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Searching for the Inverted U-Shaped Relationship Between Time and Performance: Meta-Analyses of the Experience/Performance, Tenure/Performance, and Age/Performance Relationships

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Abstract
Theoretical and empirical research suggests that job experience, organizational tenure, and age have non-linear relationships with performance. Considered simultaneously, there should exist an inverted U-shaped relationship between time and performance. Furthermore, the nature of this inverted U-shaped relationship should be affected by characteristics of the sample and measurement of performance. Using meta-analysis, this paper seeks to confirm the existence of the inverted U-shaped relationship between time and performance, and to demonstrate the moderating effects of performance measurement (objective versus subjective measures of performance) and job complexity. The results have implications for theory, research on dynamic performance, and human resource management practice.

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relationship, human resource management, performance

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Comments

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Theoretical and empirical research suggests that job experience, organizational tenure, and age have non-linear relationships with performance. Considered simultaneously, there should exist an inverted U-shaped relationship between time and performance. Furthermore, the nature of this inverted U-shaped relationship should be affected by characteristics of the sample and measurement of performance. Using meta-analysis, this paper seeks to confirm the existence of the inverted U-shaped relationship between time and performance, and to demonstrate the moderating effects of performance measurement (objective versus subjective measures of performance) and job complexity. The results have implications for theory, research on dynamic performance, and human resource management practice.

It has been long-studied and well-documented that individual job performance is dynamic (i.e., it changes over time) (Deadrick, Bennett & Russell, 1997; Deadrick & Madigan, 1990; Henry & Hulin, 1987; Hofmann, Jacobs & Baratta, 1993; Hofmann, Jacobs & Gerras, 1992; Hulin, Henry & Noon, 1990; Ployhart & Hakel, 1998; Sturman & Trevor, 2001). However, despite the fundamental importance of predicting job performance to industrial-organizational psychology and organizational practice, the field still knows relatively little about the nature of individual performance changes over time (Ployhart & Hakel, 1998). Although there is nothing inherently causal about time (Hulin et al., 1990), some changes in any measure of job performance may be attributed to effects approximated by temporal variables (Deadrick et al., 1997; Hofmann et al., 1992, 1993). This paper examines the relationships of job experience, organizational tenure, and age with subjective overall measures of job performance (i.e., supervisory evaluations) and objective measures of job performance (i.e., productivity), and the extent to which these relationships are moderated by job complexity.

Variables such as job experience, organizational tenure, and employee age serve as easily obtainable proxies for other constructs like job knowledge, organizational socialization, and physical

skills. Consequently, these temporal variables play an important role in human resource models, empirical studies, and practitioner decision-making. For instance, theoretical models of work performance and behaviors frequently include job experience, organizational tenure, and employee age (Ackerman, 1992; Campbell, 1990; Farrell & McDaniel, 2001; Giniger, Dispenzieri & Eisenberg, 1983; Rhodes, 1983; Salthouse, 1979; Schmidt, Hunter & Outerbridge, 1986; Tesluk & Jacobs, 1998). Empirical research often employs these variables as control variables, such as for approximating job-related abilities, human capital characteristics, motivational factors, or just to partial out the effects that might be attributable to characteristics of the sample (e.g., Farrell & McDaniel, 2001; Forteza & Prieto, 1994; Lawrence, 1996; Quiñones, Ford & Teachout, 1995; Tesluk & Jacobs, 1998; Warr, 1994). In practice, job experience and seniority (i.e., organizational tenure) often play a significant part in human resource decisions (Gatewood & Feild, 2001; Quiñones et al., 1995; Tesluk & Jacobs, 1998). Furthermore, variables such as age may be related to biases that decision makers hold when making performance evaluations (Cleveland & Landy, 1983, 1987; Kuhlen, 1977; Lawrence, 1988; Siegel & Ghiselli, 1971).

In short, understanding the relationships of job experience, organizational tenure, and employee age with performance is of critical concern for theory, research, and practice. This study combines theoretical work on the effects of job experience, research on organizational socialization, and the decremental theory of aging to describe how the relationships of temporal variables with performance are expected to lead to an inverted U-shaped relationship between time and performance. I also examine how the method of performance measurement (objective versus subjective) and job complexity moderate the shape of this inverted U-shaped curve. This study tests these hypotheses using meta-analyses.

Temporal Variables and Performance

Before developing hypotheses about the expected relationships between job performance and time, it is first necessary to define clearly each of the variables this paper examines. This paper looks into temporal variables that have played notable roles in research with performance and with many other constructs. Specifically, I am examining the relationships of job performance with job experience, organizational tenure, and age. Similarly, what is meant by job performance must also be clearly specified. Job performance is a highly complex multidimensional construct, with many differences in its meaning depending on who is evaluating it, how it is evaluated, what aspect is being evaluated, etc. It is beyond the scope of this paper to consider all such aspects of performance and their relationships with time; rather, I am focusing on two common forms of performance measurement—subjective

supervisory evaluations, and objective measures of individual output—that continue to play a very important role in human resource research and practice. This section of the paper reviews the relevant literature that defines these variables; subsequently, the hypothesized relationships between them will be detailed.

Temporal Variables

Job experience. Within the context of a job, experience entails the accumulation of job-specific knowledge from action, practice, and perception of the tasks and duties associated with a specific job (Quiñones et al., 1995). Although based on perceptions and practice, experience is inherently tied to time, whose passage allows for the accumulation of the job-related knowledge.

While the concept of experience seems straightforward, recent research into the implications of its measurement shows it to be multifaceted (Quiñones et al., 1995; Tesluk & Jacobs, 1998). Despite much research using such approximations and terms for job experience as job tenure, work experience, organizational tenure, and seniority interchangeably (Hofmann et al., 1992), in-depth treatments of the variable suggest it varies by level of specification (e.g., task, job, work-group, organization) and measurement (e.g., amount, time, type, density) (Quiñones et al., 1995; Tesluk & Jacobs, 1998). This paper focuses on experience with a job (or set of highly similar jobs) involving multiple duties, which hereunto is referred to as job experience, and experience with the organization (i.e., organizational tenure) to be discussed later. Furthermore, as the focus here is on the relationships between temporal variables and performance, job experience is examined through a quantitative measure of time (in years).

Several theories lend understanding to the relationship between job experience and performance.

