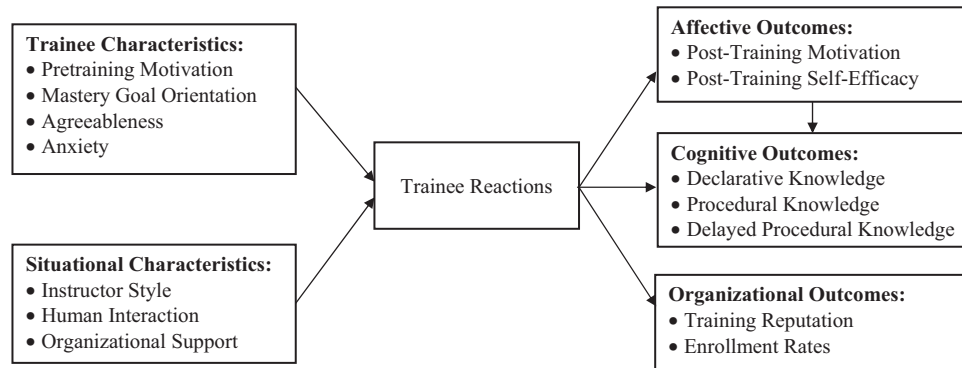


Figure 1. Antecedents and outcomes of trainee reactions.

other variable in the meta-analysis, the correlation most similar to other assessments of that particular relationship was used. Studies that included multiple independent samples were coded separately and treated as independent.

### Meta-Analytic Method

Artifact distributions were created by using formulas from Hunter and Schmidt (2004). Reliabilities from all coded studies were used to create artifact distributions, regardless of whether a study reported a correlation used in the analysis. Range restriction estimates were unavailable so no attempt was made to correct for this bias. The corrected mean and variance in validity coefficients across studies were calculated with formulas from Hunter and Schmidt (2004). The mean and variance of the correlations across studies were corrected for sampling error and unreliability in the predictor and criterion.

Prior to finalizing the analyses, a search for outliers was conducted by using a modified Huffcutt and Arthur (1995) sample-adjusted meta-analytic deviancy statistic with the variance of the mean correlation calculated according to the formula specified by Beal, Corey, and Dunlap (2002). We identified one outlier, Eden and Shani (1982), where the correlation between affective reactions and post-training procedural knowledge was .79. Inspection of this study revealed that trainers' (and through the trainers, the learners') beliefs were manipulated to be more positive, per the self-fulfilling prophecy. This study was removed from the main effect and moderator analyses.<sup>1</sup>

Two indices were used to assess whether moderators may be operating. First, we concluded moderators may be operating whenever less than 75% of the variance was attributable to statistical artifacts. Second, credibility intervals were calculated by using the corrected standard deviation around the mean corrected correlation. If the credibility interval was wide or included zero, we inferred that the mean corrected effect size was probably the mean of several subpopulations, and moderators may be operating (Whitener, 1990). Hunter and Schmidt's (2004) subgroup procedure was used to test for moderators.

### Regression Analysis

Meta-analytic true score regression analysis was used to test the multivariate hypotheses with AMOS. Several correlations required

for the meta-analytic correlation matrix were not available from studies in the current meta-analysis. Thus, we supplemented the current analyses with corrected correlations provided by Colquitt et al. (2000) and Payne et al. (2007) and collected data from adult trainees to assess the relationship between instructor immediacy and both MGO ( $N = 193$ ) and organizational support ( $N = 64$ ). We used the harmonic mean of the correlation matrix sample sizes to test the significance of the regression coefficients. We ran analyses by using maximum likelihood (ML) and ordinarily least squares (OLS) estimates, and the results were very similar. In the results section, we present the OLS estimates because, in contrast to ML, they do not assume multivariate normality, and ML estimates are less optimal when the data are correlations instead of covariances (Cudeck, 1989).

## Results

One-hundred thirty-six studies contributed data to the meta-analysis, including 88 published studies, 38 dissertations, and 10 unpublished studies. These studies reported data gathered from 27,020 trainees. Trainees were college students in 60% of studies and employees (35% of studies) or military personnel (5% of studies) in the remaining studies. Courses ranged in length from one-half hour to 120 days of training. Across all studies providing demographic data, the average age of trainees was 29 years, and 49% of participants were male while 51% of participants were female.

