

100 Years of Training and Development Research: What We Know and Where We Should Go

Bradford S. Bell
Cornell University

Scott I. Tannenbaum
The Group for Organizational Effectiveness (gOE), Inc.

J. Kevin Ford
Michigan State University

Raymond A. Noe
Ohio State University

Kurt Kraiger
Colorado State University

Author Note

Bradford S. Bell, HR Studies Department, ILR School, Cornell University; Scott I. Tannenbaum, The Group for Organizational Effectiveness (gOE), Inc.; J. Kevin Ford, Department of Psychology, Michigan State University; Raymond A. Noe, Department of Management and Human Resources, Fisher College of Business, Ohio State University; Kurt Kraiger, Department of Psychology, Colorado State University.

Correspondence concerning this article should be addressed to Bradford S. Bell, Cornell University, ILR School, 162 Ives Hall, Ithaca, NY 14853. E-mail: brad.bell@cornell.edu

Citation

Bell, B. S., Tannenbaum, S. I., Ford, J. K., Noe, R. A., & Kraiger, K. (2017). 100 years of training and development research: What we know and where we should go. *Journal of Applied Psychology, 102* (3), 305-323.

Abstract

Training and development research has a long tradition within applied psychology dating back to the early 1900's. Over the years, not only has interest in the topic grown but there have been dramatic changes in both the science and practice of training and development. In the current article, we examine the evolution of training and development research using articles published in the *Journal of Applied Psychology (JAP)* as a primary lens to analyze what we have learned and to identify where future research is needed. We begin by reviewing the timeline of training and development research in *JAP* from 1918 to the present in order to elucidate the critical trends and advances that define each decade. These trends include the emergence of more theory-driven training research, greater consideration of the role of the trainee and training context, examination of learning that occurs outside the classroom, and understanding training's impact across different levels of analysis. We then examine in greater detail the evolution of four key research themes: training criteria, trainee characteristics, training design and delivery, and the training context. In each area, we describe how the focus of research has shifted over time and highlight important developments. We conclude by offering several ideas for future training and development research.

Keywords: training, employee development, learning, instruction, individual differences

100 Years of Training and Development Research: What We Know and Where We Should Go

Over the past century, training and development in organizations has undergone a remarkable transformation. As the nature of work has changed, training objectives have broadened beyond improving efficiency on simple manual tasks to providing employees with the skills needed to perform complex and dynamic jobs. Once conducted almost exclusively on-the-job by supervisors (Kraiger & Ford, 2007), technological advances now allow learning to occur on-demand and virtually anywhere and at any time. The role of training and development has also expanded to where today it is viewed as not only a way to enhance individual capabilities but also as a valuable lever for improving team effectiveness and for organizations to gain competitive advantage (Noe, Clarke, & Klein, 2014).

This transformation has been accompanied by a growing and constantly evolving body of research across a variety of disciplines, including industrial/organizational psychology, military psychology, human factors, and cognitive psychology, which has advanced our understanding of how to design and deliver training and development in organizations (Salas & Cannon-Bowers, 2001). We examine this research evolution with particular attention on research published in the *Journal of Applied Psychology (JAP)*. We also describe particularly important and relevant pieces published in other outlets. Our goal is to highlight what we have learned from training and development research published in *JAP* in the past 100 years and to provide recommendations about potentially fruitful areas for future research.

The process we used to write this review included several steps. First, we created a database consisting of all articles on training, development, and learning published in *JAP*.¹ We included articles on mentoring and rater training if they offered insights into the effectiveness of training and development. More comprehensive treatment of these topics can be found in the

¹ The transformation of training in organizations has blurred the traditional distinctions between *training* and *development* (e.g., development is more future-oriented and focused on generalizable skills). Accordingly, we use the terms interchangeably in the current article.

articles on mentoring and performance appraisal found in this special issue. A list of the *JAP* articles included in our database, organized by decade, is provided in the online supplemental materials. Next, we used citation analysis and our own judgment to identify key themes and articles. Last, our review of the key articles served as the basis for the citations and article summaries included in each section of the paper.

We begin by presenting a timeline of training and development research in *JAP* and identifying key advances and innovations. We then examine four prominent research themes – training criteria, trainee characteristics, training design and delivery, and the training context – each of which provides unique insight into our evolving understanding of training and development. Finally, we discuss important directions for future research.

A Timeline of Training and Development Research in *JAP*

Since the first training and development article appeared in *JAP* in 1918, there has been gradual yet steady growth in the volume of training-related research. This growth is illustrated in Figure 1 along with a summary of important research advances over the past century. The figure also highlights several influential and integrative scholarly contributions that reflect what was happening in training at different points in time and spotlights a few key societal events that shaped research in the field. Below we discuss the evolution of training research within *JAP* over the past century, highlighting important developments and the factors that helped to shape them.

The Early Years (1917-1959)

The first training article to appear in *JAP* outlined a plan for the uniform training of applied psychologists, a profession that had grown in terms of both numbers and importance during World War I (Geissler, 1918). The article detailed an undergraduate curriculum that could be used to train applied psychologists and described the types of positions that would be appropriate for graduates (e.g., commerce, law, education). Over the next few decades, much of the training research shared a similar focus on describing or evaluating specific training efforts.

Articles, for example, described a sales training course at the American Steel & Wire Company (Sturdevant, 1918) and techniques for training clinical psychologists (Sibley & Stogdill, 1936). A number of learning studies also appeared during this period describing the elements involved in learning different skills (e.g., piloting a glider; Otis, 1934) and investigating rates of learning (e.g., Chapman, 1919; Renshaw, 1927).

The 1940's witnessed significant growth in the number of published articles with a greater interest in identifying factors predicting training success, particularly in military settings (e.g., Frandsen & Hadley, 1943; Lawshe & Thornton, 1943). For the first time, articles appear that are focused primarily on methods and instruments for measuring progress. Kellogg (1946), for example, described how data gathered through a pilot-response recorder could be used to provide an objective analysis of progress in the development of flying skill.

The 1950's saw continued growth, with more than twice as many articles published as compared to the previous decade. Much of the applied learning research during this period was supported by different military research agencies (Kraiger & Ford, 2007), a trend that continues today. Many of the themes that characterized prior decades carry over into this period. However, consistent with the emphasis on "human relations" during this period (Kraiger & Ford, 2007), a number of articles emerge focused on the development of supervisory skills and attitudes (e.g., Canter, 1951; Lawshe, Bolda, & Brune, 1958, 1959). Also, the transfer of learning became more of a focus by examining in laboratory settings the extent to which learning of a response in one task or situation influenced the response in another task or situation. For example, Ritchie and Michael (1955) experimented with the ordering of training pilots on two types of visual displays to determine which sequence should be used to enhance learning across the two types of displays. One study that moved beyond this approach was Benschoter and Charles (1957) who compared the retention of classroom and television learning, marking the first study published in *JAP* on technology-based, distance training. Overall, the early years of *JAP* focused on

describing or evaluating training interventions with little attention to building a broader understanding of the factors that influence training effectiveness.

The Emergence of Theory (1960's & 1970's)

In his Annual Review article, Campbell (1971) concluded, "By and large, the training and development literature is voluminous, nonempirical, nontheoretical, poorly written, and dull" (p. 174). Indeed, many of the articles published during the 1960's and 1970's continued to test interventions rather than theory (Kraiger & Ford, 2007). For instance, studies compared the effects of different training methods and approaches (e.g., Mayo & Longo, 1966; Siegel, Richline, & Federman, 1960), including computer-assisted instruction (Schwartz & Haskell, 1966). Articles continued to report on factors that predict training success, although there is a notable shift to a greater focus on training design variables, such as knowledge of results (Alexander, Kepner, & Tregoe, 1962; Wiener, 1963).

Perhaps in response to Campbell's (1971) dire portrayal of training research, there emerged more theory-driven training research and systems thinking. One notable example is Latham and Saari's (1979) application of social learning theory to the development of a behavioral modeling training program designed to improve supervisors' interpersonal skills. Also, published research began to recognize that the effectiveness of a training program is shaped by the broader system in which it is embedded (e.g., Friedlander & Greenberger, 1971). It is also worth noting that some early studies on cross-cultural training (Fiedler, Mitchell, & Triandis, 1971) and team training (Naylor & Briggs, 1965) were published during this period.

The Trainee is Alive (1980's)

Although compared to the 1970's fewer training articles were published in *JAP* during the 1980's, this period marked some important milestones. In particular, a more learner-centered orientation began to emerge as studies exhibited greater interest in how trainees approach and respond to learning during training. Kanfer and Ackerman's (1989) influential monograph, for

example, spurred interest in the interactive effects of ability, motivation, and task demands during skill acquisition, and other studies highlighted the importance of trainee self-efficacy for both performance and transfer (Gist, Schwoerer, & Rosen, 1989; Latham & Frayne, 1989).

This period also saw an increase in interest in the study of transfer to improve the application of workplace training (Baldwin & Ford, 1988; Goldstein, 1980). Transfer of training was defined as consisting of generalization, or the extent to which acquired knowledge and skills are applied to settings, people and/or situations different from those trained, and the maintenance of those learning experiences over time on the job. The first training-related meta-analysis appeared in *JAP* with Burke and Day's (1986) effort to resolve conflicting findings about the effects of managerial training on learning during training, behavior change after training, and tangible results such as reduced costs and promotions. In subsequent years, influential meta-analyses would focus on training motivation, reactions, and effectiveness, helping to summarize and clarify what we have learned and shaping the future research agenda in these areas.

Training in Context (1990's)

During the 1990's, research focused more on the role of the broader training context in shaping employees' participation in development activities, learning, and transfer. Studies demonstrated that employees' perceptions of the work environment (e.g., social support) influence their participation in continuous learning activities (Birdi, Allan, & Warr, 1997; Maurer & Tarulli, 1994; Noe & Wilk, 1993) and that pre-training contextual factors contribute to individual differences in learning (Quiñones, 1995; Smith-Jentsch, Jentsch, Payne, & Salas, 1996). Research also showed that the application of trained skills to the job can be influenced by aspects of the work environment, such as the transfer climate (Tracey, Tannenbaum, & Kavanagh, 1995). Finally, we see evidence of the cognitive revolution occurring in psychology as Kraiger, Ford, and Salas' (1993) monograph applied cognitive theory to broaden existing models of training evaluation to include cognitive, skill-based, and affective learning outcomes.

Beyond the Individual and the Classroom (2000 - Present)

During the 2000's more training articles were published than in any previous decade, stimulated in part by the development of new theoretical models, constructs, and evaluation tools (Salas & Cannon-Bowers, 2001). Research continued to feature a learner-centered approach as studies examined how different training methods, such as error training and mastery training, not only influence self-regulatory processes during learning (e.g., Keith & Frese, 2005; Kozlowski & Bell, 2006) but also interact with individual differences to impact training outcomes (Gully, Payne, Koles, & Whiteman, 2002). The burgeoning use of online training in organizations led to studies seeking to understand how such programs can be designed to improve trainee engagement and learning (e.g., Orvis, Fisher, & Wasserman, 2009; Sitzmann & Ely, 2010).

Another important development was a focus on the important benefits of learning for not only individuals but also teams and organizations (Aguinis & Kraiger, 2009). For example, studies examined the effectiveness of different team training methods (e.g., Marks, Sabella, Burke, & Zaccaro, 2002) as well as the impact of training and learning activities on unit performance and firm productivity (e.g., Kim & Ployhart, 2014; Van Iddekinge et al., 2009).

Recently, studies have increasingly focused on learning that occurs beyond the boundaries of formal training (e.g., Courtright, Colbert, & Choi, 2014; DeRue & Wellman, 2009; Dragoni, Oh et al., 2014). This research has demonstrated that the developmental value of an experience can be shaped by not only the nature of the experience but also aspects of the organizational context (e.g., supervisor support), interventions (e.g., structured reflection), and characteristics of the person (e.g., self-efficacy).

The Evolution of Key Research Themes within *JAP*

In this section we examine four important research themes: training criteria, trainee characteristics, training design, and training context. We chose these themes because historically they have been the focus of most training research and they provide an organizing framework for

a more detailed examination of how training has evolved over time. We first examine the criteria that have been used to understand training effectiveness and then discuss three sets of factors – trainee characteristics, training design, and training context – that influence these criteria.

Theme 1: Training Criteria

Given that training and development is done for a purpose it is important to examine the criteria that have been used to measure its effectiveness (Wallace, 1965). In this section, we first focus on the criteria of individual learning and transfer of learning (often to another type of task) as these are the two major criteria that have been the focus of training research in *JAP* over the last century. Then, we describe research that is broadening the criterion space of interest by examining the effects of training on broader job performance, work attitudes, and transfer outcomes at multiple levels of analysis.

An expanding understanding of learning. Learning is an inferred process that is “seen” through changes in knowledge, skills, attitudes, and behaviors during training and generalization to the transfer context (Baldwin & Ford, 1988). In one of the initial applied psychological studies on learning, Thorndike proposed principles of learning such as identical elements theory (Thorndike & Woodworth, 1901) with an emphasis on refined and sequenced content and appropriate reinforcement according to the law of effect (Thorndike, 1927). From this perspective, learning occurs when behaviors are followed by favorable consequences. Similarly, principles of behaviorism emphasized drill, practice, and reinforcement with the goal of mastery learning (Skinner, 1954). In *JAP*, Pressey (1963) argued that applications of behaviorist principles generated from animal studies to human learning were misguided. He particularly targeted the principles adopted with the “teaching machine” (programmed instruction).

Cognitive-based theories of learning emerged with an emphasis on learning more complex tasks and skills. This focus led to the development of learning hierarchies (e.g., cognitive outcomes from factual/declarative knowledge to higher order outcomes such as

synthesis and evaluation; Bloom, 1956). Conditions of learning (Gagne, 1965) targeted learning events and issues of attention, memory, retrieval and information processing. As noted by Gagne (1985), from a cognitive perspective, “learning is largely dependent on events in the environment with which the individual interacts” (p. 3). These conditions of learning were then synthesized into principles of instructional design to facilitate learning and transfer of learning (Gagne & Briggs, 1974). Based on this expanding understanding of learning, Kraiger et al. (1993) argued that there had been reliance in the training field on incomplete theories of what learning is and how learning should be measured. Drawing from a variety of research domains, they developed a multidimensional classification scheme of cognitive, skill, and affective outcomes that can guide the conceptualization and measurement of learning outcomes. For example, cognitive outcomes could include verbal knowledge (declarative), knowledge organization, and cognitive strategies, skill based outcomes could focus on compilation or automaticity, and affective outcomes could focus on motivational or attitudinal constructs. This construct oriented approach showed how to target a number of learning constructs that are interrelated in complex and interesting ways.