Human Capital Theory suggests that employees make investments of experience in themselves, which enhance their ability, and thus influence job performance (Ehrenberg & Smith, 2000). Learning theory also predicts that job experience enhances job ability (Weiss, 1990). Both perspectives suggest that job performance changes over time because individuals accumulate job experience. As job experience leads to the accumulation of relevant knowledge, skills, and abilities, performance should improve. From this basis, models of performance posit that job experience has a positive effect on job performance (e.g., Campbell, 1990; Hunter, 1983b; Schmidt et al., 1986). Providing a detailed treatment of this hypothesis, Schmidt et al. (1986) showed job experience influences job knowledge and task proficiency, which in turn has a positive effect on job performance. Their model also suggested that the

effect of experience may not be linear. Schmidt and colleagues argued that the relative advantage of one year of job experience is significantly greater at lower levels of job experience than at higher levels (McDaniel, Schmidt & Hunter, 1988; Schmidt et al., 1986), a finding that has been replicated (Avolio, Waldman & McDaniel, 1990; McDaniel et al., 1988).

Organizational tenure. Organizational experience suggests an accumulation of work-related information that is conceptually distinct from job experience (Quiñones et al., 1995; Tesluk & Jacobs, 1998). Accurate specification of the context through which experience is accumulated (i.e., job versus group versus organizational level) is important because experiences gained in different contexts may have unique effects (Tesluk & Jacobs, 1998). The literature on organizational socialization (e.g., Chatman, 1991; Feldman, 1976; Van Maanen & Schein, 1979) most directly addresses the effects of accumulating organizationally specific experience.

Organizational socialization is the process by which an individual comes to understand the social knowledge, values, and expected behaviors necessary to assume an organizational role (Chatman, 1991;Van Maanen & Schein, 1979). Through socialization, employees learn how to function within an organization's culture by gaining familiarity with the organization's systems, becoming trusted by coworkers, and establishing friendships (Feldman, 1976).

Some have argued that when experience is measured at the organizational level of specification, it is more appropriately linked to such phenomena as organizational commitment rather than job performance (Quiñones et al., 1995; Tesluk & Jacobs, 1998). While organizational experience may appear less directly related to job performance, through the acquisition of organizational experience, an individual builds individual and organizational knowledge that helps both the individual's and the organization's performance (Nonaka, 1994). The explicit and tacit organizational knowledge gained through organizational experience should have unique effects on job performance beyond those attributable to experience gained performing a specific set of tasks. Thus, measuring organizational experience should capture a level of understanding beyond that explained by changes in job experience over time.

Take for example two research scientists, both with 10 years experience. All else equal, one with the experience within the same organization should be more knowledgeable about how to get a project done (e.g., knowing who to contact for help, building upon established relationships with colleagues, locating resources) than the other scientist who is just beginning to work for the organization. As with job experience, though, the benefit of accumulated organizational experience on job performance is likely to change over time. The effects of socialization should be most pronounced early in one's tenure

than later in one's tenure. When an employee is new, she will be exposed to a whole set of cultural norms, behavioral expectations, and organizational operational information. In later years, there simply will be less to learn, and thus additional organizational experience will be associated with smaller gains of organizational knowledge. Thus, any effect of organizational tenure on performance should be non-linear, with a larger positive effect at low levels of organizational tenure that diminishes as organizational tenure increases.

Age. Simultaneous to the accumulation of job experience and organizational tenure, the individual necessarily is getting older. Aging may play a role in describing how an individual changes over time, and subsequently may affect how job performance changes over time (Waldman & Avolio, 1993).

There has long been a view of a negative age/performance relationship (Rhodes, 1983), although the belief has endured without conclusive empirical support (McEvoy & Cascio, 1989). One theoretical rationale for the hypothesized negative relationship is the decremental theory of aging (Giniger et al., 1983), which suggests that increased age causes a deterioration in abilities, such as speed, dexterity, motor coordination, and strength (Giniger et al., 1983; Rhodes, 1983; Salthouse, 1979). Age has been shown to be associated with decreases in performance on tests of learning, memory, reasoning, spatial abilities, and psychomotor speed (Lindenberger & Baltes, 1994; Salthouse, 1991; Verhaeghen & Salthouse, 1997). Similarly, Kliegl and Mayr (1992) have advanced a model that suggests there is an underlying single negative effect of age-related influences on a wide range of cognitive variables. Although the simplest single factor model (i.e., one underlying factor, affected solely by age, accounts for declining cognitive function) has been shown to be too simplistic, a large number of studies do present evidence of the negative effects of aging, and a form (albeit somewhat more complex than the simplest model) of the single factor model is strongly supported (Verhaeghen & Salthouse, 1997).

Aging may also affect performance through motivation. Wright and Hamilton (1978) suggest that older employees go through a "grinding down" stage where they accept what is available to them and lessen their expectations. Supporting this proposition, research has shown a negative relationship between age and ambition, aspirations, and overall motivation (Giblin, 1986; Judge & Hulin, 1993; Judge & Locke, 1993; Kuhlen, 1977; Rhodes, 1983).

Aging may also affect how others perceive, and therefore treat, an individual. Research suggests that older workers are evaluated more harshly than younger workers (Cleveland & Landy, 1983, 1987; Siegel & Ghiselli, 1971), are given raises less readily (Siegel & Ghiselli, 1971), and are offered fewer training and networking opportunities (Kuhlen, 1977; Lawrence, 1988). Thus, even if an individual does not change in terms of performance-causing characteristics, other employees may fulfill their own

expectations of performance changes by reducing opportunities for performance or development, or by giving lower evaluations.

The arguments suggesting a relationship between age and performance does not imply that the effect of age on performance is linear. Potentially detrimental effecting of aging— decreased ability levels, harsher evaluations, or decreased motivation—are not likely to increase at the same rate over time. Instead, there is likely to be little or no aging effect early in one's career; any potential detrimental effects are likely only to start and accelerate later in one's career (when there become fewer promotional opportunities, when one is simply older, etc.). Thus, one should expect a non-linear relationship, with the negative effects of age becoming stronger as employees age (Avolio et al., 1990).

Despite the theory suggesting that aging will affect performance, and empirical evidence showing aging's effects on performance-related constructs, research on the age/performance relationship has shown mixed results. Rhodes (1983) reported approximately equal numbers of studies with positive, negative, and no relationships. McEvoy and Cascio (1989) found some support for a curvilinear hypothesis. Specifically, they examined studies with young employees versus those of all ages and found that the young samples had a higher age/performance correlation than the other studies. Yet, meta-analyses have shown that age alone accounts for little variance in job performance (McEvoy & Cascio, 1989; Waldman & Avolio, 1986). While these results are informative, they are limited in that they had only a few studies in the younger group (K = 4 in one analysis, K = 9 in another). More importantly, prior meta-analyses of age have employed categorizations of age, rather than using the age of a sample as a continuous covariate. Such categorizations may occlude important variance in the relationship between age and performance, and thus these prior literature reviews may have missed potential non-linear relationship between age and performance over the plausible range of age values. Other individual-level studies have found support for non-linear effects of age, but lacked a sufficient range (particularly of older workers) in the sample to fully test the nature of the age/performance relationship at all values potentially facing modern employers (Avolio et al., 1990). For these reasons, stronger support of a non-linear relationship may not have been detected by this previous research, and further work is necessary to substantiate this proposed non-linear relationship.