### Main Effect Results

Meta-analytic results are presented in Table 1. J. Cohen's (1988) definition of effect sizes (small effect sizes are correlations of .10, moderate are .30, and large are .50) guided interpretation. Hypotheses 1–3 predict positive relationships between reactions and pretraining motivation, MGO, and agreeableness; Hypothesis 4 predicts a negative relationship between anxiety and reactions. Trainee characteristics had moderate mean corrected correlations with reactions. Pretraining motivation had a mean corrected cor-

<sup>1</sup> The analyses were also run without removing this study. Although the population variances were higher, the overall conclusions were not different than reported results.

Table 1  
*Meta-Analytic Correlations for Antecedents and Outcomes of Trainee Reactions*

Correlation	k	Total N	N weighted mean r	$\rho$	Sample var (e) + artifact var (a)	Pop. var	% var due to artifacts	95% confidence interval		80% credibility interval	
								Lower	Upper	Lower	Upper
<b>Reactions–antecedents</b>											
Pretraining motivation	22	3,093	.34	.42	.01	.07	14.83	.22	.46	.09	.76
Mastery goal orientation	13	2,148	.19	.24	.01	.07	11.74	-.01	.39	-.10	.59
Agreeableness	7	353	.15	.19	.02	.00	100.00	.02	.27	.19	.19
Anxiety	18	1,789	-.25	-.31	.01	.07	16.80	-.39	-.11	-.66	.04
Instructor style	28	7,924	.55	.66	.00	.01	34.37	.48	.61	.53	.79
Human interaction	4	275	.45	.56	.01	.00	100.00	.34	.55	.56	.56
Organizational support	14	1,694	.20	.25	.01	.05	20.21	.06	.35	-.03	.54
Pretraining self-efficacy	30	3,944	.12	.15	.01	.03	30.58	.04	.21	-.06	.36
Pretraining declarative knowledge	17	1,930	.04	.05	.01	.02	51.07	-.09	.16	-.11	.22
<b>Reactions–affective learning</b>											
Post-training motivation	36	6,359	.55	.68	.01	.08	9.49	.44	.66	.31	1.00
Post-training self-efficacy	22	3,543	.25	.31	.01	.05	16.74	.13	.37	.03	.58
<b>Reactions–cognitive learning</b>											
Post-training declarative knowledge	78	11,005	.08	.12	.01	.03	31.45	.03	.14	-.11	.34
Post-training procedural knowledge	43	4,688	.12	.15	.01	.02	40.48	.05	.18	-.04	.34
Delayed procedural knowledge	14	1,408	.08	.10	.01	.01	54.77	.00	.16	-.05	.25

Note. k = the number of studies providing information included in the analysis; total N = sum of the sample sizes of studies providing information included in the analysis; N weighted mean r = sample size weighted mean r;  $\rho$  = mean correlation corrected for predictor and criterion reliability; sample var (e) + var (a) = sampling error variance + variance due to differences in reliability in the predictor and criterion; pop. var = variance of the corrected correlations; % var due to artifacts = proportion of variance in the observed correlation due to statistical artifacts.

relation of .42 with reactions, supporting Hypothesis 1. MGO had a positive relationship with reactions ( $\rho = .24$ ), but the confidence interval included zero. Thus, Hypothesis 2 was not supported. Trainee agreeableness had a mean corrected correlation of .19, and anxiety had a mean corrected correlation of  $-.31$  with reactions, supporting Hypotheses 3 and 4.

Hypotheses 5, 6, and 7 predict positive correlations between perceived situational characteristics and reactions. Instructor style, human interaction, and organizational support had estimated mean corrected correlations with reactions of .66, .56, and .25, respectively, supporting the hypotheses. Overall, characteristics of the training course (i.e., instructor style and human interaction) were the strongest predictors of reactions.

