This is to certify that the

dissertation entitled

AN INVESTIGATION OF THE DETERMINANTS AND CONSEQUENCES OF INDIVIDUAL DIFFERENCES IN MEASURES OF SPEED

presented by

Matthew Ross Smith

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Psychology

Neal Schmitt
Major professor

Date 12/1/99

PLACE IN RETURN BOX to remove this checkout from your record.
TO AVOID FINES return on or before date due.
MAY BE RECALLED with earlier due date if requested.

DATE DUE	DATE DUE	DATE DUE

AN INVESTIGATION OF THE DETERMINANTS AND CONSEQUENCES OF INDIVIDUAL DIFFERENCES IN MEASURES OF SPEED

By

Matthew Ross Smith

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Psychology

1999

ABSTRACT

AN INVESTIGATION OF THE DETERMINANTS AND CONSEQUENCES OF INDIVIDUAL DIFFERENCES IN MEASURES OF SPEED

By

Matthew Ross Smith

The speed with which individuals react to stimuli might have a large influence on a company's competitiveness and an individual's success. While current research suggests a number of variables that can predict individual differences in speed, empirical verification has not been fully conducted. The current study addressed two major research objectives. First, the question as to what might influence scores on speeded tests was investigated by examining both noncognitive and cognitive factors in relationship to measures of speed. Second, if speed is considered an important individual difference, the question as to how it relates to measures of job performance was investigated. Particular emphasis was placed on instances where speed of response is an important dimension of job performance and the effects of cognitive ability have been controlled.

The current study used a multiple hurdle, personnel selection context to examine both research questions. In the study, participants were job applicants who applied for entry-level positions. As part of the process, participants went through two selection stages (testing and assessment). In testing, participants completed measures of perceptual speed, psychomotor speed, cognitive ability, and various noncognitive factors. In assessment, participants completed a group exercise where they were assessed on measures of job performance including total number of products produced, proportion of

defects built into products, and ratings on three dimensions (work orientation, problem-solving, and team skills). Such measures were used to examine the second objective of the research, namely, the incremental validity of speed.

For the first research objective, 853 participants completed both the measures of speed and the assessment of cognitive ability and noncognitive factors proposed to be related to measures speed. Mixed support was found for the hypothesized relationships between measures of speed and factors with the strongest relationships between speed and measures of conscientiousness, polychronic orientation, comparative anxiety, and cognitive ability. For the second research objective, 531 participants completed the group exercise measuring various aspects of job performance. Results found that measures of speed consistently added incremental validity to the prediction of job performance over cognitive ability, particularly with job performance measures emphasizing effort-based concepts (e.g., number of products produced, quality of products, and work orientation rating).

ACKNOWLEDGEMENTS

So many people have given me the support and assistance needed to make this dissertation a reality. I hope I do them justice in the following short paragraphs.

I would like to thank the faculty members at Michigan State for guiding my development throughout my time at Michigan State and in the years since I have left: Kevin Ford, Steve Kozlowski, Rick DeShon, Dan Ilgen, and Neal Schmitt. In particular, I would like to extend a special acknowledgement to Neal who served as my dissertation chair. Not only did Neal serve as a model of excellence throughout my time at Michigan State, but he also had the confidence in my ability to finish the dissertation in the years since I left Michigan State to work at Aon Consulting and readily made the available time to make sure I was fully prepared to finish it. Hopefully, I can emulate those personal and professional qualities in the years to come. In addition, I would also like to thank my fellow graduate students at Michigan State for their camaraderie both academically and personally and for making graduate school a little easier to bear. Without making this an awards speech, I'd like to thank Jose, Ron, Jen, Dennis, Whit, Stan, El, and Rob for providing insights, commentary, and support in my early years at Michigan State and Bill, David, Catherine, Dan, Ken, and Ann for similar assistance in my later years.

Since I joined Aon Consulting full time in March 1997, there are many people who have supported my efforts to finish this dissertation. First, I'd like to thank Tom Gawel and Dan Galant for providing me the perfect research setting and data and Becky Gaffey for ensuring that the data was collected despite numerous administrative barriers.

Without their assistance, I might still be looking for a sample to collect the data, a daunting task for someone trying to finish their dissertation and work full-time. I'd also like to thank Renee Kennedy for her help in bringing the manuscript together and not burying me in detail. Most of all, I'd like to thank both Fred Smith and Kirk Rogg who have not only served as outstanding professional mentors, but have kept me on track to complete this work even in light of competing work demands. Without their support, it would have been very easy to stay ABD.