Considering Temporal Variables Simultaneously: the Inverted U-Shaped Hypothesis

The temporal variables described above help approximate different phenomena, and thus should have different relationships with job performance. First, job experience and organizational tenure are expected to have positive relationships with performance, but the strength of these effects

are expected to diminish over time. Second, employee age should be initially unrelated to job performance, but a negative relationship should develop and become stronger as age increases. It is important to note that the strengths of the effects vary over time. The positive effects of job experience and organizational tenure should be initially strong, but grow weaker over time; simultaneously, the expected negative effects of age should be at first small (or non-significant), but become increasingly stronger while the positive effects of experience and seniority are diminishing. These effects should operate simultaneously, thus suggesting a general relationship that exists between time and performance. Because the expected magnitude of the forces changes over time, their effects should not simply cancel each other out; rather, the combination of these forces should yield an inverted U-shaped relationship between time and performance (Avolio et al., 1990).

Note that the proposition of an inverted U-shaped relationship between temporal variables and job performance is not new (e.g., Avolio et al., 1990; McEvoy & Cascio, 1989; Rhodes, 1983); however, previous research has failed to provide conclusive empirical evidence either for or against this relationship (McEvoy & Cascio, 1989; Rhodes, 1983). However, the lack of support for this relationship may be attributable to the lack of older or highly experienced workers in examined samples. Because we expect the negative effects of aging to occur for older employees, if a sample did not include enough older workers, then any analyses of that sample would fail to reveal specifically any existing inverted U-shaped relationship.

For example, the McDaniel et al. (1988) study clearly demonstrated a non-linear relationship between experience and performance (i.e., the correlation between experience and performance decreased as the experience of the group being investigated increased), but did not support an inverted U-shaped relationship (i.e., the correlation did not become negative). Failure to reveal an inverted U-shaped relationship, though, is not equivalent to falsifying this hypothesis. McDaniel et al. (1988) only investigated the experience/performance relationship for a population with an average experience of fewer than 6 years, and their last reference group in their analysis was “12 years and up.” Thus, although the study did not provide support for the existence of an inverted U-shaped relationship, due to its lack of range, their study did not provide evidence to the contrary. Similarly, Avolio et al. (1990) investigated the age/performance and experience/performance relationships. They too found non-linear relationships, as evidenced by their graphs and the significant and negative coefficients for squared terms in their models. The negative quadratic terms mean that the positive relationship of age and experience with performance diminishes at higher levels, and may even become negative and form an inverted U-shape. However, Avolio et al. (1990) failed to support (or reject) the notion of an inverted

U-shaped curve for the majority of their samples because they did not have a large number of older workers: only 6% of Avolio et al.'s (1990) sample were aged 55 or more. Had the Avolio et al. (1990) sample included more older employees, they might have supported the inverted U-shaped hypothesis.

The trend toward increased workforce participation by older individuals (Ahlburg & Kimmel, 1986; Warr, 1994) combined with more frequent employee movements between jobs, organizations, and careers (Hall & Associates, 1996; Hall & Mirvis, 1995), suggests that organizations will increasingly encounter diverse ranges of job experience, organizational tenure, and age levels. This trend highlights the need for research to explore the temporal variable/performance relationships over a wider range of the time-related variables. This paper posits that there are theoretical reasons to expect an inverted U-shaped relationship between time and performance which, although potentially difficult to observe, should help predict individual performance levels over employees' careers. Thus, the review of job experience/performance, organizational tenure/performance, and age/performance relationships suggests the following:

Hypothesis 1: There exists an inverted U-shaped relationship between temporal variables (i.e., job experience, organizational tenure, and employee age) and job performance.

Moderators to the Time/Performance Relationship

This paper has reviewed literature about temporal variables and job performance to suggest a generalizable relationship between the two in the form of an inverted U-shape. Yet, the above section does not differentiate between different jobs, and it deals with the job performance variable in a very general manner. It is unlikely that this relationship is exactly the same for all jobs and performance measurement contexts. Thus, I now turn to examining some moderators that will likely affect the nature of the inverted U-shaped curve. Specifically, I examine the form of performance measurement (supervisory ratings of overall performance versus productivity measures of task performance) and job complexity.

Supervisory Measure of Overall Performance Versus Objective Performance Measures

Research on job performance is increasingly recognizing the complexities associated with the construct of performance. This is in part because there are historical, practical, and theoretical reasons for the human resource literature to examine (a) general, overall measures of performance (e.g., Schmidt & Kaplan, 1971; Scullen, Goff & Mount, 2000), (b) different dimensions of job performance (e.g., Borman & Motowidlo, 1993; Conway, 1999; Rotundo & Sackett, 2002; Van Scotter, Motowidlo & Cross, 2000), and (c) different ways that job performance can be measured (Bommer, Johnson, Rich

Podsakoff & Mackenzie, 1995; Heneman, 1986; Lance, Teachout & Donnelly, 1992; Vance, MacCallum, Coovert & Hedge, 1988). Although the human resource literature would benefit from examinations in each of these areas, this paper focuses on overall measures of performance, measured through either supervisory evaluations or objective (i.e., productivity) measures.

Overall performance ratings represent (generally supervisory) estimates of the overall contribution of the individual to the successful operation of the organization. Although it is tenuous to consider overall measures of job performance equivalent to a true measure of some overarching performance construct (Scullen et al., 2000), it is undeniable that supervisory performance ratings play an important role in human resource decision-making and research. Overall measures of job performance are of interest because this is generally what supervisory performance measures attempt to capture, and are ultimately used in decision-making for feedback, compensation, promotion, and termination (Scullen et al., 2000). Supervisory ratings are also frequently used in research studies, whether for validating selection measures, assessing training techniques, or examining outcomes in studies of behavioral or attitudinal variables.