*Meta-Analytic Regression Results*

Hypotheses 8 and 9 were tested by using meta-analytic regression. To ensure the validity of our results, we required all reactions main effects to have a minimum N of 500 and k of 8 to be included in the regression analyses. The analyses for Hypothesis 8, reactions predict changes in affective learning outcomes, are presented in Table 2. The table shows regression analyses with pretraining declarative knowledge and pretraining affect (entered first) and trainee reactions (entered second) predicting post-training motivation and self-efficacy. The harmonic mean was 499 for motivation and 895 for self-efficacy. Reactions predicted both post-training

motivation (controlling for pretraining declarative knowledge and motivation,  $\beta = .51$ ) and post-training self-efficacy (controlling for pretraining declarative knowledge and self-efficacy,  $\beta = .24$ ) and accounted for an additional 20% of the variance in motivation and 6% of the variance in self-efficacy. Because these analyses control for pretraining variables, they indicate reactions predict changes in motivation and self-efficacy over the course of training, supporting Hypothesis 8.

Hypothesis 9 is reactions will predict cognitive learning outcomes while controlling for affective learning outcomes. Table 3 contains the results from regressing cognitive learning outcomes on pretraining declarative knowledge (entered first), post-training motivation and self-efficacy (entered second), and trainee reactions (entered last). The harmonic mean was 562 for post-training declarative knowledge, 520 for post-training procedural knowledge, and 197 for delayed procedural knowledge. After controlling for pretraining declarative knowledge and affective learning outcomes, reactions predicted post-training declarative and procedural knowledge ( $\beta = .22, .32$ , respectively,  $p < .05$ ) and accounted for an additional 2% of the variance in post-training declarative knowledge and 5% in post-training procedural knowledge. Reactions did not account for additional variance in delayed procedural knowledge in this same analysis. Thus, the results support Hypothesis 9 for declarative and procedural knowledge, but not for delayed procedural knowledge. Notably, post-training self-

Table 2  
Results of Two Hierarchical Regression Analyses Predicting  
Post-Training Motivation and Post-Training Self-Efficacy

Block	Post-training motivation	Post-training self-efficacy
Block 1		
Pretraining declarative knowledge	-.18*	-.04
Pretraining affect <sup>a</sup>	.67*	.51*
R <sup>2</sup>	.38*	.25*
Block 2		
Pretraining declarative knowledge	-.10*	-.05
Pretraining affect <sup>a</sup>	.42*	.48*
Trainee reactions	.51*	.24*
R <sup>2</sup>	.58*	.31*
$\Delta R^2$	.20*	.06*

Note. All regression weights reported in the table are standardized. The harmonic mean was 499 for post-training motivation and 895 for post-training self-efficacy.

<sup>a</sup> Pretraining motivation was included in the analysis predicting post-training motivation; pretraining self-efficacy was included in the analysis predicting post-training self-efficacy.

\*  $p < .05$ .

efficacy had stronger, positive relationships than either reactions or post-training motivation with post-training and delayed procedural knowledge ( $\beta = .43, .50$ , respectively,  $p < .05$ ).

As a final multivariate analysis, Table 4 presents a regression analysis with reactions as a dependent variable. This regression included pretraining motivation, MGO, anxiety, instructor style, and organizational support predicting trainee reactions.<sup>2</sup> The harmonic mean was 357. Together these predictors accounted for 58% of the variance in reactions. Pretraining motivation, anxiety, and instructor style were all unique predictors of trainee reactions ( $\beta = .49, .18, .68$ , respectively,  $p < .05$ ). These results suggest both situational and individual factors predict reactions.

### Moderator Analysis Results

Twelve out of 14 of the main effect analyses presented in Table 1 had 80% credibility intervals that were fairly wide (i.e., ranged from .26 to .70), and the percent of variance attributed to three statistical artifacts (i.e., sampling error and between-study differences in predictor and criterion reliability) was less than 75%.<sup>3</sup> Together the credibility intervals and 75% rule indicate a high probability of multiple population values (Hunter & Schmidt, 2004). Thus, it is appropriate to test for moderators.

Hunter and Schmidt's (2004) subgroup analysis was used to test for moderators. Meta-analytic estimates for each subgroup are presented in Table 5. When the average corrected correlation varied between subgroups by at least .10 and at least one of the population variances was lower than the population variance for the entire sample of studies, we concluded that the moderator had a meaningful effect.