The Kraiger et al. (1993) paper was the likely trigger to the more precise measurement of the effectiveness of training at the individual level. A thorough review of examples can be found in Ford, Kraiger, and Merritt (2010). However, examples specific to *JAP* include cognitive outcomes such as knowledge structures (Day, Arthur, & Gettman, 2001) and metacognitive activity (Ford, Smith, Weissbein, Gully, & Salas, 1998); affective outcomes such as self-efficacy (Bell & Kozlowski, 2002; Chen, Thomas, & Wallace, 2005); and skill-based outcomes such as skill retention (Arthur, Day, Bennett, McNelly & Jordan, 1997) and the generalization of learning to tasks that had not been practiced during training (Holladay & Quiñones, 2003).

Learning tasks and outcomes. To understand how learning has been conceptualized and measured in *JAP*, one must first examine the task to be learned. The learning task (e.g., the objectives of training) guides what was trained, which has important implications for what can

and should be measured as learning and transfer outcomes.

The research can be broken down into two main categories of learning tasks – operator/manual tasks and cognitive/mental tasks. Most articles on learning and transfer from 1919 to 1972 focused on understanding learning rates for operator/motor skill tasks such as typewriting (Chapman, 1919), transcription (Henry & Wasson, 1939), knitting (Blankenship & Taylor, 1938), street car operators (Ghiselli & Brown, 1947), assembly tasks (Lawshe & Cary, 1952; Smader & Smith, 1953), and steering and/or tracking tasks (e.g., Garvey 1960; Hinrichs, 1970). The studies typically measured learning as the rate of improvement over time –with studies spanning many days, practice trials, and blocks of trials. Most studies presented learning curves to visually show the rate of improvement in terms of the reduction in time to perform a task, increase in productivity (Blankenship & Taylor, 1938, Chapman, 1919), increase in accuracy (Ehrlich, 1943; Hinrichs, 1970) or reduction in error rates or accidents (e.g., Ghiselli & Brown, 1947; Smith & Sussman, 1970). For example, Blankenship and Taylor (1938) examined improvements in output using weekly work samples and found the now familiar learning curve characteristics of an early sharp increase in output with negative acceleration, and the development of a learning plateau beyond which little improvement occurred. They also found that early proficiency level was not a good predictor of later proficiency and that there were individual differences in the learning curves. Interestingly, Wagner (1933) studied the cognitive strategies that participants used while attempting to complete paper mazes – an early forerunner to taking a cognitive perspective to understanding strategies that are linked to learning outcomes.

The majority of studies in this time period that explicitly focused on transfer of learning of a response in one task or situation to another mainly examined the learning of operator/manual skills such as basic assembly (Woodward, 1943), aiming (Stockbridge & Chambers, 1958), operator tasks (Hammerton & Tickner, 1967) and tracking/radar control tasks (e.g., Briggs & Weiner, 1966; Lincoln & Smith, 1951). The measure of learning transfer included the number of

transfer trials to reach a criterion level (Muckler & Matheny, 1954), error rates (Briggs & Weiner, 1966), time on target (Lincoln & Smith, 1951), efficiency indices such as reductions in time to perform (Von Trebra & Smith, 1952) and measures of both accuracy and commissive errors (Weiner, 1963). Many of these studies examined the generalizability of the training conditions for reducing negative transfer where the learning of a response in the learning context can interfere with the appropriate response in the transfer context.

Since 1972 there has been an increase in the complexity of operator/manual skills in studies of learning and transfer such as vehicle maintenance safety (Komaki, Heinzmann & Lawson, 1980), navigation skills (Olea & Rea, 1994), computer software skills and video games (e.g., Day et al., 2001; Hughes et al., 2013), and more complex radar tracking studies that require accessing more information and making strategic decisions over time (Ackerman, 1992; Ford et al., 1998). These studies have tended to measure learning (or transfer) in terms of decision accuracy and skilled performance (total points scored given game/simulation rules).

Studies that incorporated cognitive/mental tasks can be divided into two main categories – those employing simple learning tasks such as basic memory and paired association tasks and those investigating knowledge gained from courses/classes. The majority of studies employing basic cognitive tasks were conducted prior to 1980 and included learning tasks such as memorizing the position of cards in a deck through paired associations (Renshaw, 1927), making English translations (Thisted & Remmers, 1932), completing paper mazes (Wagner, 1933), and recalling words (Rubenstein & Aborn, 1958). The main measure of learning was often the rate of improvement or how long it took to reach a set criterion level (e.g., Renshaw, 1927). A number of studies (some before 1980, but most after 1980) have studied learning through examining knowledge acquisition. The typical measure of learning targeted declarative knowledge such as grades (Hollander, 1954; LePine, LePine, & Jackson, 2004) or achievement test scores (e.g., Chen, Gully, Whiteman & Kilcullen, 2000). But some studies also assessed procedural

knowledge (Neal et al., 2006; Sitzmann & Johnson, 2012). A recent focus on decision making in more dynamic contexts (e.g., Goodman & Wood, 2004) has led to measuring learning in terms of strategic as well as declarative knowledge (Bell & Kozlowski, 2008; Hughes et al., 2013).

Broadening the criteria. The first efforts to broaden training criteria beyond direct measures of learning and training transfer emerged in the 1950's and 1960's as research began to examine job performance, specifically performance that was not directly related to the training itself. Kraiger and Ford (2007) noted that during the 1940's the responsibility for training shifted from supervisors to training experts. Since training was now emerging as a cost center, organizations began to consider their return on investment. Organizations moved beyond an interest in determining whether trainees learn faster or retain skills longer to a focus on improved job performance. One strategy for showing training benefits was to look at the impact of training on a standardized assessment related to the job. For example, Barthol and Zeigler (1956) examined the effectiveness of a 20-week supervisory training program on production, safety, budgeting, and human relations topics that had been given to 210 first- and second-line supervisors. The researchers compared group means on parallel forms of a previously validated assessment of knowledge of supervisory practices and found a significant increase in post-test scores. Interestingly, they also argued that reduced variability was an indicator of training effectiveness, a proposal made three decades later by Alliger and Katzman (1997).

During the 1970's and 1980's, criteria further expanded to include trainee attitudes as an outcome of training, and, presumably, a benefit to the individual and to the organization. As one example, O'Brien and Plooij (1977) compared programmed instruction (PI) and "prose" training (standard text) to a control group in preparing nurses to work with Aboriginals in South Australia. Although there were positive effects for PI training on cultural knowledge, there was no effect on trainees' interest in or apprehension about working in the Aboriginal community. Similarly, Zacker and Bard (1973) compared affective-experiential training and special cognitive

(classroom) training to a no-training condition for 60 New York City police officers. The affective-experiential training, which included role plays and simulations of interpersonal conflict, showed stronger effects on both performance criteria and a danger-tension index (total arrests/total sick days * 100) which was operationalized as a measure of officer morale.

More recently, several papers have used different forms of multilevel analyses to demonstrate the relationship of training to both team and organizational effectiveness. Multilevel modeling provides a powerful tool for examining both within-person and cross-level relationships (e.g., Kolozlowski & Klein, 2000; Ployhart & Hakel, 1998; Ployhart & Vandenberg, 2010). It has long been assumed that changes in individual knowledge or skills affect individual or team performance, which in turn affects unit-level or organizational-level indicators of effectiveness. But, prior to the development of advanced statistical analyses for treatment of hierarchical data, it had been difficult to *show* this. Several *JAP* papers offer examples of these effects. Van Iddekinge et al. (2009), for example, examined the effects of selection and training programs on customer service indicators and financial performance in 861 fast-food restaurants on a monthly basis for one year. Latent growth curve modeling was used to examine the effects of changes in the use of training on change in the performance indicators. They reported that use of training was both directly related to financial performance and indirectly related through improved customer service. Kim and Ployhart (2014) used over 12 years of longitudinal data to examine the effects of selective staffing and internal training on the financial performance of 359 firms during pre- and postrecessionary periods. Prior to the recession, they found that more internal training contributed to firm profit growth and this effect could be partially explained by the effects of training on firm productivity. In addition, they found a significant interaction between selective staffing and internal training, such that firms only achieved consistent profit growth when both were high. In contrast, they found that internal training conducted during and after the recession did not have an effect on postrecession profit.

All this suggests that training may help firms develop slack resources during strong economic periods (i.e., prerecession) that help them to weather and recover from economic downturns.

Theme 2: Trainee Characteristics

Trainee characteristics can be broadly defined to include capabilities (e.g., general mental ability and intelligence, and specific aptitudes), personality traits (e.g., Big Five, locus of control), motivational constructs (e.g., self-efficacy, goal-orientation), values and interests (e.g., vocational and occupational interests), attitudes and emotions (e.g., motivation to learn) and perceptions (e.g., perceived managerial support, climate for training).

A focus on trainee ability and aptitudes for training success. Munsterberg (1913) suggested that we cannot place enough emphasis on considering how differences in ability determine how much individuals benefit from training. Not surprisingly, most of the studies on trainee characteristics published in *JAP* prior to the 1960's focused on the role of general mental ability and specific aptitudes for training success.

The first studies published in *JAP* on trainee characteristics found that IQ was related to success in learning mechanical, printing, garment, culinary, and farmwork trades (Cowdery, 1922). Gilbert (1941) emphasized that "aptitude" (the relative ability of individuals to benefit from training) was an important factor in how much individuals will benefit from training. Research also showed that intelligence and aptitudes were related to vocational and occupational choice (e.g., Hillman, 1934). Studies helped the U.S. military predict who would succeed in pilot or soldier training during WWII. For example, Fiske (1947) found that the Wonderlic was useful for predicting Navy flight training candidate's ground school failures and a combination of a mechanical comprehension test and biographical data was useful for predicting flight failures.

The role of personality and attitudes in training received some, but notably less attention than aptitudes during the early years. For example, Geiger, Remmers, and Greenly (1938) developed a measure of attitudes toward training which included items related to fellow

employees, instruction, and management. Wiener and Simon (1950) showed that embalmer trainees had a greater concern for their own personal health (hypochondriasis) as measured by the MMPI compared to a control group with different career objectives.

Moving beyond ability and aptitude for predicting training success. In the 1960's through the 1970's research continued to focus on predicting training success, with increasing interest in trainee characteristics other than cognitive ability and aptitude. Several studies suggested that considering trainees' cognitive ability as well as interests, personality, moods, values, biographical data, motivation, and physical and mental health might enhance prediction of training success. For example, Gordon and Alf (1962) showed that interest inventory scores contributed beyond aptitude test scores in the prediction of naval school training grades. Mobley, Hand, Baker and Meglino (1979) using a role choice model, a variant of expectancy theory, found that expectancies about completing training, a Marine's role, and finding a civilian role predicted the turnover of Marine Corp recruits during training.

Trainability and matching trainee and instructional characteristics. Studies on trainee characteristics published in *JAP* between 1970 and 1990 made two important contributions. First, based on the work of Brown and Ghiselli (1952), trainability was considered distinct from job success. Trainability testing, distinguished from cognitive ability tests by the inclusion of a period of structured instruction followed by an assessment of learning, was used to select employees for training rather than to choose employees who are already qualified for the job. Studies by Robertson and Downs (1979, 1989) emphasized the differences between work sample tests and trainability tests (e.g., a structured learning period, observation of how things are done and what is done, and including assessment of these observations, error correction, and perceptual and manual skills) and showed that trainability work sample tests predict short-term success more accurately than longer term success. Reilly and Israelski (1988) found that minicourses, a variant of trainability testing used for assessing job candidates' ability to acquire

knowledge related to training courses, had similar validities with job performance and training performance as work samples, trainability tests, and ability tests.

A second contribution was the development and testing of multivariate models of how trainee characteristics influence motivation and subsequent learning (e.g., Noe, 1986), which answered calls for systematic and theoretical research which incorporates motivation theories and investigates how learning is influenced by trainee and instructional characteristics (Campbell, 1971; Goldstein, 1980). Kanfer and Ackerman (1989) integrated motivation and cognitive ability within an information processing framework. They showed that information processing and ability demands change as a function of practice, training paradigm, and timing of goal setting. Mumford, Weeks, Harding, and Fleishman (1989) found that individual attributes (e.g., aptitude, academic achievement motivation) are likely to have a greater impact on achievement and motivational outcomes than course content variables (e.g., practice, instructional aids). Also, research identified new trainee characteristics that can influence training success and learning, including managerial motivation (Butler, Lardent, & Miner, 1983), seniority (Gordon, Cofer, & McCullough, 1986), and self-efficacy (Gist et al., 1989).

Expansion of the scope of trainee characteristics research. Compared to the previous forty years, during the 1990's there was a noticeable increase in the number of studies of trainee characteristics published in *JAP*. This was likely due to Tannenbaum and Yukl's (1992) observation that more studies were needed to understand how trainee characteristics interacted with program design features to affect learning outcomes rather than continuing to focus on identifying the factors responsible for trainees who would pass training programs. Also, the "War for Talent" (Chambers, Foulton, Handfield-Jones, Hankin & Michaels, 1998) emphasized the role of training and development for attracting, retaining, and motivating employees throughout their employment. Three new research areas emerged in the 1990's. The first focused on understanding how trainee characteristics related to participation in development activities.

Studies showed that person (e.g., learning motivation, self-efficacy, values) and environment (e.g., social support, organization policies, incentives) influence participation in development activities. Noe and Wilk (1993), Maurer and Tarulli (1994), and Birdi et al. (1997) identified some common predictors of participation in different types of development activities (e.g., work-based on work time, career planning activities on own time) and found that job satisfaction and organizational commitment were related to participation in work-based development activity.