A common criticism of using supervisory performance ratings, though, is that they are subject to unreliability and bias (Bommer et al., 1995; Campbell, 1990; Feldman, 1981). Thus, many researchers have used objective measures of job performance. Although objective job performance measures do capture obviously important outcomes from an organization's point of view, and are correlated with supervisory evaluations, objective and subjective measures of job performance are not equivalent (Bommer et al., 1995; Heneman, 1986; Lance et al., 1992;Vance et al., 1988). Others have called for work on job performance to differentiate between objective and subjective measures of performance, suggesting that future research should consider the potentially moderating effects of each type of job performance measurement (Bommer et al., 1995).

Objective measures capture the results of behaviors on the job and not specifically the behaviors themselves. As such, they should be more related to specifically task related components of the job, and less related to social issues, citizenship performance, and subjective perceptions or biases. Subjective measures of performance, though, are influenced by different types of behaviors on the job. Based on a review of the past 20 years of research on job performance, Rotundo and Sackett (2002) identified three broad performance components: task performance, citizenship performance, and counterproductive performance. These components of job performance have been shown to explain unique variance in supervisory performance evaluations (Conway, 1999; Motowidlo & Van Scotter, 1994; Rotundo & Sackett, 2002;Van Scotter et al., 2000). Thus, interpersonal relations, job-specific

knowledge, organizational knowledge, and attitudes may influence supervisors' overall performance scores.

In short, subjective evaluations capture a wider range of employee behaviors (Rotundo & Sackett, 2002), and objective measures of performance focus on the results of behaviors (often, only individual output). Consequently, the variety of outcomes associated with phenomena approximated by temporal variables could be captured in different ways by supervisory evaluations, but not observed in measures of productivity.

Because there are inherent differences between objective and subjective measures of performance, relationships with temporal variables should also exhibit different relationships. Thus, the shape of the generalizable pattern between time and performance, hypothesized above to be U-shaped, should be affected by whether the performance measure is subjective or objective. Because objective measures of performance capture a narrower range of an overall performance construct, the diminishing benefits of gained experience and the negative effects of age are more likely to be observed without the rating system taking into account any mitigating factors. On the other hand, added experience, organizational tenure, and age may alter the nature of the job somewhat, with an individual acquiring more leadership and training responsibility. Exhibiting organizational citizenship behaviors (OCBs) will influence overall performance ratings (Rotundo & Sackett, 2002), and therefore should add variance into the relationships between temporal variables and performance. Thus, when the performance measure captures a wider aspect of an overall performance construct, relationships with any single variable are likely to be occluded somewhat by the fact that the variables have different relationships with different components of performance (i.e., task performance, OCBs). Therefore, I hypothesize:

Hypothesis 2: The inverted U-shaped relationship between temporal variables (i.e., job experience, organizational tenure, and employee age) and job performance will be moderated by the performance measurement type (objective versus subjective).

More specifically,

Hypothesis 2a: The relationship between temporal variables and job performance should be initially greater for objective than subjective measures of performance.

Hypothesis 2b: The curvilinearity in the temporal variable/performance relationship will be greater for objective than for subjective measures of performance.

Job Complexity

Job complexity has been shown to moderate the relationship between job experience and supervisory performance evaluations (e.g., Farrell & McDaniel, 2001; Gutenberg, Arvey, Osburn & Jeanneret, 1983; McDaniel et al., 1988). Because job knowledge and performance capability share causal pathways to performance, and given the evidence that job complexity moderates the validity of mental ability, the effect of temporal variables may also be moderated by job complexity (Farrell & McDaniel, 2001; McDaniel et al., 1988).

Greater levels of complexity on the job make the acquisition of the skills necessary to perform the job consistently more difficult. Based on work by Ackerman on skill acquisition (e.g., Ackerman, 1987, 1988), Murphy (1989) developed a model positing that a person's tenure in an organization includes two distinct stages: transition stage and maintenance stage. The transition stage occurs when an employee enters a new job or when a job's major duties or responsibilities change. During this stage, workers cannot depend on previous job experience, instead relying on cognitive ability to learn new tasks and solve new problems. Once workers learn the job, they enter the maintenance stage. During this stage, task performance is attributable to the performance of well-learned processes, and experience should play a larger role in predicting individual performance.

In jobs with greater complexity, that complexity will cause individuals to experience more time in transition-like stages. Thus, the various phenomena approximated by temporal variables should be less related to performance when complexity in the job is greater. However, in lower complexity jobs, early gains in job and company experience should play a larger role as employees in such jobs are likely to operate most often in a maintenance stage. Thus, when they otherwise have very little or no experience, such employees will be rapidly gaining the type of knowledge necessary to perform the job in the long run. McDaniel et al. (1988) confirm this by showing that job experience is a better predictor of job performance for low complexity jobs.

I argue that the evidence described above regarding the hypothesized inverted U-shaped relationship between time and performance should generalize across jobs, regardless of job types, complexity, etc.; however, as with measurement type, it is likely that the generalizable pattern between time and performance will be affected by job complexity. In low complexity jobs, the effects of time are likely to be more pronounced than in higher complexity jobs. In low complexity jobs, initial experience will be more strongly related to measures of job performance; however, because of the low complexity, the additional benefits of accumulated experience are likely to decrease rapidly. In more complex jobs,

experience is likely to have a weaker effect initially, but the potential benefits of experience are likely to last longer.

Similarly, the detrimental effects of aging (reduced physical capacity, lack of career opportunities) are likely to be greater in low complexity jobs. In complex jobs, the potential negative effects of aging are likely to be smaller and occur later—for example, because complex jobs will depend more on cognitive rather than physical skills and may have more promotional opportunities. Consequently, I hypothesize:

Hypothesis 3: The inverted U-shaped relationship between temporal variables (i.e., job experience, organizational tenure, and employee age) and job performance will be moderated by the job complexity.

More specifically,

Hypothesis 3a: The relationship between temporal variables and job performance should be initially lower for higher complexity jobs than lower complexity jobs.

Hypothesis 3b: The curvilinearity in the temporal variable/performance relationship will be lower for higher complexity jobs than for lower complexity jobs.

Methods

This paper employs meta-analyses to test the study's hypotheses. Although a large number of studies have examined relationships between the temporal variables of interest in this paper and job performance, few have examined potential non-linearities. Consideration of the hypothesized non-linear relationships between temporal variables and performance and the predicted moderators of these relationships may help explain the variance of prior findings and the inability of prior meta-analyses to explain a substantial portion of such variance. This study employs a meta-analytic method that facilitates testing continuous covariates, and thus allows the investigation of non-linear relationships and moderators.