On a more personal note, I also want to thank God for giving me the necessary KSAs needed to make this dissertation possible. I want to thank my family, especially my parents, for teaching me the value of striving to do my best, and providing me with the support I needed, not only through graduate school, but throughout my life. I'd like to indirectly thank my brother Todd who was completing his Ph.D. in Physics at the same time as me for providing some necessary competitive motivation. Finally, I'd like to thank my wife and family for not only providing me with love and support every step of the way, but for constantly reminding me what was really important in life. This dissertation was a four-year affair that saw our lives change dramatically with the addition of three children, Samantha, Jack, and Mark, as well as increased work and family responsibilities. In particular, my wife made great sacrifices over those years to provide me the time I needed to complete this dissertation. I believe I said the same thing on my thesis, but this accomplishment is as much hers as it is mine.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The speed in which individuals complete tasks has been of interest to researchers since the beginnings of psychology. Often, speed was equated with measures of intelligence for such historic researchers as Galton and Spearman who equated constructs such as general sensory discrimination with general intelligence (Vernon, 1987). Other researchers such as Thorndike and colleagues (1926) distinguished the difference between level of performance and speed of performance as logically distinct components of intellectual measurement. However, speed has more recently been viewed more as a potential byproduct and hindrance in the measurement of other abilities, typically cognitive abilities (Hartigan & Wigdor, 1989; Peterson, 1993; Rindler, 1979). While speed/time issues have been considered by some researchers (i.e., McGrath & Rothchrod, 1983), an investigation of its determinants and impacts has not been adequately described. There are three reasons why speed would be an important topic for researchers today: (1) the importance of speed in today's jobs, (2) the unexplored relationships between speed and noncognitive factors, and (3) the unexamined validity relationship between speed and measures of job performance.

First, speed of response has emerged as a critical feature in an organization's competitive strategy whereby a customer is offered a competitive value in terms of reduced time for products and services (Carnevale, 1991; Muchinsky, 1997; Schuler & Jackson, 1987). The U.S. economy is currently converting from what has been traditionally a mass production economy to one of a service nature (Heneman &

Heneman, 1994). With such changes, new competitive standards that characterize the service economy include expectations of high productivity levels, elevated awareness of customer service, and an increased pressure on providing goods and services in a timely manner (Carnevale, 1991). An important skill applicable to jobs with a service focus includes the ability to allocate time and resources to complete tasks in which speed can play a vital role (SCANS, 1992). In addition to economic changes, the downsizing of employee workforces and the increased workload of the survivors of such interventions can also increase the role of speed in the performance of organizational duties, particularly those duties that are more repetitive and routine. When employees need to acquire the tasks of displaced workers, time allocation and the speed in which tasks are completed can be important not only to organizational performance but to survival in the organization as well. The role speed can play in the effective performance of a job can also vary as a function of the level of speed inherent in the performance criterion of the occupation. Speed can play a role in such specific tasks as searching radar to locate ships, identifying errors in documents and products, preparing food in a restaurant at rush hour, and scanning stock market prices to make decisions. The speed in which an individual performs such tasks can be the critical point in determining whether or not someone is successful on the job. Other organizational implications of speed include the decrease of stress through the overload reduction and adaptation to organizational cultures that expect people to adhere to certain time and scheduling demands and pressures.

The questions concerning what factors are related to speed of response falls along the familiar lines of performance being determined by ability and motivation. Abilities related to speed often fall under the category of cognitive abilities (i.e., Carroll, 1993). While a relationship between reaction time and intelligence has been demonstrated (i.e., Jensen, 1993), the equivalence of the two constructs is less than complete. Many researchers agree that such a relationship between the two constructs exists, however, they also agree that noncognitive factors such as motivation, persistence, carefulness, anxiety, personality, temperament, interest, etc., play a role in the measurement of speed and should be taken into account when modeling test/task performance (Carlson & Widaman, 1987; Carroll, 1993; Jensen, 1980). In addition, factor analyses of speeded tests often demonstrate an unique speed factor in addition to that represented by cognitive ability (Carroll, 1993; Hunter, 1986). However, what the relationship is between noncognitive factors and measures of speed has never been fully examined or empirically demonstrated beyond the mere conversation level. When the difficulty of the tasks are low, the influence of cognitive abilities may be reduced whereas relationships with noncognitive factors may be increased. Empirical verification of the existence of relationships between noncognitive factors and speed could be an essential missing step.

While some research in personnel selection contexts has demonstrated that speeded tests of cognitive ability add little to the prediction of job performance (i.e., Hunter, 1986), such research has failed to explore the nature of the criterion in terms of speeded performance (Kendall, 1964) or has used cognitive ability tests that were speeded, thus inflating part-whole correlations between power tests of cognitive ability and measures of speed (Carroll, 1993). While not denying the importance of cognitive ability in the prediction of a variety of constructs (Brand, 1987), a further examination of criterion issues in job performance could add to the understanding of the influence of speeded tests. With a rising increase in the significance of speed in today's workforce, this could lead to an expansion of the criterion space of job performance to include speeded components as an important factor. With such a rise in time pressure and service, the relationship of speed to measures of job performance could increase over and above the relationship of cognitive ability with job performance.