The second research area focused on the role of training and learning in socializing new employees. Self-efficacy, prior experience, and the extent to which training meets or fulfills trainees expectations were shown to be related to new employees' training motivation, commitment, and intentions to quit. For new employees with low levels of self-efficacy, training was more strongly related to post-training self-efficacy, ability to cope, job performance, and intentions to leave the profession (Saks, 1995). The extent to which training meets trainees' expectations (training fulfillment) influences motivation, organizational commitment, and different types of self-efficacy (Tannenbaum, Mathieu, Salas, & Cannon-Bowers, 1991). The third area expanded our understanding of the role of self-efficacy, conscientiousness, goal orientation, climate and culture, and their interaction on motivation to learn, development of learning goals, task analysis, metacognitive activity, and learning and transfer of training (Brett & Vandewalle, 1999; Colquitt & Simmering, 1998; Ford, Smith, Segó, & Quiñones, 1993; Ford et al., 1998; Martocchio & Judge, 1997; Tracey et al., 1995). For example, Brett and Vandewalle (1999) found that goal orientation was related to the type of goals that trainees adopted for a training program. Trainees with a high learning goal orientation adopted skill improvement goals, which resulted in better training performance. In addition to these three areas, studies identified other important trainee characteristics such as proactive personality (Parker & Sprigg, 1999) and continued to advance our understanding of the effects of cognitive ability and its relationship with other trainee characteristics. For example, Eyring, Johnson, and Francis (1993)

used learning curve modeling with multilevel models to show that cognitive ability was more important earlier than later in skill acquisition and that practice resulted in reduced performance differences between individuals higher and lower in ability, self-efficacy, and task familiarity.

New theoretical frameworks and consideration of instructional context. The number of published studies on trainee characteristics during the 2000's continued at the same rate as in the 1990's. These studies made several notable contributions. First, two important meta-analysis of trainee characteristics were published in *JAP* during the 2000's. Colquitt, Lepine, and Noe (2000) summarized how trainee characteristics influence training motivation and learning outcomes and proposed and tested an integrative theory of training motivation. Training motivation explained incremental variance beyond the effects of cognitive ability. The effects of personality, climate, and age on training were only partially mediated by self-efficacy, valence, and job involvement. Payne, Youngcourt, and Beubien (2007) found that both learning goal orientation and prove goal orientation were positively related to learning, although the former had a larger effect. Avoid-goal orientation had close to a zero relationship with learning. Second, studies emphasized that how trainee ability and motivation influence learning is more complex and nuanced than shown in earlier studies. Gully et al. (2002), for example, found that trainees with high cognitive ability or openness to experience benefited more from error training than trainees with low cognitive ability or openness to experience. Several studies also added to our understanding of the relationship between cognitive ability, goal orientation, self-efficacy, and personality and how they influence self-regulation, learning, and skill performance. Bell and Kozlowski (2002) found that learning goal orientation was adaptive for high ability individuals but had no effect for low ability individuals. The effects of performance orientation depended on cognitive ability and the specific learning outcomes examined. Using multilevel analysis, Yeo and Neal (2004) showed that the relationship between effort and performance increased with practice and this rate of this increase was faster for trainees with high ability or low performance

orientation. Vancouver and Kendall (2006) showed that the self-efficacy-learning relationship is likely more dynamic than suggested by prior studies using between subject designs. Using a within-person analysis they found that high self-efficacy may cause trainees to allocate fewer resources when planning, which results in a negative, rather than positive, relationship between self-efficacy and learning performance.

Third, researchers moved beyond using expectancy theory to explain participation in development activities and instead relied on a broader array of theories and models, including the theory of planned behavior, proactive personality, social exchange, career motivation theory, person-environment fit, and deprivation theory (Kraimer, Siebert, Wayne, Liden, & Bravo, 2011; Major, Turner, & Fletcher, 2006; Simmering, Colquitt, Noe, & Porter, 2003). Research continued to show the importance of trainee characteristics as antecedents of motivation to learn and participation in development activities found in studies in the 1980's and 1990's were replicated. Maurer, Weiss, and Barbeite (2003) found that age negatively affects individual and situational factors that predispose employees to participate in development. Emotional stability, self-efficacy, and learning orientation were positively related to self-perceived role knowledge, which is important for how new leaders acquire knowledge and learn behaviors (Dragoni, Park, Soltis, & Forte-Trammell, 2014). A new research area also showed that learning orientation and self-efficacy likely buffer trainees from the potentially negative effects of stress on learning from challenging job experiences (DeRue & Wellman, 2009; Courtright et al., 2014).

Fourth, research moved away from the prevalent focus in the 1990's on how trainee characteristics interacted with instructional design to consider instructional modality and instructor style. Towler and Dipboye (2001), for example, found during face-to-face instruction that trainees with a high mastery orientation had their poorest problem solving performance after listening to an organized and inexpressive instructor. Organization or inexpressiveness did not influence participants with a low mastery orientation. In the late 2000's to 2015, new training

delivery and instructional methods (e.g., e-learning, games, and simulations) have stimulated the examination of how trainee characteristics including cognitive ability, goal orientation, and self-efficacy, influence the learner's engagement (practice difficulty, cognitive involvement) and anxiety in training, and in turn, knowledge acquisition and task performance (Hughes et al., 2013; Orvis et al., 2009; Watson et al., 2013). For example, mastery orientation was positively related to pre-training motivation to learn, trainee satisfaction, and learning in an e-learning program. Learner control had a positive relationship with trainee satisfaction, but unlike performance orientation, was unrelated to off-task attention (Orvis et al., 2009). In one of the few original studies attempting to understand how trainee characteristics influence trainee reactions, Harman, Ellington, Surface, and Thompson (2015) found that interest in the topic, satisfaction, and entity beliefs influenced open-ended comments provided by trainees.

Theme 3: Training Design and Delivery

An important step in designing any training program involves choosing methods and techniques appropriate for delivering content to trainees, identifying and sequencing instructional objectives, and determining the instructional tools and strategies necessary to support learning and transfer (Salas & Cannon-Bowers, 1997). In this section, we discuss the evolution of research on training design and delivery. We then turn attention to three topics - active learning, technology-based learning, and team training - which have captured significant attention over the past few decades and are likely to remain influential in the years ahead.

Designing training to support learning. Much of the training research published during the early years of *JAP* did not focus on issues of training design and delivery. This may be due, in part, to the fact that during this time there was very little variability in training methods (Kraiger & Ford, 2007). Training was typically conducted on the job by either a supervisor or more experienced worker and involved demonstrating and explaining the steps until the trainee could perform them correctly. Most training design articles published in *JAP* during this period

provided descriptions of successful training programs. For example, Lindahl (1945) provided a detailed description of a method designed to teach workers the proper hand and foot movements for operating machines used to cut tungsten rods into small discs.

By the 1960's, new techniques, such as case studies, role playing, programmed instruction, and television, were introduced, leading to greater variability in training methods. In an effort to sort through this variety, the focus of research over the next two decades shifted largely to comparing the utility of different methods. For example, Barbee and Keil (1973) compared videotape-feedback and behavior modification techniques for training job-interviewing skills and O'Brien and Plooij (1977) compared the effectiveness of programmed instruction and essays for training nurses. The value of such studies, however, was limited since there were few attempts to explain why a particular method yielded superior outcomes. As Goldstein (1980, p. 261) concluded, "a continuation of studies which only compare techniques and are not concerned with the particular behaviors being taught is probably not very fruitful for computer-assisted instruction, programmed instruction, or any technique, for that matter."

Over time, the field began to shift from an emphasis on hardware and techniques to understanding how training systems should be designed to support the process of learning. However, research on traditional learning principles, such as stimulus variability and conditions of practice, was criticized as having limited utility for training the complex skills required by organizations (Baldwin & Ford, 1988; Goldstein, 1974). These concerns coupled with developments in the fields of cognitive psychology (Anderson, 1983) and instructional psychology (Pintrich, Cross, & Kozma, 1986) helped spur research on training approaches that leverage mental processes and motivational factors to develop more complex skills. Within *JAP*, theory-driven research examined goal-directed learning (e.g., Kanfer & Ackerman, 1989), overlearning (Driskell, Willis, & Copper, 1992), and learner control (Simon & Werner, 1996). In contrast to earlier trends, these studies often investigated the learning mechanisms through which

the approaches have their effects. For example, Eden and Aviram (1993) showed that a behavioral-modeling workshop delivered to unemployed individuals boosted their general self-efficacy, which in turn increased job-search activity and led to a higher rate of reemployment among individuals who were low in initial general self-efficacy. In addition, research recognized the importance of aligning training delivery methods with learning objectives. Arthur, Bennett, Edens, and Bell's (2003) meta-analysis found that the effectiveness of specific training delivery methods often varied considerably depending on the skill or task being trained (e.g., cognitive skills, interpersonal skills) and the criteria used to evaluate training (e.g., learning, behavior).

A shift from passive to active learning. Over the years, research and practice has often treated the learner as a passive recipient of instruction (Ford & Kraiger, 1995). This is due largely to the dominance of the behavioral paradigm, which emphasized tightly structured training designed to walk trainees through the steps to be learned and to eliminate errors and increase efficiency (Smith, Ford, & Kozlowski, 1997). In contrast, more recent research has adopted an active learning approach in which the trainee is seen as an active participant in the learning experience (Bell & Kozlowski, 2009). This evolution has occurred as the result of changes in both the nature of work and training. For example, research suggests that although behavioral approaches may be effective for developing routine expertise, they are ill-suited for developing the flexible and adaptable skills (i.e., adaptive expertise) needed in today's more complex and dynamic work environments (Ford, Santoro, & Showler, in press; Kozlowski et al., 2001). In addition, the increased reliance on technology-based training and informal learning within organizations has led to more learner-centered training and has given trainees unprecedented control over their learning (Noe et al., 2014).

Research published in *JAP* has been instrumental in not only developing models of active learning but also advancing our understanding of how to design and support more learner-centered training (Ford et al., 1998). For example, studies have demonstrated that active, self-

regulated learning can be supported by providing guidance on the sequencing of practice tasks (i.e., guided exploration; DeBowski, Wood, & Bandura, 2001), encouraging trainees to actively explore and to make and learn from errors (i.e., error management training; Gully et al., 2002; Keith & Frese, 2005; 2008), and using goals, situational cues, and instructions to encourage trainees to adopt a mastery orientation (i.e., mastery training; Kozlowski & Bell, 2006). A study by Bell and Kozlowski (2008) integrated this and other work into a model of active learning consisting of three core training design elements – exploratory learning, error-encouragement framing, and emotion control – that interact with individual differences (e.g., cognitive ability, goal orientation) to influence cognitive, motivational, and emotional self-regulatory processes during learning and, as a result, impact both proximal (e.g., skill acquisition) and distal (e.g., generalization) training outcomes.

Growth in technology-based training. The proliferation of technology-based training in the workplace (Sitzmann, Kraiger, Stewart, & Wisher, 2006) has sparked significant research interest. Examination of this research reveals an evolutionary pattern similar to the one described earlier for more traditional training methods. For the first few decades, studies compared technology-based methods (e.g., computer-assisted instruction) to more conventional methods (e.g., classroom) (e.g., Schwartz & Haskell, 1966; Schwartz & Long, 1967). These studies found that although technology often reduced training time, trainee attitudes and achievement were generally comparable to more conventional methods. Researchers now largely agree that efforts to evaluate the comparative effectiveness of different technologies are of limited value (Brown, Charlier, & Pierotti, 2012; Clark, 1994). Rather, what is more important is understanding the pedagogical features that influence the effectiveness of technology-based training and the conditions under which it is likely to be most effective (Bell & Federman, 2013). In the late 1980's, research in *JAP* began to move in this direction as Gist et al. (1989) examined different approaches (modeling vs. tutorial) to computer-based training as well as their interaction with

trainees' computer efficacy. They found that the modeling approach led to better training outcomes, including higher performance and more positive affective responses. In addition, trainees in the modeling condition developed higher levels of software self-efficacy, particularly if they had low pre-training computer self-efficacy. More recently, research has focused on the effects of learner control in technology-based training (Hughes et al., 2013; Orvis et al., 2009) and strategies designed to help learners make better use of this control (Sitzmann & Ely, 2010; Sitzmann & Johnson, 2012) or to monitor their behavior during technology-based training (Watson et al., 2013). This research suggests that a variety of factors, including individual differences (e.g., cognitive ability, self-efficacy), training design features (e.g., error framing), and the provision of support (e.g., self-regulatory prompts), shape the decisions individuals make during learner-controlled training and ultimately how much they learn.

Using training to improve team functioning. While a number of studies through the 1970's examined the role of training on team effectiveness (e.g., Briggs & Johnston, 1966; Naylor & Briggs, 1965), it was not until the late 1980's and 1990's that team training became driven by both theory and research. Integral in the maturation of team training research was the distinction between taskwork and teamwork skills (e.g., Salas, Stagl, Burke, & Goodwin, 2007). The former are those skills team members need to perform the work (often with coordination), and the latter are those required to perform more effectively as a team. This distinction enabled researchers to identify and test more general strategies for team skills as opposed to testing more task-specific team training interventions. Marks et al. (2002), for example, examined the impact of cross-training on shared mental-models among team members. Cross-training involves training team members in the role behaviors of other team members, and shared mental models have been found to be determinants of team performance (Mathieu, Heffner, Goodwin, Salas, & Cannon-Bowers, 2000). Marks et al. (2002) found across two studies and nearly 100 trained teams that cross-training enhanced the development of shared team-interaction models.

Finally, other research has shown that leader briefings (Marks, Zaccaro, & Matheiu, 2000) and after-event reviews (S. Ellis & Davidi, 2005; Villado & Arthur, 2013) can also improve team functioning. Leader briefings help team members focus on priorities before accomplishing tasks, while after-event reviews or team debriefs can be considered “mini-trainings” in which the leader reviews with the team examples of successful and unsuccessful performance with respect to tasks and teamwork.

Theme 4: Training in Context: Conditions Before and After Training

In the last 30 years, training research in *JAP* evolved, in part, to reflect an awareness that organizational training and development does not occur in a vacuum. Proper instructional design is necessary but insufficient because learning and transfer of learning to the job involves people who work in complex and varied environments. The work context, including what happens before and after formal learning experiences (Tannenbaum & Yukl, 1992), can affect how employees think, feel, learn, and behave with important implications for understanding and ensuring training effectiveness.

A systems perspective. In the original *Handbook of Industrial and Organizational Psychology*, Hinrichs (1976) offered an initial view of training as a system. By the late 1980’s, researchers began taking more of a systems perspective in their attempts to understand training and development. A training “system” includes three major components that can influence overall effectiveness (Baldwin & Ford, 1988): a) instructional design and training methods—including the attributes of the experience designed to promote learning; b) trainee or personal characteristics—the makeup and mindset of the learners; and c) organizational conditions or work environment—the context in which employees work. In earlier sections we examined the first two components, instructional design and trainee factors. Here, we examine how conditions before and after a learning event influence trainee motivation, training transfer, and ultimately, the organizational effectiveness of training and development.