Summary of Literature Searches

There are many potential studies to include in a meta-analysis of job experience, organizational tenure, employee age, and job performance. Many studies report these variables even when not specifically examining relationships among them. The search for such studies involved two major steps: one, using the references from previous meta-analyses on these relationships; and two, performing a manual search of top management and human resource journals. I used references from

age/performance meta-analyses (McEvoy & Cascio, 1989; Rhodes, 1983; Waldman & Avolio, 1986), and the experience/performance and tenure/performance meta-analyses by Quiñones et al. (1995). The manual search examined seven management journals—Academy of Management Journal, Administrative Science Quarterly, Industrial and Labor Relations Review, Journal of Management, Journal of Applied Psychology, Organizational Behavior and Human Decision Processes, and Personnel Psychology—from 1980–2001. A list of all the studies used in the three meta-analyses is provided in the Appendix A.

Results of the meta-analyses' literature reviews yielded greater sample sizes than other meta-analyses in these areas (e.g., Hunter & Hunter, 1984; McEvoy & Cascio, 1989; Quiñones et al., 1995; Waldman & Avolio, 1986). For the meta-analysis of job experience and performance, 58 studies (K = 95; N = 87,189) were obtained. Of those studies also reporting the mean job experience of the sample (S = 52; K = 86; N = 84,173), the mean job experience was 5.64 (SD = 4.01), and ranged from .67 to 22.04. For most of these studies, job experience was approximated as job tenure; however, this was not always the case, and in two studies the mean experience of the sample was greater than the mean organizational tenure of the sample. As this study examines the relationships between temporal variables and performance, all covariates were expressed in units of time and the level of specificity was the job.

The type of performance measure was coded for each study. In the entire sample of studies with a job experience/performance correlation, 68 samples measured performance through supervisory performance rating, and 14 included objective ratings (e.g., sales, production, etc.) of performance. Fifty-five of the samples were of white collar employees, 21 were blue collar employees, 18 samples included a variety of jobs, and one was on military trainees. The correlation between job complexity and measure type (0 = subjective, 1 = objective) was .18 (n.s.).

The literature review for studies examining the organizational tenure/performance yielded 74 studies, containing 87 separate samples and a total sample size of 59,444. Sixty-four samples used supervisory ratings; 13 samples employed objective performance measures. Fifty-nine of the samples were of white collar employees, 14 were of blue collar employees, 12 samples were of mixed groups of employees, and two were of police officers. The correlation between job complexity and measure type was −.05 (n.s.). Sixty-five of these studies (K = 77; N = 56,664) reported the average organizational tenure of the sample. Mean organizational tenure levels ranged from .22 to 19.16, with a mean of 7.72 (*SD* = 4.87).

The age/performance meta-analysis was based on 115 studies (K = 167; N = 96,866). Thirty-eight of the samples used objective performance measures; 108 samples used supervisory ratings. One hundred four of the correlations were from samples of white collar workers, 44 from blue collar, 14 from diverse samples, three from studies of police officers, and two from studies of military trainees. The correlation between job complexity and measure type was −.06 (n.s.). In the subset of studies reporting the mean ages of the samples (S = 106, K = 155, N = 94,290), the weighted mean age was 35.5 (*SD* = 7.35), and ranged from 17.4 to 64.

For each sample, the job being investigated was recorded and a measure of job complexity was estimated. The measure of job complexity was based on Hunter's (1983a) complexity scale. This scale was derived from the "Data and Things" dimension provided in the Dictionary of Occupational Titles (United States Department of Labor, 1991). As reported in Farrell and McDaniel (2001), who used this scale and whose measurement method I am replicating here, Gandy (1986) questioned the reliability of the "Things" dimension reported in the DOT. Thus, Farrell and McDaniel (2001) used only the Data dimension, a practice I am following here. The Data scale ranges from 0 (connoting high complexity) to 6 (low complexity); I am reverse coding it (and adding 1) here so that 7 represents high complexity and 1 represents low complexity. For those samples with a variety of jobs, I used the mean complexity (i.e., mean substitution), both because of the advantages of mean substitution over list-wise deletion (Roth & Switzer, 1995), and because the mean level from the reported jobs conceptually is a sensible value to represent the average complexity level of a variety of jobs.

Meta-Analytic Approach

Although a number of methods of meta-analysis exist which could be used to test this study's hypotheses (e.g., Bryk & Raudenbush, 1992; Erez, Bloom & Wells, 1996; Hedges & Olkin, 1985; Hunter & Schmidt, 1990), it is important that the assumptions of the metaanalysis are appropriate for the analyses in question (Hunter & Schmidt, 2000; Overton, 1998). Most notably, if a random effects model is appropriate and a fixed effects model is used, sampling error variances are seriously underestimated resulting in far more false positives than expected due to chance (Hunter & Schmidt, 2000; Overton, 1998). The study's hypotheses all suggest that the "true" correlation for a sample depends on the mean level of the temporal variable for the sample, the type of performance measure, and the complexity of the job being investigated. As there is no single "true" correlation being estimated, random effects models appropriately describe the nature of the relationships under investigation. Note, though, that if

a fixed effects model would have been more appropriate, the random effects model would yield a more conservative test of the study's hypotheses (Overton, 1998).

I employ a hierarchical approach to the meta-analysis (e.g., Bryk & Raudenbush, 1992; Erez et al., 1996). The basic model I wish to estimate (for testing H1) is the following:

$$r_i = \rho_i + e_i \qquad e \rightarrow N(0, \sigma^2)$$

$$\rho_i = \beta_0 + \beta_1 x_i + \delta_i \qquad \delta \rightarrow N(0, \tau^2)$$

where r_i is the observed correlation coefficient of study i, ρ_i is the true correlation coefficient of study i, ei, is the within-study error, σ2 is the variance of within-study error, δi is the across-study error, τ^2 is the variance of across-study error, xi is the level of the temporal variable for study i, and β are the parameters describing the relationships. I also test the moderating effects of performance measurement and job complexity and thus the following model:

$$r_i = \rho_i + e_i \qquad e \rightarrow N(0, \sigma^2)$$

$$\rho_i = \beta_0 + \beta_1 x_1 + \beta_1 x_2 + \beta_1 x_3 + \beta_1 x_1 x_2 + \beta_1 x_1 x_3 + \delta_i \qquad \delta \rightarrow N(0, \tau^2)$$

where x_1 is the covariate representing the temporal variable, x_2 is a dummy variable representing the measurement type (1 = supervisory rating, 0 = objective rating), and x_3 is job complexity.

The specific methods of calculation are described in detail elsewhere (cf., Bryk & Raudenbush, 1992; Erez et al., 1996), but essentially entail (a) transforming the observed correlations using Fisher's Z-transformation (Fisher, 1932) and Hotelling's (1953) transformation, and (b) using a maximum likelihood estimation method to approximate β and $\tau 2$.