Hypothesis 10 predicted the reactions–outcomes relationships would be stronger when a high level rather than a low level of technology was used to deliver instruction. The post-training mo-

tivation, self-efficacy, and declarative knowledge effect sizes were larger in courses with high ( $\rho = .57, .58, .25$ , respectively) rather than low ( $\rho = .47, .18, .06$ , respectively) levels of technology. However, the delayed procedural knowledge relationship was weaker in the high technology subgroup (high technology  $\rho = .00$  vs. low technology  $\rho = .13$ ), and use of technology did not moderate the relationship between reactions and post-training procedural knowledge. For each detected moderator, at least one of the subgroup variances was lower than the overall population variance. Overall, the results support Hypothesis 10 for affective and declarative knowledge but not for procedural knowledge.

Hypothesis 11 predicted antecedents–reactions (11b) and reactions–outcomes (11a) relationships would be stronger in shorter than in longer training programs. We calculated the sample size weighted correlation between length of training and the reaction–antecedents and reactions–outcomes relationships, but none of the correlations were statistically significant due to the limited number of studies included in most analyses. Three of the 10 correlations were moderate to strong and negative ( $r = -.45$  for anxiety;  $-.22$  for post-training motivation; and  $-.33$  for post-training self-efficacy), suggesting correlations tend to be stronger for shorter rather than longer courses. The remaining correlations were weak, suggesting length of training did not moderate the reactions correlations ( $r = -.05$  for pretraining motivation;  $-.02$  for MGO;  $.06$  for instructor style;  $.02$  for organizational support;  $.08$  for post-training declarative knowledge;  $-.13$  post-training procedural knowledge; and  $-.06$  for delayed procedural knowledge). In sum, results provide limited support for Hypothesis 11.

To examine whether there is publication bias in this research area, we also examined whether the study was published or unpublished as a moderator. Pretraining motivation and post-training motivation had stronger mean corrected correlations for unpublished studies ( $\rho = .57$  and  $.76$ ) than for published studies ( $\rho = .36$  and  $.64$ ). However, trainee anxiety and delayed procedural knowledge reported stronger correlations for published studies ( $\rho = -.46$  and  $.16$ ) than for unpublished studies ( $\rho = -.07$  and  $-.07$ ). For all of these effects, at least one of the subgroup variances was smaller than the overall population variance. This pattern of findings does not suggest that there is substantial file drawer bias in reactions research.

Finally, a post hoc moderator analysis examined whether affective or utility reactions had stronger relationships with cognitive learning outcomes. This analysis tested Alliger et al.'s (1997) finding that relationships between reactions and outcomes varied depending on the facet of reactions assessed. On the basis of criteria set forth previously, the relationships between reactions and learning outcomes were not moderated by the facet of reactions. Moreover, our estimates of the affective reactions–outcomes relationships were higher than those obtained by Alliger et al., and

<sup>2</sup> Agreeableness and human interaction were not included in the analysis due to the scarcity of research that has examined the relationship between these constructs and the other antecedents of trainee reactions.

<sup>3</sup> Agreeableness and human interaction did not meet the criteria for moderation and were not included in the moderator analyses.

Table 3  
Results of Three Hierarchical Regression Analyses Predicting Post-Training Declarative Knowledge, Post-Training Procedural Knowledge, and Delayed Procedural Knowledge

Block	Post-training declarative knowledge	Post-training procedural knowledge	Delayed procedural knowledge
Block 1			
Pretraining declarative knowledge	.56*	.38*	.21*
R <sup>2</sup>	.31*	.14*	.04*
Block 2			
Pretraining declarative knowledge	.55*	.36*	.16*
Post-training motivation	-.12*	-.27*	-.04
Post-training self-efficacy	.19*	.46*	.50*
R <sup>2</sup>	.35*	.34*	.28*
ΔR <sup>2</sup>	.04*	.20*	.24*
Block 3			
Pretraining declarative knowledge	.56*	.37*	.16*
Post-training motivation	-.26*	-.48*	.00
Post-training self-efficacy	.17*	.43*	.50*
Trainee reactions	.22*	.32*	-.07
R <sup>2</sup>	.37*	.39*	.28*
ΔR <sup>2</sup>	.02*	.05*	.00

Note. All regression weights reported in the table are standardized. The harmonic mean was 562 for post-training declarative knowledge, 520 for post-training procedural knowledge, and 197 for delayed procedural knowledge.