Work conditions that can influence the effectiveness of training include supervisor and peer support; the amount of time and opportunity learners have to apply new skills, and the challenges and constraints they face on the job; organizational policies and practices; the broader organizational climate and culture in which they work; and previous work and training experiences they have encountered (Ford, Quiñones, Segó, & Sorra, 1992; Mathieu, Tannenbaum, & Salas, 1992; Noe, 1986; Tracey et al., 1995). Prior to the 1980's, few studies considered how the work environment affects training effectiveness, and almost none appeared in *JAP*. However, a few *JAP* studies presaged subsequent research themes. For example, Alderfer (1971) showed that employees who were more satisfied with their career prospects were more likely to view a management development program positively. This study hinted at a future research theme – how the work environment affects employees' motivations and perceptions about training. Similarly, Bowen and Kilmann (1975) developed an early measure of learning climate for use in an academic environment which was a precursor to later research efforts examining learning climate in work settings

Conditions affect participation in developmental activities. As noted earlier, employees should be considered active participants in the training system, possessing differing levels of motivation to participate in developmental activities, to learn when they are participating, and to use what they have learned back on the job. Employees often have some choice about whether to participate in development, so it is important to understand why some employees are more active than others (Kozlowski & Hults, 1987). Several studies in *JAP* confirmed that work conditions and prior experiences can influence motivation to participate.

Birdi et al. (1997) conducted a study of 1,700 manufacturing employees. They examined formal and informal, as well as voluntary and required developmental experiences and discovered that employees who received greater management support were more likely to participate in voluntary developmental activities. Noe and Wilk (1993) also found that

employees' perceptions of social support and work conditions influenced their participation in developmental activities. Hurtz and Williams (2009) gathered data from four organizations across two time periods. They reported that participation in developmental activities was greater when employees were aware of available learning opportunities, and perceived support for employee development, particularly from "important people." Similarly, Fecteau, Dobbins, Russell, Ladd, and Kudisch (1995) reported a strong correlation between training reputation and pre-training motivation. So while trainee reactions are not necessarily a strong predictor of learning (Alliger, Tannenbaum, Bennett, Traver, & Shotland, 1997), reactions become more important when viewed as part of the larger training system. A positive learning experience may contribute to future participation and motivation, beginning a virtuous learning cycle. In sum, it appears that positive experiences, ample opportunities, and a supportive environment can increase employee participation in developmental activities.

The role of supervisor and peer support and organizational practices. Colquitt et al.'s (2000) meta-analysis examined how the work environment influences trainee motivation. They concluded that supervisor support, peer support, and positive climate are all positively related to motivation to learn and motivation to apply learned skills on the job. Maurer and Tarulli (1994) found that manager support is particularly influential for those employees who value such support.

Team leader support and team climate are also positively related to post-training behaviors. When a leader behaves in a manner that supports what was taught in training, trainees are more likely to apply what they learned. This was true even when leader support was demonstrated during an interaction with someone other than the trainee (Smith-Jentsch, Salas, & Brannick, 2001). In addition to behavioral outcomes, trainees are more likely to respond positively to training when they perceive that learning is supported (Sitzmann, Brown, Casper, Ely, & Zimmerman, 2008). One way that support for development can be shown is through

mentoring. When employees receive career mentoring they are more likely to perceive greater organizational support for development (Kraimer et al., 2011). Managers can also support the development of others through both “showing” (e.g., modeling appropriate behaviors) and “telling” (e.g., providing job related information) (Dragoni, Park et al., 2014).

A trainee’s supervisor plays a clear role in transfer of knowledge and skills learned in training to the job. Interestingly, Taylor, Ross-Eft, and Chan’s (2005) meta-analysis of behavior modeling training found that subsequent trainee behavioral changes on the job was far greater when the trainee’s supervisor also received the training. That may be because the supervisor was fully aware of the training and was better equipped to support and encourage the trainee to apply what they learned. Tracey et al. (1995) studied 500+ supermarket managers from 52 stores. They found that both workplace climate (e.g., supervisors and peers encouraging use of trained skills) and continuous learning culture (i.e., more general cues about learning, such as being given stretch assignments) significantly influenced post training behaviors.

Organizational practices and policies may also be important, including how training opportunities are communicated. As noted above, employees need to know about the opportunities that are available (Hurtz & Williams, 2009). The message provided about the training also matters. Quiñones (1995) found that whether training was described as “remedial” vs. “advanced” influenced trainees’ expectations and in turn their motivation to learn and subsequent learning and behavioral outcomes. Expectation setting has other implications, as Tannenbaum et al. (1991) found that the extent to which training meets a trainee’s expectations influences post-training commitment and self-efficacy.

The role of work experiences. Prior training experiences can influence trainee motivation about and reactions to subsequent training and so can prior work experiences. In a study of assertiveness training for pilots, Smith-Jentsch et al. (1996) found that pilots who had previously experienced work events where assertiveness was needed (e.g., being pressured to fly

in bad weather) were more motivated to learn and more likely to demonstrate trained assertiveness skills.

Several studies in *JAP* have examined how work experiences, including job challenges, can contribute to or hinder development. In a study involving over 660 managers, McCauley, Ruderman, Ohlott, and Morrow (1994) designed and validated a developmental challenge profile for managerial jobs. The profile identified on-the-job challenges that promote leadership development (e.g., situations where a leader had to manage business diversity or influence without authority). Morrison and Brantner (1992) found that employees learn faster on the job when they have greater role clarity and face fewer job challenges, suggesting that ambiguity and stress can in some instances hinder learning. But the influence of job stress and challenge on learning may be complex. LePine et al. (2004) found that stress associated with “challenge” stressors (e.g., working on multiple projects) were positively related to learning motivation while “hindrance” stressors (e.g., a lot of busy work) were negatively related. DeRue and Wellman (2009) concluded that to optimize learning there needs to be ample challenge. In a study of leader development, they found that developmental challenge (e.g., unfamiliar responsibilities, working across boundaries) was a plus for development, but only up to a point. It also appears that teams learn more when their workload is distributed evenly (Ellis et al., 2003). Perhaps when team members are overloaded, it creates challenges for learning throughout the team.

Collectively, these studies indicate that to fully understand training and development, it is critical to investigate the context within which training occurs. Research in *JAP* has examined and helped clarify the interrelationship between work conditions, prior experiences, employee motivation, learning, and reactions to training experiences.

Future Research Directions

As noted throughout this article, there have been many advances in training and development research and *JAP* has published many seminal articles. A summary of key

conclusions derived from the past 100 years of training and development research is provided in Table 1. These research findings have important practical implications, although there is a need for more translations of what we know so as to bridge the science-practice gap. As the field of training and development continues to evolve there are several areas where additional research is needed. Below we highlight future research needs for each of the four themes we have discussed.

Training Criteria: Learning, Transfer, and Effectiveness

A critical step in developing and implementing a job-relevant training program that meets trainee needs is identifying what needs to be learned. Training needs analysis is the process used to determine individual, team, and organizational training needs. Based on this information, appropriate decisions can be made regarding the objectives of the program and the content to be covered in training (Goldstein & Ford, 2002). Although widely considered one of the most important steps in developing training, needs analysis has received little research attention and only two articles in our database specifically studied the process (Ford et al., 1993; Trabue & Dvorak, 1934). This area also warrants greater consideration because of the emerging challenges organizations face when conducting training needs analysis. As organizations seek to become more agile, for example, the focus is shifting toward more rapid development and deployment of training solutions, which means they no longer have the luxury of taking months to conduct a detailed needs assessment. Thus, research is needed to understand how to identify training needs more rapidly without sacrificing the quality of the information that is gathered. One area to look to for guidance is research on large scale societal interventions such as emergency responses by the U.N. to a humanitarian crisis or community based interventions such as AIDS prevention. Decision makers in these domains want to know what interventions can work and real time information on whether the chosen intervention is succeeding or failing. This need has led to the development of the rapid evaluation and assessment method (REAM) (McNall & Foster-Fishman, 2007; McNall, Welch, Ruh, Mildner, & Soto, 2004), which provides the feedback link

in the instructional system design models of training that we often talk about (but seldom research) between evaluation and reassessment of needs.

We also need to continue to evolve how we think about and measure learning. The Kraiger et al (1993) paper on training evaluation is often cited by researchers as helping to drive their conceptualization and measurement of learning. While research has improved our understanding of training criteria, many studies continue to measure learning only in terms of declarative knowledge. In addition, there is a need to better understand the nomological network connecting the different training criteria of learning, transfer, and performance. For example, Warr, Allan, and Birdi (1999) employed a longitudinal design of three types of training evaluation measures – reactions (enjoyment, usefulness, perceived difficulty of learning and motivation to learn), learning (confidence, knowledge level and learning strategy), and behavioral change (frequency of use of equipment). They found that reaction measures were predictive of changes in learning outcomes but not changes in job behavior. The study demonstrates the importance of examining change scores as well as the typical post-training assessments for a greater understanding of outcome interrelationships. Blume, Ford, Baldwin and Huang (2010) distinguished use from effectiveness in their meta-analysis of factors impacting transfer. They found that factors had differential effects depending on the criteria examined. Thus, while our understanding of what we mean by learning has advanced, more empirical studies examining multiple dimensions of learning, transfer, and performance are needed to build up our foundational knowledge around criteria of training effectiveness.

Kozlowski, Brown, Weissbein, Cannon-Bowers, and Salas (2000) emphasize that taking a levels approach to understanding training effectiveness presents both key opportunities and conceptual and statistical challenges. A large scale educational research study by Zvoch, Letourneau, and Parker (2007) reflects the move to more complex designs that incorporate a multilevel and multi-site approach. They evaluated the impact of an early childhood literacy

program for over 1200 students in 49 classroom sites distributed across a number of schools. Their criterion was changes in literacy performance as assessed by growth curves. A three level model was adopted and results analyzed by hierarchical linear modeling for estimating growth trajectories. We are in need of similar large scale training designs to examine the impact of different amounts or types of training across multiple groups in order to help increase our understanding of team and multilevel effects on learning and training effectiveness.

Finally, the research on learning and transfer has focused almost exclusively on between-person effects. Recent efforts that have begun to examine within-person changes in learners over time. For example, Sitzmann and Johnson (2014) examined within-person effects of instructor use of jokes, stories, and video clips on self-regulated learning over time (e.g., time on task, attention, affect). Such research is long overdue as it can complement the between-person level of analysis studies and lead to better understanding of how differences in instructional and contextual factors over time impact changes in learning processes and outcomes.

Trainee Characteristics

Although we have learned a great deal about how trainee characteristics influence learning and training success, we need to continue to identify trainee characteristics that are relevant to new and emerging modes of learning. For instance, research is needed to identify how trainee characteristics interact with informal learning experiences to shape important outcomes. Recent research suggests that self-efficacy (Courtright et al., 2014), goal orientation (DeRue & Wellman, 2009), and personality (DeRue, Nahrgang, Hollenbeck, & Workman, 2012) play an important role in informal learning, but cognitive ability and other motivational factors (e.g., core self-evaluations; Stanhope, Pond, & Surface, 2013) likely matter as well. Similarly, future research is needed to advance our understanding of the trainee characteristics that are critical during technology-based training. Sitzmann and Johnson (2012), for instance, note that planning is critical in online training because individuals must often decide where and when to complete

the course and how much time to dedicate to learning. Trainees who are highly proactive may be more likely to develop plans for how they will successfully complete the training and to also formulate alternative strategies in the event they encounter obstacles (Grant & Ashford, 2008). In this sense, proactivity may also be important for helping trainees avoid or overcome the technical difficulties and other interruptions that often occur during technology-based training and have been shown to impair learning and increase attrition (Sitzmann, Ely, Bell, & Bauer, 2010).

Growth in knowledge management practices has also sparked research into the role of individual characteristics in knowledge sharing. Kim and Yun (2015), for example, argued that individual characteristics play an important role in determining whether recipients are likely to accept and use the knowledge shared by a coworker. In support of this contention, they found that coworker knowledge sharing had a stronger positive effect on the task performance of individuals who were low in general self-efficacy. In addition to understanding the factors that influence whether individuals utilize the knowledge received from coworkers, future research needs to identify individual characteristics (e.g., impression management motives, self-esteem) that determine whether employees share their knowledge with others (Wang & Noe, 2010).

Finally, it is important to recognize that the decision to learn and transfer learning to the job ultimately resides within the trainee. From an active learning perspective, we can view trainees as making personal choices as to what aspects in training to learn and attempt to transfer and what aspects to leave behind. Yelon, Sheppard, Sleight, and Ford (2004) developed a model of the decision making process leading to the intention to transfer. The key decision criteria were (1) how credible the information was; (2) how practical the skills were; and (3) to what extent was the knowledge or skill needed. Research is needed that focuses on within person changes in perceptions of credibility, practicality, and need as trainees move through a training program.

Training Design and Delivery

Recent research has moved us closer to a theory of learner-centered training design, but

more work is needed. Studies should focus on decomposing active learning strategies to better understand how and when different instructional, motivational, and emotional design elements should be implemented. For instance, prior research has suggested that the timing of emotion-control strategies during training may be important, although recommendations differ as to whether emotion-control should be phased in or out during training (Bell & Kozlowski, 2008). Research also needs to elaborate the mechanisms through which active learning interventions have their effects. We know quite a bit about how to design training to influence trainees' self-monitoring of cognitive functions (i.e., metacognition; Keith and Frese, 2005; Schmidt & Ford, 2003), but much less about how to influence other potentially important cognitive mechanisms, such as the coherence and breadth of trainees' knowledge structures (i.e., mental models; Bell & Kozlowski, 2009). Keith and Wolfe (2014) also note that most studies have examined active *training* and call for research that examines other forms of active learning. A good example is recent research exploring interventions, such as structured reflection, that can be used to enhance the value of developmental experiences (DeRue et al., 2012).

There are also a number of important issues to be addressed regarding the design and delivery of technology-based training. First, as noted earlier, future research on technology-based training needs to move beyond comparing different media to a focus on understanding the features and conditions that influence the effectiveness of these programs (Bell & Federman, 2013). In particular, one critical issue is to better understand the unique features offered by social media, mobile technologies, and other emerging platforms and their impact on learning and transfer. Also, in emphasizing comparisons between technology-based and traditional training, the field has directed very little attention toward understanding how to leverage blended learning methods or flipped classrooms – two increasingly common learning solutions in organizations. How does one determine the optimal mix of different formats for a program and does the sequencing of technology-based and in-person instruction within a program make a difference?