Before any meta-analyses were conducted, the correlations associated with subjective measures of performance were corrected for unreliability of the performance measure (Hunter & Schmidt, 1990: 119). If a measure of performance reliability was not reported in the original study, the reliability of performance scores from a random effects meta-analysis of the entire set of studies (S [number of studies] = 62; K [number of samples] = 87; N [combined sample size] = 93,103; rho = .88) was used. As the temporal variables were all measured in years, no measure or correction for unreliability was available or appropriate. Note that the estimates are not corrected for range restriction. Such corrections assume that the relationship between the two variables is constant over the true range of estimates (Hunter & Schmidt, 1990; Sackett & Yang, 2000), a direct contradiction to the reviewed literature and the study's hypotheses.

Results

Table 1 presents results of the meta-analyses of the temporal relationships of interest for this study with subgroup analyses of the non-temporal moderators. The results showed that there was a statistically significant moderating effect for the type of ratings when examining the experience/performance relationship; there was also a significant moderating effect for task complexity on the experience/performance and age/performance relationships. Recall, however, that the relationships with performance should be affected by the level of the temporal variable in the sample. Supporting the performance of more detailed meta-analyses, a test of homogeneity was performed on each meta-analysis shown in Table 1 (i.e., Hedges & Olkin, 1985; Hunter & Schmidt, 1990), all of which were rejected at $p < .0001$. Thus, even within the subgroups shown in Table 1, there remains significant heterogeneity suggesting the presence of further moderators.

Table 1
Meta-analytic results of temporal relationships without temporal variables as covariates

Sample	Studies	*K*	*N*	Range of *R*s	Mean *r*	ρ	*T*
Relationship: job experience and performance							
All	58	95	87,189	−.26 to .48	.12	.13	–
Productivity	10	14	3,395	−.23 to .48	.25	.28	
Supervisory ratings	40	68	76,757	−.26 to .48	.12	.15	2.66**
Low complexity	51	69	66,849	−.26 to .48	.10	.09	
High complexity	12	26	20,340	−.18 to .47	.17	.20	3.13***
Relationship: organizational tenure and performance							
All	74	87	59,444	−.34 to .39	.06	.06	–
Productivity	13	13	21,023	−.14 to .39	.13	.12	
Supervisory ratings	53	64	34,891	−.34 to .46	.05	.05	1.33
Low complexity	38	46	31,600	−.27 to .46	.08	.08	
High complexity	37	41	27,844	−.34 to .39	.03	.03	1.35
Relationship: age and performance							
All	115	167	96,866	−.36 to .39	.03	.03	–
Productivity	28	38	23,348	−.30 to .38	.08	.08	
Supervisory rating	78	108	67,936	−.36 to .39	.01	.02	1.63
Low complexity	67	111	79,699	−.36 to .39	.05	.06	
High complexity	52	56	17,167	−.36 to .38	−.02	−.02	2.69**

Notes: Mean *r* is the unweighted, uncorrected correlation; ρ is the estimated true correlation. *T* is the *T*-statistic for the test of differences between the subgroups. Dichotomization of complexity was performed by separating those jobs above the mean level of complexity from those below the mean level of complexity. ** $p < .01$, *** $p < .001$.

Table 2 presents the results of the meta-analyses with covariates. Three sets of analyses were used to test the hypotheses. For the experience/performance and the tenure/performance analyses, the samples' mean job experience and mean organizational tenure were used. To make the age/performance relationship more comparable, 17 (the smallest whole number of the samples' ages) was subtracted from each sample's mean age. This subtraction made the temporal effects easier to compare, as each now essentially started at zero.

The first set simply included only the temporal variable as the covariate and supported the first hypotheses. In this set, for all three relationships, the intercept term as was positive (i.e., the expected correlation between the temporal variables and performance at a hypothetical level of the time variable of 0 was positive), and the effect of time was negative (the correlation between time and performance decreased as the mean level of the temporal variable in the sample increased). Furthermore, for all three relationships, the strength of the temporal effect was strong enough such that, for all three relationships, the predicted relationship between time and performance began positive but then became negative.

To help illustrate this point, I refer to the results from Table 2, set 1. The terms in set 1 for the experience/performance relationship were all significant at $p < .01$. Based on these results (see column 1), the correlation between job experience and performance is .18 when the mean job experience of a sample is one year (r = HypTan[.198–.013] = .183). This correlation decreases by .013 for every additional year of experience until, when the mean job experience of a sample is equal to 15.2 years, the expected correlation is zero (from Table 2, set 1, column 1: [.198/.013] = 15.2). In samples where the mean job experience level is greater than 15.2 years, the expected correlation between job experience and performance is negative.

Similar illustrations can be made for the organizational tenure/performance and age/ performance relationships. Still using the results from set 1 of Table 2, the relationship between organizational tenure and job performance is .13 when the mean organizational tenure of a sample is one year (r = HypTan[.142–.010] = .131), equals zero in a sample whose mean organizational tenure is 14.2 years (from Table 2, set 1, column 2: [.142/.010]), and is negative in samples with greater than 14.2 years of organizational tenure. Similarly, the relationship between age and performance begins positive (when mean age is 17, r = .06), becomes zero when the mean age of the sample is 49 (from Table 2, set 1, column 3: {[.064/.002]+17}), and is negative in samples with mean ages greater than 49. The presence of correlations that begin positive, reach zero, and then become negative is indicative of an inverted U-shaped relationship. The terms for the tenure/performance relationship were significant in set one at $p < .01$; for the age/performance relationship, the terms were significant at $p < .10$.

This first set of analyses maximized the number of studies being analyzed; however, they ignored the hypothesized moderators from Hypothesis 2 and Hypothesis 3. Therefore, a second and third set of analyses were conducted that sacrificed sample size for greater model specificity. The reasons for two sets of analyses is to allow the examination of how much variance the interactive terms add to the overall model (the interaction terms are added in the third set). The second model included

the time covariate, measurement type, and job complexity. The third set adds the additional variables from set two interacted with the time covariate. The results of set three, for all three relationships, are graphed in Figure 1. In the graph, the high complexity group was plotted based on complexity being one standard deviation above the mean (5.5); for the low complexity group, complexity was set to one standard deviation below the mean (2.5).