\*  $p < .05$

our estimates of the utility reactions–outcomes relationships were lower. Thus, with the increased number of studies included in this meta-analysis, we do not find substantial value in the affective/utility reactions distinction.

### Discussion

The purpose of the current narrative and meta-analytic review is to clarify the nomological network of trainee reactions in an effort to determine the role of reactions in training effectiveness and their utility in evaluation. Specifically, we examine the degree to which trainee and situational characteristics predicted reactions and the degree to which reactions predicted changes in learning outcomes. Additional analyses examine theoretical and methodological moderators of these relationships. We discuss both theoretical and practical implications of our results as well as study limitations and directions for future research.

Table 4  
Results of a Regression Analysis Predicting Trainee Reactions

Characteristic	Trainee reactions
Trainee characteristic	
Pretraining motivation	.49*
Mastery goal orientation	-.08
Anxiety	.18*
Situational characteristic	
Instructor style	.68*
Organizational support	.04
R <sup>2</sup>	.58*

Note. All regression weights reported in the table are standardized. The harmonic mean was 357.

\*  $p < .05$

### Theoretical Implications

The results indicate reactions primarily capture trainees’ perceptions of the training environment but also characteristics of trainees (e.g., pretraining motivation and anxiety) and perceived organizational support. Across 71 studies and 14,101 trainees, instructor style ( $\rho = .66$ ) and human interaction ( $\rho = .56$ ) had the strongest effect on reactions, while trainee characteristics ( $\rho = .19$  to  $.42$ ) and organizational support ( $\rho = .25$ ) were weaker but still meaningful predictors. Instructor style, the strongest predictor, accounted for 37% of the variance in reactions above trainee characteristics and organizational support. This suggests reactions are highly sensitive to trainees’ perceptions of their training environment, supporting the assumption behind reactions measurement—reactions capture aspects of the training experience. Post hoc analyses do not support, however, the established idea that reactions should be divided into distinct facets in order to understand their relationships with learning outcomes. We found little value in distinguishing between affective and utility reactions.

In terms of outcomes, reactions have their largest relationships with changes in affective learning outcomes. Meta-analytic regression analyses revealed reactions predicted changes in motivation and self-efficacy from pre- to post-training. These findings suggest that reactions influence motivational processes during training as well as their associated outcomes. Yet, it is useful to distinguish trainee reactions and affective learning because there were important differences in the relationships between these constructs and other constructs in the meta-analysis. For example, instructor style had a stronger relationship with reactions ( $\rho = .66$ ) than with post-training motivation ( $\rho = .47$ ) or self-efficacy ( $\rho = .38$ ). This suggests reactions are more sensitive than are affective learning outcomes to what occurs during training. In addition, post hoc analyses revealed reactions fully mediated the relationship be-



Table 5  
*Moderator Analyses for the Relationships Between Trainee Characteristics, Situational Characteristics, and Learning Outcomes With Trainee Reactions*