Moreover, organizations are increasingly leveraging user-generated content (e.g., videos created by employees) in their technology-based training. How do trainees react to this content (e.g., perceived credibility) and what are the implications for learning? What guidelines, if any, can future research provide to ensure user-generated content enhances learning? Finally, employees' participation in technology-based training is often interwoven with their other work and family activities. Thus, future research needs to consider how job demands, work-life conflict, and other stressors influence participation in technology-based training during non-work hours as well as important outcomes, such as learning and attrition, and investigate the factors (e.g., manager and peer support) that may mitigate their impact.

In recent years, a number of meta-analyses have provided evidence for the effectiveness of different team training techniques (e.g., Salas et al., 2008). Thus, as noted by Kozlowski and Bell (2013), future research needs center on refining these tools and examining their effects across different team contexts. Recent work by Tannenbaum, Mathieu, Salas, and Cohen (2012) argues that the fundamental nature of teams is changing. For instance, team composition is increasingly dynamic and advances in communication and collaboration technologies make it possible for teams to operate with few, if any, face-to-face interactions. These changes suggest that our approaches to training and developing teams may also need to evolve. Approaches designed to develop generic or transportable teamwork skills, for example, may be particularly valuable as team membership becomes more fluid and employees find themselves working on multiple teams simultaneously (Ellis, Bell, Ployhart, Hollenbeck, & Ilgen, 2005).

Training in Context

Although recent research has provided valuable insight into learning that occurs in the context of work experiences, more attention is warranted given growing organizational efforts to exploit the potential of informal learning (Tannenbaum, Beard, McNall, & Salas, 2010). As a starting point, research needs to develop a clear conceptualization of informal learning and its

defining elements. This is important for not only distinguishing informal and formal learning but also for identifying meaningful differences between informal learning and related concepts, such as continuous learning (Sessa & London, 2006) and self-development (Orvis & Leffler, 2011). Here too, research is needed that provides insight into how to determine the ideal mix of informal and formal learning (Noe et al., 2014) and to decompose the elements of work experiences that are critical for developing different types of skills. For instance, the developmental challenge profile developed by McCauley et al. (1994) was important because it identified the features of jobs that contribute to the development of managers. Similar work is needed to advance our understanding of how to craft work experiences for developing expertise in more technical and service-oriented fields (Ford, Santoro, & Showler, in press).

In their discussion of environmental predictors of transfer, Blume et al. (2010) note that some factors, such as support, have received considerable attention, while others, such as constraints (e.g., level of autonomy, situational constraints), have been relatively neglected. In addition, they highlight that relatively few studies have examined the effects of pre- and post-training transfer interventions (e.g., goal-setting, relapse prevention) and their results fail to provide compelling support for their effectiveness. These modest effects may be due to the fact that in most studies these interventions lasted 2 hours or less. Thus, future research is needed to explore other, more intensive pre- and post-training transfer interventions.

Conclusion

Private and public organizations spend vast amounts of money on training and development and almost every working adult will spend hours of their lives participating in learning experiences. There is both a business and personal imperative to better understand how humans learn at work and how best to design, implement, and support training and development activities. The state of knowledge regarding training and development has come a long way in the last 100 years, with research yielding many practical insights that can help guide practice

(Salas, Tannenbaum, Kraiger, & Smith-Jentsch, 2012). The over 450 related articles published in *JAP* are a rich legacy, contributing to that growth in knowledge. We hope that by examining that legacy, researchers can continue to produce meaningful studies, further promoting effective learning in the workplace.

References

- Ackerman, P. L. (1992). Predicting individual differences in complex skill acquisition: Dynamics of ability determinants. *Journal of Applied Psychology, 77*(5), 598–614. doi:10.1037/0021-9010.77.5.598
- Aguinis, H., & Kraiger, K. (2009). Benefits of training and development for individuals and teams, organizations, and society. *Annual Review of Psychology, 60*, 451-474. doi:10.1146/annurev.psych.60.110707.163505
- Alderfer, C. P. (1971). Effect of individual, group, and intergroup relations on attitudes toward a management development program. *Journal of Applied Psychology, 55*(4), 302–311. doi:10.1037/h0031536
- Alexander, L. T., Kepner, C. H., & Tregoe, B. B. (1962). The effectiveness of knowledge of results in a military system-training program. *Journal of Applied Psychology, 46*(3), 202–211. doi:10.1037/h0042151
- Alliger, G. M., & Katzman, S. (1997). When training affects variability: Beyond the assessment of mean differences in training evaluation. In J. K. Ford (Ed.), *Improving training effectiveness in work organizations* (pp. 223–243). Mahwah, NJ: Erlbaum.
- Alliger, G. M., Tannenbaum, S. I., Bennett, W., Traver, H., & Shotland, A. (1997). A meta-analysis on the relations among training criteria. *Personnel Psychology, 50*, 341-358. doi:10.1111/j.1744-6570.1997.tb00911.x
- Anderson, J. R. (1983). *The architecture of cognition*. Cambridge, MA: Harvard University Press.
- Arthur, W. J., Bennett, W. J., Edens, P. S., & Bell, S. T. (2003). Effectiveness of training in organizations: A meta-analysis of design and evaluation features. *Journal of Applied Psychology, 88*(2), 234–245. doi:10.1037/0021-9010.88.2.234

- Arthur, W. J., Day, E. A., Bennett, W. J., McNelly, T. L., & Jordan, J. A. (1997). Dyadic versus individual training protocols: Loss and reacquisition of a complex skill. *Journal of Applied Psychology, 82*(5), 783–791. doi:10.1037/0021-9010.82.5.783
- Baldwin, T. T., & Ford, J. K. (1988). Transfer of training: A review and directions for future research. *Personnel Psychology, 41*(1), 63–105. doi: 10.1111/j.1744-6570.1988.tb00632.x
- Barbee, J. R., & Keil, E. C. (1973). Experimental techniques of job interview training for the disadvantaged: Videotape feedback, behavior modification, and microcounseling. *Journal of Applied Psychology, 58*(2), 209–213. doi:10.1037/h0035655
- Barthol, R. P., & Zeigler, M. (1956). Evaluation of a supervisory training program with How Supervise? *Journal of Applied Psychology, 40*(6), 403–405. doi:10.1037/h0044833
- Bell, B. S., & Federman, J. E. (2013). E-learning in Postsecondary Education. *The Future of Children, 23*(1), 165–185.
- Bell, B. S., & Kozlowski, W. J. (2002). Goal orientation and ability: Interactive effects on self-efficacy, performance, and knowledge. *Journal of Applied Psychology, 87*(3), 497–505. doi:10.1037/0021-9010.87.3.497
- Bell, B. S., & Kozlowski, S. W. J. (2008). Active learning: Effects of core training design elements on self-regulatory processes, learning, and adaptability. *Journal of Applied Psychology, 93*(2), 296–316. doi:10.1037/0021-9010.93.2.296
- Bell, B. S., & Kozlowski, S. W. J. (2009). Toward a theory of learner-centered training design: An integrative framework of active learning. In S. W. J. Kozlowski & E. Salas (Eds.), *Learning, training, and development in organizations* (pp. 263–300). New York: Routledge.
- Benschoter, R. P., & Charles, D. C. (1957). Retention of classroom and television learning. *Journal of Applied Psychology, 41*(4), 253–256. doi:10.1037/h0043126

- Birdi, K., Allan, C., & Warr, P. (1997). Correlates and perceived outcomes of 4 types of employee development activity. *Journal of Applied Psychology, 82*(6), 845–857. doi:10.1037/0021-9010.82.6.845
- Blankenship, A. B., & Taylor, H. R. (1938). Prediction of vocational proficiency in three machine operations. *Journal of Applied Psychology, 22*(5), 518–526. doi:10.1037/h0061197
- Bloom, B. (1956). *Taxonomy of educational objectives: The cognitive domain*. New York: Donald McKay.
- Blume, B. D., Ford, J. K., Baldwin, T. T., & Huang, J. L. (2010). Transfer of training: A meta-analytic review. *Journal of Management, 36*(4), 1065-1105. doi:10.1177/0149206309352880
- Bowen, D. D., & Kilmann, R. H. (1975). Developing a comparative measure of the learning climate in professional schools. *Journal of Applied Psychology, 60*(1), 71–79. doi:10.1037/h0076363
- Brett, J. F., & VandeWalle, D. (1999). Goal orientation and goal content as predictors of performance in a training program. *Journal of Applied Psychology, 84*(6), 863–873. doi:10.1037/0021-9010.84.6.863
- Briggs, G. E., & Johnston, W. A. (1966). Stimulus and response fidelity in team training. *Journal of Applied Psychology, 50*(2), 114–117. doi:10.1037/h0023077
- Briggs, G. E., & Wiener, E. L. (1966). Influence of time sharing and control loading on transfer of training. *Journal of Applied Psychology, 50*(3), 201–203. doi:10.1037/h0023423
- Brown, C. W., & Ghiselli, E. E. (1952). The relationship between the predictive power of aptitude tests for trainability and for job proficiency. *Journal of Applied Psychology, 36*(6), 370–372. doi:10.1037/h0059054

- Brown, K. G., Charlier, S. D., & Pierotti, A. (2012). e-learning at work: Contributions of past research and suggestions for the future. In G. P. Hodgkinson & J. K. Ford (Eds.), *International Review of Industrial and Organizational Psychology* (vol. 27): 89-114. New York: Wiley.
- Burke, M. J., & Day, R. R. (1986). A cumulative study of the effectiveness of managerial training. *Journal of Applied Psychology*, 71(2), 232–245. doi:10.1037/0021-9010.71.2.232
- Butler, R. P., Lardent, C. L., & Miner, J. B. (1983). A motivational basis for turnover in military officer education and training. *Journal of Applied Psychology*, 68(3), 496–506. doi:10.1037/0021-9010.68.3.496
- Campbell, J. P. (1971). Personnel training and development. *Annual Review of Psychology*, 22, 565-602. doi:10.1146/annurev.ps.22.020171.003025
- Canter, R. R. J. (1951). A human relations training program. *Journal of Applied Psychology*, 35(1), 38–45. doi:10.1037/h0053739
- Chambers, E. G., Foulton, M., Handfield-Jones, H., Hankin, S. M., & Michaels, E. G. (1998, Issue 3). The war for talent. *McKinsey Quarterly*, 44-57.
- Chapman, C. J. (1919). The learning curve in type writing. *Journal of Applied Psychology*, 3(3), 252–268. doi:10.1037/h0072933
- Chen, G., Gully, S. M., Whiteman, J.-A., & Kilcullen, R. N. (2000). Examination of relationships among trait-like individual differences, state-like individual differences, and learning performance. *Journal of Applied Psychology*, 85(6), 835–847. doi:10.1037/0021-9010.85.6.835
- Chen, G., Thomas, B., & Wallace, J. C. (2005). A Multilevel examination of the relationships among training outcomes, mediating regulatory processes, and adaptive performance. *Journal of Applied Psychology*, 90(5), 827–841. doi:10.1037/0021-9010.90.5.827

- Clark, R. E. (1994). Media will never influence learning. *Educational Technology Research and Development, 42*(2), 21-29.
- Colquitt, J. A., LePine, J. A., & Noe, R. A. (2000). Toward an integrative theory of training motivation: A meta-analytic path analysis of 20 years of research. *Journal of Applied Psychology, 85*(5), 678–707. doi:10.1037/0021-9010.85.5.678
- Colquitt, J. A., & Simmering, M. J. (1998). Conscientiousness, goal orientation, and motivation to learn during the learning process: A longitudinal study. *Journal of Applied Psychology, 83*(4), 654–665. doi:10.1037/0021-9010.83.4.654
- Courtright, S. H., Colbert, A. E., & Choi, D. (2014). Fired up or burned out? How developmental challenge differentially impacts leader behavior. *Journal of Applied Psychology, 99*(4), 681–696. doi:10.1037/a0035790
- Cowdery, K. M. (1922). Measures of general intelligence as indices of success in trade learning. *Journal of Applied Psychology, 6*(4), 311–330. doi:10.1037/h0071110
- Day, E. A., Arthur, W. J., & Gettman, D. (2001). Knowledge structures and the acquisition of a complex skill. *Journal of Applied Psychology, 86*(5), 1022–1033. doi:10.1037/0021-9010.86.5.1022
- DeBowski, S., Wood, R. E., & Bandura, A. (2001). Impact of guided exploration and enactive exploration on self-regulatory mechanisms and information acquisition through electronic search. *Journal of Applied Psychology, 86*(6), 1129–1141. doi:10.1037/0021-9010.86.6.1129
- DeRue, D. S., Nahrgang, J. D., Hollenbeck, J. R., & Workman, K. (2012). A quasi-experimental study of after-event reviews and leadership development. *Journal of Applied Psychology, 97*(5), 997–1015. doi:10.1037/a0028244

- DeRue, D. S., & Wellman, N. (2009). Developing leaders via experience: The role of developmental challenge, learning orientation, and feedback availability. *Journal of Applied Psychology, 94*(4), 859–875. doi:10.1037/a0015317
- Dragoni, L., Oh, I.-S., Tesluk, P. E., Moore, O. A., VanKatwyk, P., & Hazucha, J. (2014). Developing leaders' strategic thinking through global work experience: The moderating role of cultural distance. *Journal of Applied Psychology, 99*(5), 867–882. doi:10.1037/a0036628
- Dragoni, L., Park, H., Soltis, J., & Forte-Trammell, S. (2014). Show and tell: How supervisors facilitate leader development among transitioning leaders. *Journal of Applied Psychology, 99*(1), 66–86. doi:10.1037/a0034452
- Driskell, J. E., Willis, R. P., & Copper, C. (1992). Effect of overlearning on retention. *Journal of Applied Psychology, 77*(5), 615–622. doi:10.1037/0021-9010.77.5.615
- Eden, D., & Aviram, A. (1993). Self-efficacy training to speed reemployment: Helping people to help themselves. *Journal of Applied Psychology, 78*(3), 352–360. doi:10.1037/0021-9010.78.3.352
- Ehrlich, G. (1943). A method of constructing learning curves for a motor skill involving total body speed and accuracy. *Journal of Applied Psychology, 27*(6), 494–503. doi:10.1037/h0053607
- Ellis, A. P. J., Bell, B. S., Ployhart, R. E., Hollenbeck, J. R., & Ilgen, D. R. (2005). An evaluation of generic teamwork skills training with action teams: Effects on cognitive and skill-based outcomes. *Personnel Psychology, 58*(3), 641–672. doi:10.1111/j.1744-6570.2005.00617.x
- Ellis, A. P. J., Hollenbeck, J. R., Ilgen, D. R., Porter, C. O. L. H., West, B. J., & Moon, H. (2003). Team learning: Collectively connecting the dots. *Journal of Applied Psychology, 88*(5), 821–835. doi:10.1037/0021-9010.88.5.821

- Ellis, S., & Davidi, I. (2005). After-event reviews: Drawing lessons from successful and failed experience. *Journal of Applied Psychology, 90*(5), 857–871. doi:10.1037/0021-9010.90.5.857
- Eyring, J. D., Johnson, D. S., & Francis, D. J. (1993). A cross-level units-of-analysis approach to individual differences in skill acquisition. *Journal of Applied Psychology, 78*(5), 805–814. doi:10.1037/0021-9010.78.5.805
- Facteau, J. D., Dobbins, G. H., Russell, J. E., Ladd, R. T., & Kudisch, J. D. (1995). The influence of general perceptions of the training environment on pretraining motivation and perceived training transfer. *Journal of Management, 21*(1), 1-25. doi:10.1177/014920639502100101
- Fiedler, F. E., Mitchell, T., & Triandis, H. C. (1971). The culture assimilator: An approach to cross-cultural training. *Journal of Applied Psychology, 55*(2), 95–102. doi:10.1037/h0030704
- Fiske, D. W. (1947). Validation of naval aviation cadet selection tests against training criteria. *Journal of Applied Psychology, 31*(6), 601–614. doi:10.1037/h0054274
- Ford, J. K., & Kraiger, K. (1995). The application of cognitive constructs and principles to the instructional systems model of training: Implications for needs assessment, design, and transfer. In C. L. Cooper & I. T. Robertson (Eds.), *International review of Industrial and Organizational Psychology* (vol. 10, pp. 1-48). New York: Wiley.
- Ford, J. K., Kraiger, K., & Merritt, S. M. (2010). An updated review of the multidimensionality of training outcomes: New directions for training evaluation research. In S. W. J. Kozlowski & E. Salas (Eds.), *Learning, training, and development in organizations* (pp. 135-165). New York: Routledge.