Table 2
Meta-analysis of temporal variables and performance with covariates

Covariate	Temporal variable		
	(1) Job experience (β)[a]	(2) Organizational tenure (β)[b]	(3) Age (β)[c]
Set 1 (Simple analysis)			
Intercept	.198***	.142***	.064†
Temporal variable	−.013**	−.010**	−.002†
Variance explained (%)	9	15	2
Set 2 (Analysis with additional covariates)			
Intercept	.152***	.095†	.060
Temporal variable	−.014**	−.011*	−.002†
Performance measure	.122*	.112*	.000
Task complexity	.017*	.016	.001
Variance explained (%)	17	22	2
Set 3 (Analysis with additional covariates)			
Intercept	.260***	.269**	.279**
Temporal variable	−.034***	−.026*	−.013*
Performance measure	.135†	.312***	−.057
Task complexity	−.023†	−.034*	−.052*
Performance measure × temporal variable	−.003	−.029**	.003
Task complexity × temporal variable	.008*	.004*	.003*
Variance explained (%)	24	28	8

Notes: S is the number of studies; K is the number of samples; N is the total sample size. The temporal variable is the reported mean job experience level of the sample in column 1, the mean organizational tenure of each sample in column 2, and the mean sample ages in column 3. When age is used as a covariate, 17 was subtracted from each sample's mean age so that the covariate would essentially begin at zero and thus making the coefficient more comparable to the other two sets. To convert predicted values back to correlations, the hyperbolic tangent of the predicted value must be taken. For purposes of comparing the percent of variance explained, statistics are all computed using the group of studies employed in set two. Task complexity is measured from 1 to 7; for ratings, 0 = supervisory ratings, 1 = productivity.

[a] In set 1, $S = 52$; $K = 86$; $N = 84{,}173$. In sets 2 and 3, $S = 44$; $K = 73$; $N = 77{,}136$.

[b] In set 1, $S = 65$; $K = 77$; $N = 56{,}664$. In sets 2 and 3, $S = 59$; $K = 70$; $N = 54{,}584$.

[c] In set 1, $S = 106$; $K = 155$; $N = 94{,}290$. In sets 2 and 3, $S = 96$; $K = 135$; $N = 89{,}778$.

† $p < .10$.

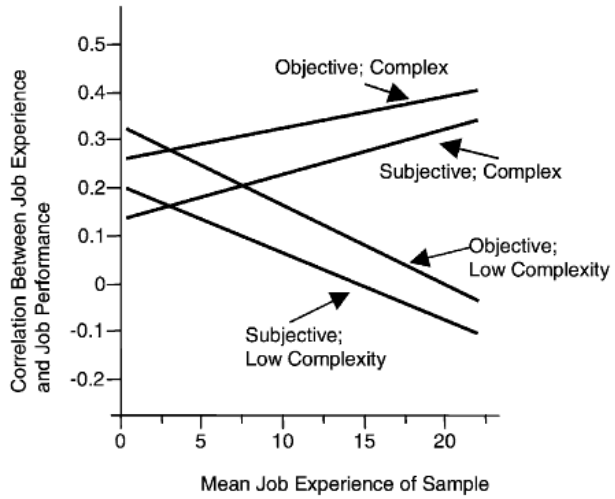
* $p < .05$.

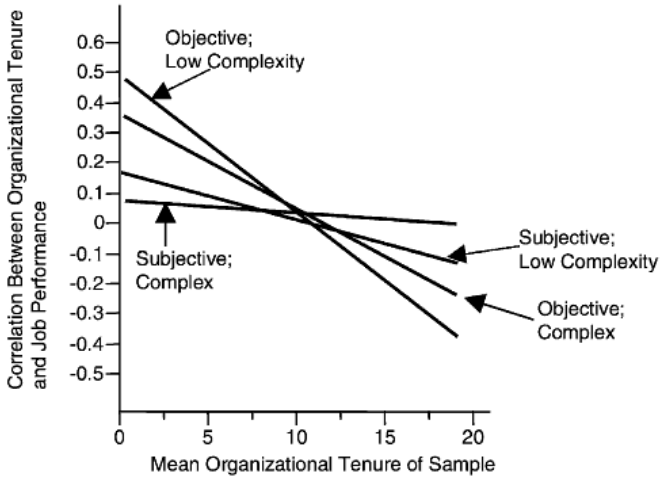
** $p < .01$.

*** $p < .001$.

The first hypothesis is supported with the second set of analyses, and somewhat supported by the third set of analyses. In set two, for all three relationships, the correlation between the temporal variables and performance decreased as the average level of the temporal variable in the sample increased ($p < .10$ for the age/performance relationship; $p < .05$ for the organizational tenure/performance relationship, and $p < .01$ for the job experience/performance relationship). The

term for the temporal variable is also significant and negative (all at $p < .05$) in the third set of analyses; however, the graphical representation of the results suggests that the results are not so easy to interpret. The mean level of the temporal variable is actually positively related to the relationship between time and performance in high complexity jobs for the job experience/performance and age/performance relationships (i.e., the lines have positive slopes). Thus, these results strongly support the idea that the level of the temporal variable moderates the relationship between the temporal variable and job performance; however, the relationship is not always in the form of an inverted U-shape curve.





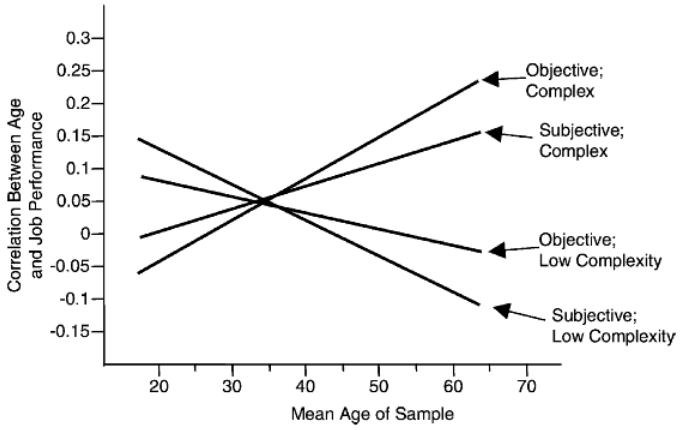


Figure 1.

The second hypothesis is partially supported by the analyses. The analyses in sets two and three show that objective measures are associated with stronger correlations for the experience/ performance and organizational tenure/performance relationships when the level of the temporal variable is low(supporting H2a for these two relationships). However, the relationships are only statistically significantly moderated by the level of the temporal variable (H2b) in the organizational tenure/performance relationship ($p < .01$). No significant effect was shown for objective versus subjective measures in the age/performance relationships.