Characteristic or outcome	<i>k</i>	Total <i>N</i>	<i>N</i> weighted mean <i>r</i>	$\rho$	Sample var (e) + artifact var (a)	Pop. var	% var due to artifacts	95% confidence interval		80% credibility interval	
								Lower	Upper	Lower	Upper
Pretraining motivation											
Unpublished	8	945	.45	.57	.01	.12	10.31	.18	.71	.12	1.00
Published	13	2,025	.28	.36	.01	.04	23.24	.15	.42	.12	.60
Mastery goal orientation											
Unpublished	8	1,165	.22	.27	.01	.08	12.42	-.05	.48	-.08	.63
Published	5	983	.16	.21	.01	.07	11.07	-.16	.49	-.12	.54
Anxiety											
Unpublished	7	688	-.06	-.07	.01	.02	39.62	-.27	.15	-.27	.12
Published	11	1,101	-.37	-.46	.01	.05	23.37	-.55	-.20	-.73	-.18
Instructor style											
Unpublished	11	3,362	.55	.67	.00	.00	67.01	.48	.62	.60	.73
Published	17	4,562	.54	.65	.00	.02	25.79	.44	.64	.49	.81
Organizational support											
Unpublished	6	831	.24	.30	.01	.08	11.23	-.05	.53	-.07	.67
Published	8	863	.17	.21	.01	.01	55.56	.04	.30	.08	.34
Post-training motivation											
Low technology	16	2,234	.38	.47	.01	.16	5.94	.18	.59	-.04	.99
High technology	8	615	.46	.57	.01	.03	33.42	.31	.61	.34	.80
Unpublished	10	1,729	.61	.76	.01	.03	21.84	.43	.80	.53	.99
Published	26	4,699	.52	.64	.01	.11	7.17	.38	.65	.22	1.00
Affective reactions	14	3,450	.52	.64	.00	.11	6.42	.31	.73	.22	1.00
Utility reactions	3	275	.55	.68	.01	.04	23.59	.20	.89	.42	.94
Post-training self-efficacy											
Low technology	12	2,069	.15	.18	.01	.03	26.33	-.04	.33	-.02	.39
High technology	8	805	.47	.58	.01	.03	3.98	.31	.62	.37	.79
Unpublished	9	1,820	.28	.35	.00	.07	9.65	.07	.50	.01	.69
Published	13	1,735	.23	.28	.01	.03	29.19	.07	.38	.07	.49
Affective reactions	10	2,008	.24	.30	.00	.04	15.42	.08	.41	.04	.57
Utility reactions	5	1,172	.28	.35	.00	.00	100.00	.10	.46	.35	.35
Post-training declarative knowledge											
Low technology	44	7,289	.04	.06	.01	.03	28.50	-.03	.11	-.17	.28
High technology	26	2,314	.18	.25	.01	.01	64.37	.09	.27	.11	.39
Unpublished	24	3,117	.04	.06	.01	.04	26.08	-.06	.14	-.21	.33
Published	54	7,888	.10	.14	.01	.02	36.44	.04	.17	-.06	.34
Affective reactions	36	6,202	.05	.07	.01	.02	30.47	-.03	.13	-.13	.28
Utility reactions	26	2,668	.11	.16	.01	.01	58.32	.01	.21	.01	.30
Post-training procedural knowledge											
Low technology	24	3,116	.14	.17	.01	.04	22.45	.02	.25	-.10	.44
High technology	15	1,255	.12	.16	.01	.02	46.15	.00	.24	-.04	.35
Unpublished	11	1,236	.10	.13	.01	.00	100.00	.02	.18	.13	.13
Published	32	3,452	.12	.16	.01	.03	32.34	.04	.21	-.07	.39
Affective reactions	19	2,675	.06	.08	.01	.02	30.88	-.04	.17	-.12	.28
Utility reactions	13	1,495	.12	.15	.01	.02	45.00	.02	.22	-.01	.32
Delayed procedural knowledge											
Low technology	9	1,025	.10	.13	.01	.02	41.15	-.01	.21	-.06	.31
High technology	3	251	.00	.00	.01	.00	100.00	-.16	.16	.00	.00
Unpublished	4	344	-.06	-.07	.01	.00	100.00	-.16	.04	-.07	-.07
Published	10	1,064	.12	.16	.01	.01	62.68	.04	.21	.04	.28
Affective reactions	4	347	-.02	-.03	.01	.00	100.00	-.15	.11	-.03	-.03
Utility reactions	5	400	.03	.04	.01	.00	100.00	.00	.06	.04	.04

*Note.* *k* = the number of studies providing information included in the analysis; total *N* = sum of the sample sizes of studies providing information included in the analysis; *N* weighted mean *r* = sample size weighted mean *r*;  $\rho$  = mean correlation corrected for predictor and criterion reliability; sample var (e) + var (a) = sampling error variance + variance due to differences in reliability in the predictor and criterion; pop. var = variance of the corrected correlations; % var due to artifacts = proportion of variance in the observed correlation due to statistical artifacts.

tween instructor style and post-training motivation and partially mediated the relationship between instructor style and post-training self-efficacy.<sup>4</sup> Thus, training characteristics seem to influence affective learning indirectly, through their effect on trainee reactions.