- Ford, J. K., Quiñones, M. A., Segó, D. J. & Sorra, J. S. (1992). Factors affecting the opportunity to perform trained tasks on the job. *Personnel Psychology*, 45, 511-527. doi:10.1111/j.1744-6570.1992.tb00858.x
- Ford, J. K., Santoro, J., & Showler, M. (in press). Building deep specialization in core jobs through intentional learning activities. In K. Brown (Ed.), *Cambridge Handbook of Workplace Training and Employee Development*. Nyack, NY: Cambridge University Press.
- Ford, J. K., Smith, E. M., Segó, D. J., & Quiñones, M. A. (1993). Impact of task experience and individual factors on training-emphasis ratings. *Journal of Applied Psychology*, 78(4), 583–590. doi:10.1037/0021-9010.78.4.583
- Ford, J. K., Smith, E. M., Weissbein, D. A., Gully, S. M., & Salas, E. (1998). Relationships of goal orientation, metacognitive activity, and practice strategies with learning outcomes and transfer. *Journal of Applied Psychology*, 83(2), 218–233. doi:10.1037/0021-9010.83.2.218
- Frandsen, A. N., & Hadley, J. M. (1943). The prediction of achievement in a radio training school. *Journal of Applied Psychology*, 27(4), 303–310. doi:10.1037/h0057213
- Friedlander, F., & Greenberg, S. (1971). Effect of job attitudes, training, and organization climate on performance of the hard-core unemployed. *Journal of Applied Psychology*, 55(4), 287–295. doi:10.1037/h0031532
- Gagne, R.M. (1965). *The conditions of learning*. New York: Holt, Rinehart, and Winston.
- Gagne, R.M. (1985). *The conditions of learning* (4th ed.). New York: Holt, Rinehart, and Winston.
- Gagne, R.M., & Briggs, L.J. (1974). *Principles of instructional design*. New York: Holt, Rinehart & Winston.

- Garvey, W. D. (1960). A comparison of the effects of training and secondary tasks on tracking behavior. *Journal of Applied Psychology, 44*(6), 370–375. doi:10.1037/h0042426
- Geiger, H. E., Remmers, H. H., & Greenly, R. J. (1938). Apprentices' attitudes toward their training and the construction of a diagnostic scale. *Journal of Applied Psychology, 22*(1), 32–41. doi:10.1037/h0063078
- Geissler, L. R. (1918). A plan for the technical training of consulting psychologists. *Journal of Applied Psychology, 2*(1), 77–83. doi:10.1037/h0072539
- Ghiselli, E. E., & Brown, C. W. (1947). Learning in accident reduction. *Journal of Applied Psychology, 31*(6), 580–582. doi:10.1037/h0062641
- Gilbert, G. M. (1941). "Aptitude" and training: a suggested restandardization of the K-D music test norms. *Journal of Applied Psychology, 25*(3), 326–330. doi:10.1037/h0062231
- Gist, M. E., Schwoerer, C., & Rosen, B. (1989). Effects of alternative training methods on self-efficacy and performance in computer software training. *Journal of Applied Psychology, 74*(6), 884–891. doi:10.1037/0021-9010.74.6.884
- Goldstein, I. L. (1974). *Training: Program development and evaluation*. Monterey, CA: Brooks/Cole.
- Goldstein, I. L. (1980). Training in work organizations. *Annual Review of Psychology, 31*, 229–272. doi:10.1146/annurev.ps.31.020180.001305
- Goldstein, I. L., & Ford, J. K. (2002). *Training in organizations: Needs assessment, development, and evaluation*. Belmont, CA: Wadsworth.
- Goodman, J. S., & Wood, R. E. (2004). Feedback Specificity, Learning Opportunities, and Learning. *Journal of Applied Psychology, 89*(5), 809–821. doi:10.1037/0021-9010.89.5.809

- Gordon, L. V., & Alf, E. F. (1962). The predictive validity of measured interest for Navy vocational training. *Journal of Applied Psychology, 46*(3), 212–219.
doi:10.1037/h0042622
- Gordon, M. E., Cofer, J. L., & McCullough, P. M. (1986). Relationships among seniority, past performance, interjob similarity, and trainability. *Journal of Applied Psychology, 71*(3), 518–521. doi:10.1037/0021-9010.71.3.518
- Grant, A. M., & Ashford, S. J. (2008). The dynamics of proactivity at work. *Research in Organizational Behavior, 28*, 3-34. doi:10.1016/j.riob.2008.04.002
- Gully, S. M., Payne, S. C., Koles, K. L. K., & Whiteman, J.-A. K. (2002). The impact of error training and individual differences on training outcomes: An attribute-treatment interaction perspective. *Journal of Applied Psychology, 87*(1), 143–155.
doi:10.1037/0021-9010.87.1.143
- Hammerton, M., & Tickner, A. H. (1967). Visual factors affecting transfer of training from a simulated to a real control situation. *Journal of Applied Psychology, 51*(1), 46–49.
doi:10.1037/h0024240
- Harman, R. P., Ellington, J. K., Surface, E. A., & Thompson, L. F. (2015). Exploring qualitative training reactions: Individual and contextual influences on trainee commenting. *Journal of Applied Psychology, 100*(3), 894–916. doi:10.1037/a0038380
- Henry, L. K., & Wasson, R. (1939). The repetition of classical experiments: I. Starch's distribution of practice. *Journal of Applied Psychology, 23*(4), 503–507.
doi:10.1037/h0059941
- Hillman, L. F. (1934). Training for vocations in those of high and low intelligence. *Journal of Applied Psychology, 18*(3), 401–408. doi:10.1037/h0074839
- Hinrichs, J. R. (1970). Ability correlates in learning a psychomotor task. *Journal of Applied Psychology, 54*(1, Pt.1), 56–64. doi:10.1037/h0028525

- Hinrichs, J. R. (1976). Personnel training. In M. D. Dunnette (Ed.), *Handbook of industrial and organizational psychology* (pp. 1-27). Chicago: Rand McNally.
- Holladay, C. L., & Quiñones, M. A. (2003). Practice variability and transfer of training: The role of self-efficacy generality. *Journal of Applied Psychology, 88*(6), 1094–1103. doi:10.1037/0021-9010.88.6.1094
- Hollander, E. P. (1954). Peer nominations on leadership as a predictor of the pass-fail criterion in naval air training. *Journal of Applied Psychology, 38*(3), 150–153. doi:10.1037/h0060761
- Hughes, M. G., Day, E. A., Wang, X., Schuelke, M. J., Arsenault, M. L., Harkrider, L. N., & Cooper, O. D. (2013). Learner-controlled practice difficulty in the training of a complex task: Cognitive and motivational mechanisms. *Journal of Applied Psychology, 98*(1), 80–98. doi:10.1037/a0029821
- Hurtz, G. M., & Williams, K. J. (2009). Attitudinal and motivational antecedents of participation in voluntary employee development activities. *Journal of Applied Psychology, 94*(3), 635–653. doi:10.1037/a0014580
- Kanfer, R., & Ackerman, P. L. (1989). Motivation and cognitive abilities: An integrative/aptitude-treatment interaction approach to skill acquisition. *Journal of Applied Psychology, 74*(4), 657–690. doi:10.1037/0021-9010.74.4.657
- Keith, N., & Frese, M. (2005). Self-regulation in error management training: Emotion control and metacognition as mediators of performance effects. *Journal of Applied Psychology, 90*(4), 677–691. doi:10.1037/0021-9010.90.4.677
- Keith, N., & Frese, M. (2008). Effectiveness of error management training: A meta-analysis. *Journal of Applied Psychology, 93*(1), 59–69. doi:10.1037/0021-9010.93.1.59
- Keith, N. & Wolff, C. (2014). Encouraging active learning. In K. Kraiger, J. Passmore, N. R. dos Santos, & S. Malvezzi (Eds.), *The Wiley-Blackwell handbook of the psychology of*

- training, development, and performance improvement* (pp. 92-116). John Wiley & Sons: Chichester, UK.
- Kellogg, W. N. (1946). The learning curve for flying an airplane. *Journal of Applied Psychology*, 30(5), 435–441. doi:10.1037/h0060547
- Kim, S. L., & Yun, S. (2015). The effect of coworker knowledge sharing on performance and its boundary conditions: An interactional perspective. *Journal of Applied Psychology*, 100(2), 575-582. doi:10.1037/a0037834
- Kim, Y., & Ployhart, R. E. (2014). The effects of staffing and training on firm productivity and profit growth before, during, and after the Great Recession. *Journal of Applied Psychology*, 99(3), 361–389. doi:10.1037/a0035408
- Komaki, J., Heinzmann, A. T., & Lawson, L. (1980). Effect of training and feedback: Component analysis of a behavioral safety program. *Journal of Applied Psychology*, 65(3), 261–270. doi:10.1037/0021-9010.65.3.261
- Kozlowski, S. W. J., & Bell, B. S. (2006). Disentangling achievement orientation and goal setting: Effects on self-regulatory processes. *Journal of Applied Psychology*, 91(4), 900–916. doi:10.1037/0021-9010.91.4.900
- Kozlowski, S. W. J., & Bell, B. S. (2013). Work groups and teams in organizations. In I. B. Weiner, N. W. Schmitt, & S. Highhouse (Eds.), *Handbook of psychology. Volume 12: Industrial and organizational psychology* (2nd ed.): 412– 469. Hoboken, NJ: Wiley
- Kozlowski, S. W. J. & Hults, B. M. (1987). An exploration of climates for technical updating and performance. *Personnel Psychology*, 40, 539-563. doi:10.1111/j.1744-6570.1987.tb00614.x
- Kozlowski, S. W. J., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. J. Klein & S. W. J.

- Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions* (pp. 3-90). San Francisco, CA: Jossey-Bass.
- Kozlowski, S. W. J., Toney, R. J., Mullins, M. E., Weissbein, D. A., Brown, K. G., & Bell, B. S. (2001). Developing adaptability: A theory for the design of integrated-embedded training systems. In E. Salas (Ed.), *Advances in human performance and cognitive engineering research* (Vol. 1, pp. 59-123). New York: JAI Press.
- Kozlowski, S. W. J., Brown, K. G., Weissbein, D. A., Cannon-Bowers, J. A., & Salas, E. (2000). A multilevel approach to training effectiveness: Enhancing horizontal and vertical transfer. In K. J. Klein & S. W. J. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundations, extensions, and new directions* (pp. 157-210). San Francisco: CA: Jossey-Bass.
- Kraiger, K. & Ford, J. K. (2007). The expanding role of workplace training: Themes and trends influencing training research and practice. In L. L. Koppes (Ed.), *Historical perspectives in industrial and organizational psychology* (pp. 281-309). Mahwah, NJ: Lawrence Erlbaum.
- Kraiger, K., Ford, J. K., & Salas, E. (1993). Application of cognitive, skill-based, and affective theories of learning outcomes to new methods of training evaluation. *Journal of Applied Psychology, 78*(2), 311–328. doi:10.1037/0021-9010.78.2.311
- Kraimer, M. L., Seibert, S. E., Wayne, S. J., Liden, R. C., & Bravo, J. (2011). Antecedents and outcomes of organizational support for development: The critical role of career opportunities. *Journal of Applied Psychology, 96*(3), 485–500. doi:10.1037/a0021452
- Latham, G. P., & Frayne, C. A. (1989). Self-management training for increasing job attendance: A follow-up and a replication. *Journal of Applied Psychology, 74*(3), 411–416. doi:10.1037/0021-9010.74.3.411

- Latham, G. P., & Saari, L. M. (1979). Application of social-learning theory to training supervisors through behavioral modeling. *Journal of Applied Psychology, 64*(3), 239–246. doi:10.1037/0021-9010.64.3.239
- Lawshe, C. H., Bolda, R. A., & Brune, R. L. (1958). Studies in management training evaluation: I. Scaling responses to human relations training cases. *Journal of Applied Psychology, 42*(6), 396–398. doi:10.1037/h0048894
- Lawshe, C. H., Bolda, R. A., & Brune, R. L. (1959). Studies in management training evaluation: II. The effects of exposures to role playing. *Journal of Applied Psychology, 43*(5), 287–292. doi:10.1037/h0047802
- Lawshe, C. H., & Cary, W. (1952). Verbalization and learning a manipulative task. *Journal of Applied Psychology, 36*(1), 44–46. doi:10.1037/h0057951
- Lawshe, C. H. J., & Thornton, G. R. (1943). A test battery for identifying potentially successful Naval electrical trainees. *Journal of Applied Psychology, 27*(5), 399–406. doi:10.1037/h0057059
- LePine, J. A., LePine, M. A., & Jackson, C. L. (2004). Challenge and hindrance stress: Relationships with exhaustion, motivation to learn, and learning performance. *Journal of Applied Psychology, 89*(5), 883–891. doi:10.1037/0021-9010.89.5.883
- Lincoln, R. S., & Smith, K. U. (1951). Transfer of training in tracking performance at different target speeds. *Journal of Applied Psychology, 35*(5), 358–362. doi:10.1037/h0060168
- Lindahl, L. G. (1945). Movement analysis as an industrial training method. *Journal of Applied Psychology, 29*(6), 420–436. doi:10.1037/h0054759
- Major, D. A., Turner, J. E., & Fletcher, T. D. (2006). Linking proactive personality and the Big Five to motivation to learn and development activity. *Journal of Applied Psychology, 91*(4), 927–935. doi:10.1037/0021-9010.91.4.927