The third hypothesis is generally supported in all three relationships in set three of the analyses. For each case, more complex jobs are associated with lower correlations between the temporal variables and performance at low

levels of the temporal variable (at $p < .10$ for the job experience/performance relationships; at $p < .05$ for the organizational tenure/performance and age/performance relationships). Furthermore, as predicted, the moderating effect of job complexity on the temporal variable/performance relationships are affected by the level of the temporal variable in the sample (all at $p < .05$).

Plotting the results of set three, though, presents some unexpected findings. As discussed above, the effect of complexity actually yields a positive effect for time in the job experience/ performance and age/performance relationships when job complexity is high. This result essentially falsifies the notion of a universally generalizable inverted U-shaped relationship between time and performance. Although the inverted U-shaped relationship appears to exist in many circumstances, controlling for job complexity reveals a more complex relationship.

Discussion

This study's results provide some support for the study's hypotheses, but even more importantly provide some unexpected findings and important information on the relationships between temporal variables and job performance. This paper shows that there exist trends in the nature of individual performance levels over time, but that this relationship is not generalizable across all job contexts. The presence of an inverted U-shaped relationship between time and performance is present for all three relationships examined in low complexity jobs. When jobs are of high complexity, the relationship is non-linear but not an inverted U-shape. In fact, the results for high complexity jobs are contrary to the earlier interpretation of Murphy's (1989) model. These results show that, over time, experience becomes more predictive of job performance in high complexity jobs.

In short, this paper (1) supports the idea that some of performance dynamism is attributable to changes in job experience, organizational experience, and age; (2) shows that these relationships are moderated by sample and job characteristics; and (3) falsifies the notion of a universal inverted U-shaped relationship between time and performance. These results indicate that performance prediction and research on dynamic performance should not over-generalize the results obtained from any single sample. The non-linear relationships also suggest that consideration of performance over time needs to delve into the consequences of the passage of time. Simply including one temporal variable as a linear "control" in models of job performance is overly simplistic. Efforts should be made to consider non-linear effects and the simultaneous effects associated with the three variables: job experience, organizational tenure, and age.

The practical implications of these results are also noteworthy. These results suggest that job experience can be a useful selection device in low complexity jobs, when considering candidates with low experience levels, and where productivity ratings reflect the importance of individual job performance. In such circumstances (such as when the average experience level of applicants is one year and task complexity = 2.5), job experience can serve as a highly effective selection device (r = .31, computed given the above assumptions and the results reported in Table 2). Using job experience for a high complexity job (task complexity = 5.5), with a sample with a mean of one year of job experience and where performance is evaluated using supervisory ratings, would produce an expected validity of .14.Onthe other hand, for a highly complex job with a mean experience level of 15 years, and where performance is captured through objective measures, experience is correlated .36 with job performance. For a sample with 15 years experience, but for a low complexity job where performance is captured through subjective ratings, the correlation between experience and performance would be −.01.

These results also support the use of seniority as a valid internal selection device at lower levels of organizational tenure in low complexity jobs. This is particularly noteworthy given that bona fide seniority systems provide valid exceptions to key employment legislation, such as the civil rights acts of 1964 and 1991, the Age Discrimination in Employment Act, and the Equal Pay Act (Heneman, Heneman & Judge, 1997; Kahn, Brown, Zepke & Lanzarone, 1994).

It should again be noted, though, that job experience, organizational tenure, and age are not causal factors in and of themselves. Ideally, when investigating individual performance, researchers would collect the specific constructs of interest, such as physical and mental ability, job knowledge, motivation, etc. Unfortunately, this is not always feasible. The ease of collecting temporal variables, compared to the variety of constructs that they may approximate, indicates that such proxies will continue to be used in the future. The fact that this study shows significant relationships between temporal variables and performance demonstrates the importance of collecting such information when predicting performance. Furthermore, the need to include such proxies is only increasing as modern organizations are facing more diverse sets of employees.

Conclusions, Limitations, and Future Research

The present study's results should help inform dynamic performance research on the theoretical need and practical value of including temporal variables as predictors of individual change patterns. This study shows that there does not exist an inverted U-shaped relationship between time and performance

for all temporal variances and all job contexts; however, the findings show that all three relationships are moderated by the average level of the temporal variable in the samples, revealing notable and varied non-linear relationships between temporal variables and performance. These results suggest that the validity of temporal variables in performance prediction depends on the characteristics of the subjects, job, and performance measurement system.

Unfortunately, there were insufficient studies reporting all the necessary means and relationships to perform meta-analyses with all the desired covariates simultaneously, thus making it impossible to determine the specific effects of each temporal variable because the effects of the other temporal variables could not be partialled out. It would be valuable for future research to investigate the effects of all three temporal variables simultaneously.

It would also be valuable to explore the relationship of temporal variables with performance, but considering performance from a multidimensional focus. This study purposely chose to focus on the moderating effects of measurement. As such, this study is limited in how much it contributes to the theoretical understanding of temporal variables with the construct of job performance. A valuable line of research would be to pursue how temporal variables are related to task performance, citizenship performance, and counterproductive performance. Such a study would complement the present study and provide a fuller picture of temporal variables' relationships with job performance.

Another limitation of this study is that it only examined a single characteristic of any given job: job complexity. This limitation, though, also presents a number of opportunities for future research. Clearly, many other job characteristics could also be examined. For example, some jobs may have a physical component to them that may moderate the relationship between age and performance. One could also consider a number of other jobs characteristics, such as skill variety, task identity, task significance, autonomy, and feedback (e.g., Hackman & Oldham, 1975). Understanding the effects of task complexity is an important first step when considering moderating effects on the temporal variable/performance relationships, yet there is much room for future research to further delve into this domain.

Yet even with these limitations noted, this study still makes a contribution to the understanding of job performance. It details how very commonly used variables (experience, organizational tenure, and age) have complex and moderated relationships with measures of overall job performance. Although the findings are based on cross-sectional original studies, they suggest that these temporal variables will affect the way performance changes over time. Theoretical models of performance are needed that explicitly detail how performance changes over time. It would also be valuable for future

theoretical and empirical research to consider the constructs approximated by temporal variables to help understand the forces causing individual performance changes over time. Future empirical work should examine whether the effects of temporal variables on performance are a function of individual changes over time, or the result of others' perceptions of the effects of time. This study does not lend insight to whether temporal variables approximate actual changes in individual characteristics and/or if others fulfill their own expectations of temporal effects. Although temporal variables are easily measured and have significant practical value for research and practice, the prediction of job performance would benefit from a more detailed understanding of the causes of performance and how those characteristics and their effects change over time.

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