As for the link between reactions and cognitive learning outcomes, these results challenge the established view that reactions are not associated with learning (e.g., Hook & Bunce, 2001). When examined with meta-analytic regression analyses, reactions predicted changes in declarative ( $\beta = .22$ ) and procedural ( $\beta = .32$ ) knowledge from pre- to posttest. Consequently, it is inaccurate to claim that reactions do not matter with regard to learning. That said, the results also suggest that post-training self-efficacy is a much better predictor of cognitive learning outcomes than are reactions. Specifically, post-training self-efficacy accounted for variance in all three cognitive learning outcomes, including 14% of the variance in post-training procedural knowledge ( $\beta = .37$ ) and 24% of the variance in delayed procedural knowledge ( $\beta = .48$ ) after controlling for pretraining declarative knowledge. This suggests that among post-training self-reported constructs, self-efficacy is the most useful predictor of learning outcomes, particularly delayed procedural knowledge.

Cognitive learning measures and reactions provide different information regarding training programs. Pretraining motivation, MGO, anxiety, and organizational support predict both reactions and cognitive learning (Colquitt et al., 2000; Payne et al., 2007), but the strongest predictors of reactions, instructor style and human interaction, are generally weak predictors of cognitive learning outcomes (Hess & Smythe, 2001; Hornick & Tupchiy, 2006). Reactions and learning also predict different outcomes. Learning during training leads to improved job performance, whereas reactions predict changes in attitudes and may predict course reputation and enrollment rates (Kraiger, 2002). Thus, the information desired from training evaluation should drive the choice of evaluation measures.

The results of the technology and length moderator analyses partially support the hypotheses that reactions correlations will be stronger in short courses and in courses that utilize a high level of technology. Under these conditions, reactions generally had a stronger relationship with antecedents and post-training learning outcomes. The effect was most prominent with regard to the reactions-outcomes relationships in high technology environments. These results suggest that reactions are a particularly important construct to examine in models of the design of technology-delivered instruction.

### *Recommendations for Practitioners*

Consistent with Kraiger (2002), we suggest the goal of an evaluation effort should guide the selection of outcome measures. Within this context, reactions are one potentially meaningful outcome, depending on the goal of training. Reactions measures are appropriate for evaluating course characteristics given that they are highly sensitive to variance related to the training environment, such as instructor style and human interaction. Thus, measuring course characteristics may provide invaluable feedback for instructors whose job performance is primarily assessed with end-of-course satisfaction surveys.

If the training goals are for trainees to learn new knowledge and skills, learning measures should be used. Reactions have a predictive relationship with cognitive learning outcomes, but the relationship is not strong enough to suggest reactions should be used as an indicator of learning. In fact, when learning measures are impractical to collect, the best indicator of learning would be post-training self-efficacy because it is the best predictor of both immediate and delayed procedural knowledge. Given these results, we recommend that post-training self-efficacy should be regularly included in end-of-training survey instruments. Assessing trainees' self-efficacy provides a cost-effective predictor of post-training knowledge transfer.

In some courses (e.g., motivational speakers, diversity training, ethics training), the goal of training is to change affective learning outcomes such as motivation and attitudes (Kraiger, Ford, & Salas, 1993). In these courses, reactions are important because they affect trainees' receptivity to attitude change. Thus, when the goal of training is to change affective outcomes, training designers should pay attention to design features that foster satisfaction. For example, designers might build instructor-student interaction into training, and organizations can select personable, lively, and humorous trainers.

Theory suggests reactions may predict course reputation, enrollment rates, and attrition during training (Brown, 2005; Kraiger, 2002). However, little research has examined these relationships, highlighting the need for scientist-practitioner partnerships to expand knowledge about whether other aspects of the training environment, trainee individual differences, and other training outcomes are related to reactions. Given the direct contact that training practitioners have with trainees, they are critical for gathering the data necessary to further our understanding of the nomological network of trainee reactions.