- Marks, M. A., Sabella, M. J., Burke, C. S., & Zaccaro, S. J. (2002). The impact of cross-training on team effectiveness. *Journal of Applied Psychology, 87*(1), 3–13. doi:10.1037/0021-9010.87.1.3
- Marks, M. A., Zaccaro, S. J., & Mathieu, J. E. (2000). Performance implications of leader briefings and team-interaction training for team adaptation to novel environments. *Journal of Applied Psychology, 85*(6), 971–986. doi:10.1037/0021-9010.85.6.971
- Martocchio, J. J., & Judge, T. A. (1997). Relationship between conscientiousness and learning in employee training: Mediating influences of self-deception and self-efficacy. *Journal of Applied Psychology, 82*(5), 764–773. doi:10.1037/0021-9010.82.5.764
- Mathieu, J. E., Heffner, T. S., Goodwin, G. F., Salas, E., & Cannon-Bowers, J. A. (2000). The influence of shared mental models on team process and performance. *Journal of Applied Psychology, 85*(2), 273–283. doi:10.1037/0021-9010.85.2.273
- Mathieu, J. E., Tannenbaum, S. I., & Salas, E., (1992). Influences of individual and situational characteristics on measures of training effectiveness. *Academy of Management Journal, 35*, 828–847. doi:10.2307/256317
- Maurer, T. J., & Tarulli, B. A. (1994). Investigation of perceived environment, perceived outcome, and person variables in relationship to voluntary development activity by employees. *Journal of Applied Psychology, 79*(1), 3–14. doi:10.1037/0021-9010.79.1.3
- Maurer, T. J., Weiss, E. M., & Barbeite, F. G. (2003). A model of involvement in work-related learning and development activity: The effects of individual, situational, motivational, and age variables. *Journal of Applied Psychology, 88*(4), 707–724. doi:10.1037/0021-9010.88.4.707
- Mayo, G. D., & Longo, A. A. (1966). Training time and programmed instruction. *Journal of Applied Psychology, 50*(1), 1–4. doi:10.1037/h0022934

- McCauley, C. D., Ruderman, M. N., Ohlott, P. J., & Morrow, J. E. (1994). Assessing the developmental components of managerial jobs. *Journal of Applied Psychology, 79*(4), 544–560. doi:10.1037/0021-9010.79.4.544
- McNall, M. A., & Foster-Fishman, P. G. (2007). Methods of rapid evaluation, assessment and reappraisal. *American Journal of Evaluation, 28*, 1151-168.
doi:10.1177/1098214007300895
- McNall, M. A., Welch, V. E., Ruh, K. L., Mildner, C. A., & Soto, T. (2004). The use of rapid-feedback evaluation methods to improve the retention rates of an HIV/AIDS healthcare intervention. *Evaluation and Program Planning, 3*, 287-294.
doi:10.1016/j.evalprogplan.2004.04.003
- Mobley, W. H., Hand, H. H., Baker, R. L., & Meglino, B. M. (1979). Conceptual and empirical analysis of military recruit training attrition. *Journal of Applied Psychology, 64*(1), 10–18. doi:10.1037/0021-9010.64.1.10
- Morrison, R. F., & Brantner, T. M. (1992). What enhances or inhibits learning a new job? A basic career issue. *Journal of Applied Psychology, 77*(6), 926–940. doi:10.1037/0021-9010.77.6.926
- Muckler, F. A., & Matheny, W. G. (1954). Transfer of training in tracking as a function of control friction. *Journal of Applied Psychology, 38*(5), 364–367. doi:10.1037/h0060314
- Mumford, M. D., Weeks, J. L., Harding, F. D., & Fleishman, E. A. (1988). Relations between student characteristics, course content, and training outcomes: An integrative modeling effort. *Journal of Applied Psychology, 73*(3), 443–456. doi:10.1037/0021-9010.73.3.443
- Munsterberg, H. (1913). *Psychology and industrial efficiency*. Boston: Houghton-Mifflin Company.
- Naylor, J. C., & Briggs, G. E. (1965). Team-training effectiveness under various conditions. *Journal of Applied Psychology, 49*(4), 223–229. doi:10.1037/h0022448

- Neal, A., Godley, S. T., Kirkpatrick, T., Dewsnap, G., Joung, W., & Hesketh, B. (2006). An examination of learning processes during critical incident training: Implications for the development of adaptable trainees. *Journal of Applied Psychology, 91*(6), 1276–1291. doi:10.1037/0021-9010.91.6.1276
- Noe, R. A. (1986). Trainees' attributes and attitudes: Neglected influences on training effectiveness. *Academy of Management Review, 11*, 736-749. doi:10.5465/AMR.1986.4283922
- Noe, R. A., Clarke, A. D. M., & Klein, H. J. (2014). Learning in the twenty-first-century workplace. *Annual Review of Organizational Psychology and Organizational Behavior, 1*, 245–275. doi:10.1146/annurev-orgpsych-031413-091321
- Noe, R. A., & Wilk, S. L. (1993). Investigation of the factors that influence employees' participation in development activities. *Journal of Applied Psychology, 78*(2), 291–302. doi:10.1037/0021-9010.78.2.291
- O'Brien, G. E., & Plooj, D. (1977). Comparison of programmed and prose culture training upon attitudes and knowledge. *Journal of Applied Psychology, 62*(4), 499–505. doi:10.1037/0021-9010.62.4.499
- Olea, M. M., & Ree, M. J. (1994). Predicting pilot and navigator criteria: Not much more than g. *Journal of Applied Psychology, 79*(6), 845–851. doi:10.1037/0021-9010.79.6.845
- Orvis, K. A., Fisher, S. L., & Wasserman, M. E. (2009). Power to the people: Using learner control to improve trainee reactions and learning in web-based instructional environments. *Journal of Applied Psychology, 94*(4), 960–971. doi:10.1037/a0014977
- Orvis, K. A., & Leffler, G. P. (2011). Individual and contextual factors: An interactionist approach to understanding employee self-development. *Personality and Individual Differences, 51*(2), 172-177. doi:10.1016/j.paid.2011.03.038

- Otis, A. S. (1934). Learning to glide. *Journal of Applied Psychology, 18*(2), 197–208.
doi:10.1037/h0071954
- Parker, S. K., & Sprigg, C. A. (1999). Minimizing strain and maximizing learning: The role of job demands, job control, and proactive personality. *Journal of Applied Psychology, 84*(6), 925–939. doi:10.1037/0021-9010.84.6.925
- Payne, S. C., Youngcourt, S. S., & Beaubien, J. M. (2007). A meta-analytic examination of the goal orientation nomological net. *Journal of Applied Psychology, 92*(1), 128–150.
doi:10.1037/0021-9010.92.1.128
- Pintrich, P. R., Cross, D. R., Kozma, R. B., & McKeachie, W. J. (1986). Instructional psychology. *Annual Review of Psychology, 37*(1), 611-651.
- Ployhart, R. E., & Hakel, M. D. (1998). The substantive nature of performance variability: Predicting interindividual differences in intraindividual performance. *Personnel Psychology, 51*, 859-901. doi: 10.1111/j.1744-6570.1998.tb00744
- Ployhart, R. E., & Vandenberg, R. J. (2010). Longitudinal research: The theory, design, and analysis of change. *Journal of Management, 36*, 94-120.
doi: 10.1177/0149206309352110
- Pressey, S. L. (1963). Teaching machine (and learning theory) crisis. *Journal of Applied Psychology, 47*(1), 1–6. doi:10.1037/h0047740
- Quiñones, M. A. (1995). Pretraining context effects: Training assignment as feedback. *Journal of Applied Psychology, 80*(2), 226–238. doi:10.1037/0021-9010.80.2.226
- Reilly, R. R., & Israelski, E. W. (1988). Development and validation of minicourses in the telecommunication industry. *Journal of Applied Psychology, 73*(4), 721–726.
doi:10.1037/0021-9010.73.4.721
- Renshaw, S. (1927). An experiment on the learning of “paired associates.” *Journal of Applied Psychology, 11*(3), 226–233. doi:10.1037/h0073992

- Ritchie, M. L., & Michael, A. L. (1955). Transfer between instrument and contact flight training. *Journal of Applied Psychology, 39*(3), 145–149. doi:10.1037/h0042441
- Robertson, I., & Downs, S. (1979). Learning and the prediction of performance: Development of trainability testing in the United Kingdom. *Journal of Applied Psychology, 64*(1), 42–50. doi:10.1037/0021-9010.64.1.42
- Robertson, I. T., & Downs, S. (1989). Work-sample tests of trainability: A meta-analysis. *Journal of Applied Psychology, 74*(3), 402–410. doi:10.1037/0021-9010.74.3.402
- Rubenstein, H., & Aborn, M. (1958). Learning, prediction, and readability. *Journal of Applied Psychology, 42*(1), 28–32. doi:10.1037/h0039808
- Saks, A. M. (1995). Longitudinal field investigation of the moderating and mediating effects of self-efficacy on the relationship between training and newcomer adjustment. *Journal of Applied Psychology, 80*(2), 211–225. doi:10.1037/0021-9010.80.2.211
- Salas, E., & Cannon-Bowers, J.A. (1997). Methods, tools, and strategies for team training. In M. A. Quinones & A. Ehrenstein (Eds.), *Training for a rapidly changing workplace: Applications of psychological research* (pp. 249–279). Washington, DC: American Psychological Association.
- Salas, E., & Cannon-Bowers, J. A. (2001). The science of training: A decade of progress. *Annual Review of Psychology, 52*, 471–499. doi:10.1146/annurev.psych.52.1.471
- Salas, E., DiazGranados, D., Klein, C., Burke, C. S., Stagl, K. C., Goodwin, G. F., et al. (2008). Does team training improve team performance? A meta-analysis. *Human Factors, 50*(6), 903–933. doi:10.1518/001872008X375009
- Salas, E., Stagl, K. C., Burke, C. S., & Goodwin, G. F. (2007). Fostering team effectiveness in organizations: Toward an integrative theoretical framework of team performance. In R. A. Dienstbier, J. W. Shuart, W. Spaulding, & J. Poland (Eds.), *Modeling complex*

- systems: Motivation, cognition and social processes: Nebraska Symposium on Motivation* (Vol. 51, pp. 185–243). Lincoln: University of Nebraska Press.
- Salas, E., Tannenbaum, S.I., Kraiger, K., & Smith-Jentsch, K. (2012). The science of training and development in organizations: What matters in practice. *Psychological Science in the Public Interest*, 13 (2), 76-103. doi:0.1177/1529100612436661
- Schmidt, A. M., & Ford, J. K. (2003). Learning within a learner control training environment: The interactive effects of goal orientation and metacognitive instruction on learning outcomes. *Personnel Psychology*, 56(2), 405-429. doi:10.1111/j.1744-6570.2003.tb00156.x
- Schwartz, H. A., & Haskell, R. J. J. (1966). A study of computer-assisted instruction in industrial training. *Journal of Applied Psychology*, 50(5), 360–363. doi:10.1037/h0023849
- Schwartz, H. A., & Long, H. S. (1967). A study of remote industrial training via computer-assisted instruction. *Journal of Applied Psychology*, 51(1), 11–16. doi:10.1037/h0024241
- Sessa, V. I., & London, M. (2006). *Continuous learning in organizations: Individual, group, and organizational perspectives*. Mahwah, NJ: Lawrence Erlbaum.
- Sibley, A. B., & Stogdill, E. L. (1936). The abstracting of clinical re-education techniques as a method of training beginners in clinical psychology. *Journal of Applied Psychology*, 20(5), 609–619. doi:10.1037/h0061924
- Siegel, A. I., Richlin, M., & Federman, P. (1960). A comparative study of “transfer through generalization” and “transfer through identical elements” in technical training. *Journal of Applied Psychology*, 44(1), 27–30. doi:10.1037/h0042021
- Simmering, M. J., Colquitt, J. A., Noe, R. A., & Porter, C. O. L. H. (2003). Conscientiousness, autonomy fit, and development: A longitudinal study. *Journal of Applied Psychology*, 88(5), 954–963. doi:10.1037/0021-9010.88.5.954

- Simon, S. J., & Werner, J. M. (1996). Computer training through behavior modeling, self-paced, and instructional approaches: A field experiment. *Journal of Applied Psychology, 81*(6), 648–659. doi:10.1037/0021-9010.81.6.648
- Sitzmann, T., Brown, K. G., Casper, W. J., Ely, K., & Zimmerman, R. D. (2008). A review and meta-analysis of the nomological network of trainee reactions. *Journal of Applied Psychology, 93*(2), 280–295. doi:10.1037/0021-9010.93.2.280
- Sitzmann, T., & Ely, K. (2010). Sometimes you need a reminder: The effects of prompting self-regulation on regulatory processes, learning, and attrition. *Journal of Applied Psychology, 95*(1), 132–144. doi:10.1037/a0018080
- Sitzmann, T., Ely, K., Bell, B. S., & Bauer, K. (2010). The effects of technical difficulties on learning and attrition during online training. *Journal of Experimental Psychology: Applied, 16* (3), 281-292. doi:10.1037/a0019968
- Sitzmann, T., & Johnson, S. K. (2012). The best laid plans: Examining the conditions under which a planning intervention improves learning and reduces attrition. *Journal of Applied Psychology, 97*(5), 967–981. doi:10.1037/a0027977
- Sitzmann, T., & Johnson, S.K. (2014). The paradox of seduction by irrelevant details: How irrelevant information helps and hinders self-regulated learning. *Learning and Individual Differences, 34*, 1-11. doi:10.1016/j.lindif.2014.05.009
- Sitzmann, T., Kraiger, K., Stewart, D., & Wisher, R. (2006). The comparative effectiveness of web-based and classroom instruction: A meta-analysis. *Personnel Psychology, 59*(3), 623-664. doi:10.1111/j.1744-6570.2006.00049.x
- Skinner, B.F. (1954). Science of learning and the art of teaching. *Harvard Educational Review, 24*, 86-97.