Our study also suggests that reactions had their strongest relationship with post-training motivation, self-efficacy, and declarative knowledge when technology was used to deliver training. Thus, it makes sense to be particularly sensitive to reactions in technology-delivered courses. Designing technology-based courses that trainees feel are useful and interesting should improve reactions and enhance training effectiveness.

Instructors may also be interested in how to enhance the satisfaction of trainees in their courses. Instructor immediacy was strongly related to reactions, suggesting instructors should aim for an open, relaxed style to make trainees comfortable and enhance trainee satisfaction. Because anxious trainees also had lower satisfaction, instructors who teach challenging courses where trainees might be anxious could utilize anxiety-reduction techniques. For instance, the class might engage in brief relaxation exercises during breaks, and the instructor might try to be supportive of trainees who appear anxious. Such instructor behaviors may facilitate trainee satisfaction.

<sup>4</sup> The beta for immediacy predicting post-training motivation was reduced from a significant .47 to a non-significant .03 when reactions were added as a mediator. The beta for immediacy predicting post-training self-efficacy was reduced from a .38 to .31 when reactions were added as a mediator, but the beta was still significant.

### Limitations and Directions for Future Research

As with any study, this meta-analysis has limitations. Correlations between reactions and post-training motivation, self-efficacy, instructor style, and human interaction are likely inflated by common method bias (constructs are self-reported at the same point in time). To reduce this bias in future studies, researchers might separate administration of measures, which would at least reduce shared transient error (Schmidt, Le, & Ilies, 2003).

Many studies examined reactions to a single training course, which may underestimate correlations due to range restriction in trainee reactions. For example, when a course is entertaining most trainees will react favorably, decreasing variability in reactions and attenuating correlations with reactions. In such studies, there is no true score variance in training characteristics and relationships between reactions and other variables may be hard to identify given the lack of variability. Thus, research is needed to examine the extent to which range restriction is attenuating correlations with reactions.

Additional research is also needed to focus on antecedents and outcomes of reactions. Specifically, we propose reactions should be heavily influenced by affective events during training (e.g., failing an exam or being criticized by the instructor) and trainees' trait affect levels. Smith-Jentsch, Jentsch, Payne, and Salas (1996) suggested that reactions to negative events influence trainees' openness to new concepts presented in training and attentiveness to course objectives. Additional research is needed to examine how particular events influence trainee reactions. Furthermore, trainees high in positive affect may react favorably to training, regardless of the course characteristics.

Research on objective training characteristics would also be useful. In this study, we examine trainees' perceptions of training characteristics and their relationship with reactions. Future research on the direct influence of objective training characteristics on perceived training characteristics and reactions would help to clarify what types of training characteristics and experiences are most useful for creating positive reactions. Of course, creating positive reactions should not be the primary concern of training research. Efforts to identify training characteristics that have positive effects on both reactions and learning outcomes would be more useful.

Kraiger (2002) suggested reactions are valuable for making decisions about course revisions and retention of instructors, for providing feedback to instructors, and for marketing courses. Thus, research is needed to answer several questions. Can trainees provide organizations with feedback for revising a course that will improve course effectiveness? Will positive trainee reactions be shared and, over time, increase the demand for a course through trainee referral? Are trainees the most knowledgeable people for deciding which instructors to retain? Does feedback from reactions improve instructors' teaching styles? Will positive reactions improve the bottom line for training practitioners? If the answer to any of these questions is yes, it suggests trainee reactions have utility for organizations and should be the focus of additional research. Given that studies to date have not addressed these issues, research may not have examined the most important outcomes of trainee reactions.

### Conclusion

The current meta-analysis examines data from 136 research reports and 27,020 trainees to assess the nomological network of trainee reactions. The results indicate reactions capture characteristics of the training environment, primarily, and characteristics of trainees and organizational support, secondarily. Instructor style and human interaction were the best predictors of reactions, while pretraining motivation, trainees' personalities, anxiety, and perceived organizational support had weaker effects. Reactions also predict changes in motivation and self-efficacy during training and are more sensitive to the quality of training received than are affective or cognitive learning measures. The results suggest reactions may be utilized to measure training quality and to predict changes in affective learning in future theory and research on training effectiveness.

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