- Smader, R., & Smith, K. U. (1953). Dimensional analysis of motion: VI. The component movements of assembly motions. *Journal of Applied Psychology, 37*(4), 308–314. doi:10.1037/h0054421
- Smith, E. M., Ford, J. K., & Kozlowski, S. W. J. (1997). Building adaptive expertise: Implications for training design strategies. In M. A. Quinones & A. Ehrenstein (Eds.), *Training for a rapidly changing workplace: Applications of psychological research* (pp. 89–118). Washington, DC: American Psychological Association.
- Smith, K. U., & Sussman, H. M. (1970). Delayed feedback in steering during learning and transfer of learning. *Journal of Applied Psychology, 54*(4), 334–342. doi:10.1037/h0029523
- Smith-Jentsch, K. A., Jentsch, F. G., Payne, S. C., & Salas, E. (1996). Can pretraining experiences explain individual differences in learning? *Journal of Applied Psychology, 81*(1), 110–116. doi:10.1037/0021-9010.81.1.110
- Smith-Jentsch, K. A., Salas, E., & Brannick, M. T. (2001). To transfer or not to transfer? Investigating the combined effects of trainee characteristics, team leader support, and team climate. *Journal of Applied Psychology, 86*(2), 279–292. doi:10.1037/0021-9010.86.2.279
- Stanhope, D. S., Pond, S. B. I., & Surface, E. A. (2013). Core self-evaluations and training effectiveness: Prediction through motivational intervening mechanisms. *Journal of Applied Psychology, 98*(5), 820–831. doi:10.1037/a0032599
- Stockbridge, H. C. W., & Chambers, B. (1958). Aiming, transfer of training, and knowledge of results. *Journal of Applied Psychology, 42*(3), 148–153. doi:10.1037/h0048339
- Sturdevant, C. R. (1918). Training course of the American Steel and Wire Company. *Journal of Applied Psychology, 2*(2), 140–147. doi:10.1037/h0071047

- Tannenbaum, S. I., Beard, R. L., McNall, L. A., & Salas, E. (2010). Informal learning and development in organizations. In S. W. J. Kozlowski & E. Salas (Eds.), *Learning, Training, and Development in Organizations* (pp. 303-332). New York: Routledge.
- Tannenbaum, S. I., Mathieu, J. E., Salas, E., & Cannon-Bowers, J. A. (1991). Meeting trainees' expectations: The influence of training fulfillment on the development of commitment, self-efficacy, and motivation. *Journal of Applied Psychology, 76*(6), 759–769.
doi:10.1037/0021-9010.76.6.759
- Tannenbaum, S. I., Mathieu, J. E., Salas, E., & Cohen, D. (2012). Teams are changing: Are research and practice evolving fast enough? *Industrial and Organizational Psychology, 5*(1), 2-24. doi:10.1111/j.1754-9434.2011.01396.x
- Tannenbaum, S. I., & Yukl, G. (1992). Training and development in work organizations. *Annual Review of Psychology, 43*, 399-441. doi:10.1146/annurev.ps.43.020192.002151
- Taylor, P. J., Russ-Eft, D. F., & Chan, D. W. L. (2005). A meta-analytic review of behavior modeling training. *Journal of Applied Psychology, 90*(4), 692–709. doi:10.1037/0021-9010.90.4.692
- Thisted, M. N., & Remmers, H. H. (1932). The effect of temporal set on learning. *Journal of Applied Psychology, 16*(3), 257–268. doi:10.1037/h0070302
- Thorndike, E. L. (1927). The law of effect. *American Journal of Psychology, 39*, 212-222.
doi:10.2307/1415413
- Thorndike, E. L., & Woodworth, R. S. (1901). The influence of improvement in one mental function upon the efficiency of other functions. *Psychological Review, 8*, 247-261.
doi:10.1037/h0074898
- Towler, A. J., & Dipboye, R. L. (2001). Effects of trainer expressiveness, organization, and trainee goal orientation on training outcomes. *Journal of Applied Psychology, 86*(4), 664–673. doi:10.1037/0021-9010.86.4.664

- Trabue, M. R., & Dvorak, B. J. (1934). A study of the needs of adults for further training. *Journal of Applied Psychology, 18*(6), 826. doi:10.1037/h0069749
- Tracey, J. B., Tannenbaum, S. I., & Kavanagh, M. J. (1995). Applying trained skills on the job: The importance of the work environment. *Journal of Applied Psychology, 80*(2), 239–252. doi:10.1037/0021-9010.80.2.239
- Van Iddekinge, C. H., Ferris, G. R., Perrewé, P. L., Perryman, A. A., Blass, F. R., & Heetderks, T. D. (2009). Effects of selection and training on unit-level performance over time: A latent growth modeling approach. *Journal of Applied Psychology, 94*(4), 829–843. doi:10.1037/a0014453
- Vancouver, J. B., & Kendall, L. N. (2006). When self-efficacy negatively relates to motivation and performance in a learning context. *Journal of Applied Psychology, 91*(5), 1146–1153. doi:10.1037/0021-9010.91.5.1146
- Villado, A. J., & Arthur, W. J. (2013). The comparative effect of subjective and objective after-action reviews on team performance on a complex task. *Journal of Applied Psychology, 98*(3), 514–528. doi:10.1037/a0031510
- Von Trebra, P., & Smith, K. U. (1952). The dimensional analysis of motion: IV. Transfer effects and direction of movement. *Journal of Applied Psychology, 36*(5), 348–353. doi:10.1037/h0056398
- Wagner, R. P. (1933). An experiment with the number maze as a measure of learning. *Journal of Applied Psychology, 17*(5), 614–620. doi:10.1037/h0071631
- Wallace, S. R. (1965). Criteria for what? *American Psychologist, 20*, 411-417. doi:10.1037/h0022446
- Wang, S., & Noe, R. A. (2010). Knowledge sharing: A review and directions for future research. *Human Resource Management Review, 20*, 115-131. doi:10.1016/j.hrmr.2009.10.001

- Warr, P., Allan, C., & Birdi, K. (1999). Predicting three levels of training outcome. *Journal of Occupational and Organizational Psychology*, 72, 351-375.
doi:10.1348/096317999166725
- Watson, A. M., Foster Thompson, L., Rudolph, J. V., Whelan, T. J., Behrend, T. S., & Gissel, A. L. (2013). When big brother is watching: Goal orientation shapes reactions to electronic monitoring during online training. *Journal of Applied Psychology*, 98(4), 642–657.
doi:10.1037/a0032002
- Wiener, D. N., & Simon, W. (1950). Personality characteristics of embalmer trainees. *Journal of Applied Psychology*, 34(6), 391–393. doi:10.1037/h0059706
- Wiener, E. L. (1963). Knowledge of results and signal rate in monitoring: A transfer of training approach. *Journal of Applied Psychology*, 47(3), 214–222. doi:10.1037/h0048038
- Woodward, P. (1943). An experimental study of transfer of training in motor learning. *Journal of Applied Psychology*, 27(1), 12–32. doi:10.1037/h0059610
- Yelon, S., Sheppard, L., Sleight, D., & Ford, J. K. (2004). Intention to transfer: how do autonomous professionals become motivated to use new ideas? *Performance Improvement Quarterly*, 17, 82–103. doi:10.1111/j.1937-8327.2004.tb00309.x
- Yeo, G. B., & Neal, A. (2004). A multilevel analysis of effort, practice, and performance: Effects of ability, conscientiousness, and goal orientation. *Journal of Applied Psychology*, 89(2), 231–247. doi:10.1037/0021-9010.89.2.231
- Zacker, J., & Bard, M. (1973). Effects of conflict management training on police performance. *Journal of Applied Psychology*, 58(2), 202–208. doi:10.1037/h0035659
- Zvoch, K., Letourneau, L. E., & Parker, R. P. (2007). A multilevel multi-site outcomes-by-implementation evaluation of an early childhood literacy model. *American Journal of Evaluation*, 28, 132-150. doi:10.1177/1098214007301138

Table 1: Summary of Key Conclusions from 100 Years of Training and Development Research

Training Criteria

Learning is multidimensional, consisting of cognitive outcomes and strategies, skill-based outcomes, and affective outcomes.

Training can be used to influence a broad array of criteria at the individual, team and organizational levels.

Within-person changes in learners over time provide important information for diagnosing and maximizing training effectiveness.

Trainee Characteristics

Cognitive ability is an important predictor of motivation to learn and learning outcomes, but personality traits, motivational constructs, values, interests, attitudes, emotions, and perceptions should also be considered.

Trainee characteristics, instructional design, modality, and instructor style influence motivation to learn and learning outcomes.

Trainability, which focuses on a person's capacity to learn a job, is distinct from job success and can be measured through tests that include a period of structured instruction followed by an assessment of learning.

Age, motivation to learn, self-efficacy, learning goal orientation, values, and perceptions of social support, organizational policies, and incentives predict participation in and/or learning from development activities.

Trainee characteristics which have been found to influence learner motivation and outcomes in face-to-face training are relevant for new training delivery methods such as e-learning, games, and simulations.

The strength and direction of the relationships between learning outcomes and ability, self-efficacy, and goal orientation can vary over time depending on practice and self-regulatory processes.

Training Design and Delivery

The effectiveness of a particular training delivery method depends on the skills or tasks being trained and the desired learning outcomes.

Training designs that encourage and support more active, self-regulated learning can facilitate the development of complex skills and adaptive performance.

The effectiveness of technology-based training is determined not by the media but by the design of the instruction and the support provided to learners.

Team training interventions, such as cross-training, leader briefings, and after-event reviews, can be effective tools for improving team functioning.

Training in Context

What happens prior to and after training can greatly influence training effectiveness, so it is critical to take a systems perspective that goes beyond instructional design and trainee characteristics and considers the context within which training occurs.

Supervisor and peer support, opportunities to apply learned skills on the job, and organizational culture and practices can determine the extent to which newly acquired competencies are applied on the job.

Contextual factors such as managerial support and prior training experiences can influence whether employees choose to participate in non-mandatory developmental activities.

The work context influences participation in developmental activities and the effectiveness of those activities in part because it can increase or decrease employees' motivation to learn and to apply what they have learned in training.

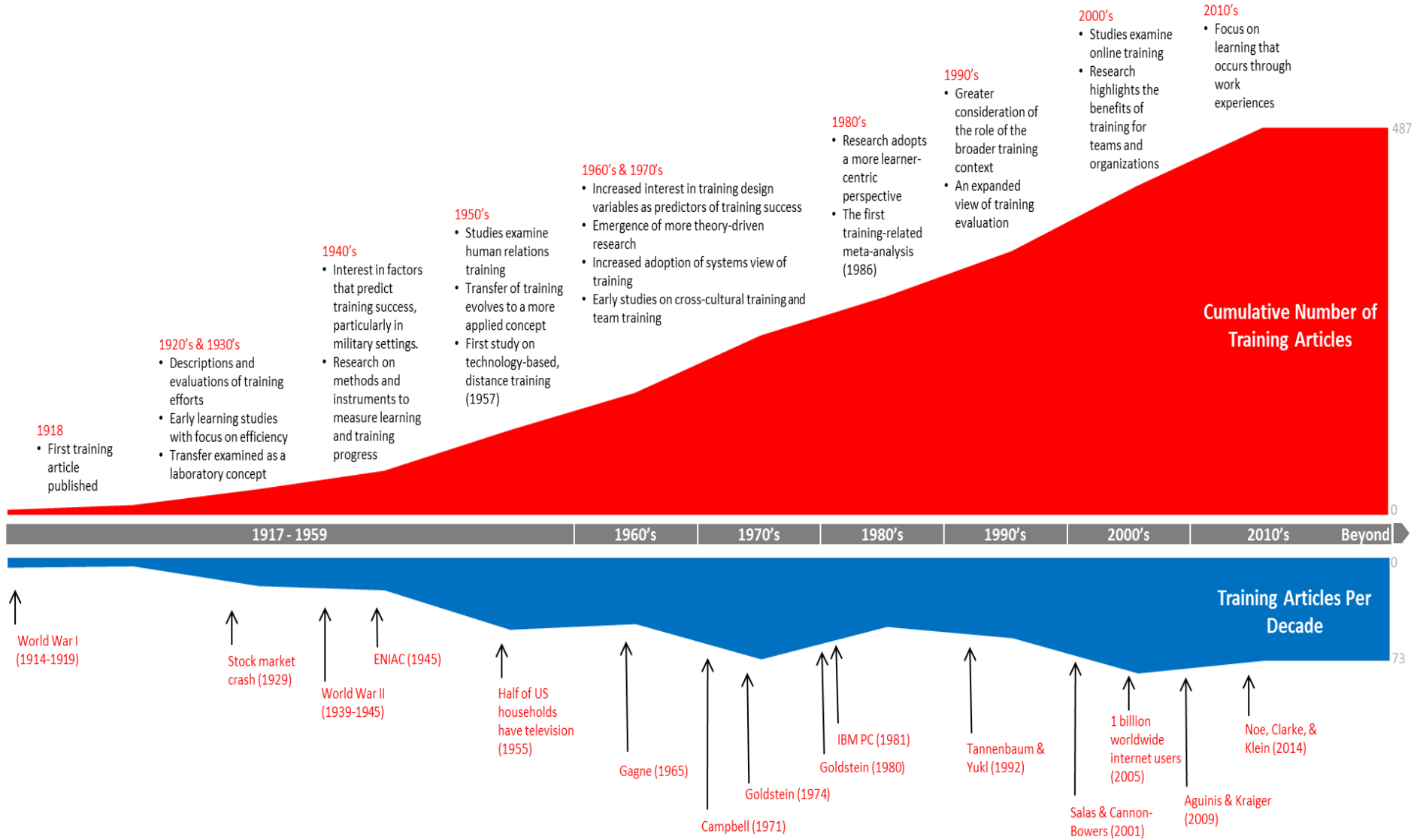


Figure 1. Timeline of training and development research in JAP. 458 training articles were published through 2015. Number of cumulative articles and articles per decade shown reflect projections for 2010's based on rate of publication from 2010 through 2015.