Overall, the objective of this research is twofold. First, the question as to the relationship between various individual difference measures and speed will be investigated by examining a variety of noncognitive and cognitive factors. Second, if we consider speed to be an important individual difference, how does it relate to measures of job performance, particularly in instances where speed of response is an important dimension of overall performance and the effects of cognitive ability have been controlled.

The subsequent literature review takes the following approach to outline the major issues involved in the accomplishment of these objectives. The first step is to investigate the measurement of speed and the potential measurement concerns involved with speeded tests that must be considered when thinking about the conceptual issues. Topics involved in the consideration of speeded test performance include the conceptual and empirical difference between speed and level constructs in testing, the examination of measures of speed as an unidimensional versus multidimensional construct, the interplay between the way speed is measured and the conceptual issues affected, and speed versus accuracy concerns when time pressures are central in the testing scenario. Once the elaboration of the conceptual domain of speed is completed, the next step examines the predictor space in terms of what would predict performance on measures of speed. Using information based on what we know about performance on speeded tests and on the nature of both cognitive and noncognitive constructs, literature will be reviewed on variables that could be related to performance on these measures.

Once that has been achieved, the focus then switches to the second objective of the research, namely the incremental validity of measures of speed in the prediction of job performance. The nature and multidimensionality of job performance, using job performance research as a basis, is examined with particular emphasis being placed on performance dimensions that should be related to individual differences in measures of speed. The type of performance setting that will be used in this research, the assessment center, will also be highlighted to examine various construct dimensions and operational issues. Based on the literature outlined in the previous sections, the final section of the introduction outlines the hypotheses of the current research study beginning with those associated with the first objective, relationships to measures of speed, and ending with the second objective, incremental validity issues.

Measuring Speed

In most practical applications of testing, particularly the testing of cognitive-related abilities, time limits are placed in the testing scenario. Time limits are placed in tests to ensure that testing is administered in a reasonable, efficient amount of time or to assess speed of performance if rate-of-work is deemed an important factor to be assessed. In early group testing research, evidence was gathered to support the assumption that speed (time limits) and power (no time limits) tests served as interchangeable measures of the same construct, such that the speed with which people solve problems is indicative of the level of difficulty of the problems they can solve (Morrision, 1960; Rindler, 1979). These conclusions regarded speed as an inconsequential influence on the assessment of cognitive abilities and disregarded the effects of speed on test scores. However, such statements have been subsequently challenged to view speed and power as separate components of test scores.

Speed Versus Level Distinction in Testing

Speed can be broadly defined as the time or rate at which tasks of a specific kind and difficulty are performed. This is conceptually different from notions of level which deal with the point of difficulty at which an individual can perform with a certain amount of accuracy (Carroll, 1993). In traditional testing, level is matched to the construct of interest that the test proposes to measure (e.g., intelligence). The correctness of the response is taken as an indication of an individual's level of ability with respect to the task or range of tasks that define an ability. Anastasi (1988) describes a pure speed test as one in which individual differences in test performance rely entirely on the speed of performance. The test is made up of items that have low difficulty and has a time limit that is short enough so no one is able to finish the test. In such a test, the construct of interest is speed itself. A pure power test has no time limit or a time limit that is long enough to allow everyone to complete all the items, but the item difficulty is steeply graded and includes some items which are too difficult for anyone to solve. It most testing situations, it is a rare case when we either have a pure speed or a pure power test due to practical issues such as making sure testing is administered in a reasonable, efficient amount of time. In most cases, test scores contain both speed and level variance. While conceptually different, the next question concerning speed versus level concepts focuses on whether there are any empirical differences between the two.

Empirical Evidence for Speed/Level Difference

Not only are speed and level different conceptually, but empirical studies have found that most tests have speed and level components that are often uncorrelated (Carroll, 1993). Typical testing scenarios introduce speed variance along with the variance of the construct the test is designed to measure into total test variance, such that speed of work influences test scores as much as accuracy/level. Early group testing research that disregarded the effects of speed on test scores was originally re-examined by Davidson and Carroll (1945). They highlighted the interchangeable misconception of speeded and power tests by indicating that the correlation between time-limit scores and power scores are part-whole correlations in that the time-limit scores measure the same construct as the power score and thus contain substantial amounts of common variance. This would artificially raise the level of the correlation (Carroll, 1993). Such problems call for the use of separate tests to measure both speed and level components. As mentioned above, speed tests in their purest sense contain items with low difficulty and are measured by the number of items completed in the time interval or the time it takes to complete the whole task. Level or power tests in their purest sense have no time-limits; person's scores on the test are the number of items that are correct (Anastasi, 1988). While practically difficult to have pure measures, separate tests should be used.

Correlational demonstrations of the distinctive contribution of speed and level to time-limit scores was first found in work by Baxter (1941), Davidson and Carroll (1945), and later by others (see Rindler, 1979 for review) in which the relationship between speed (rate of response) and level (response accuracy) scores was found to be negligible. The empirical differences between speed and level factors on test-taking has also been examined by factor-analytic methods. Probably the first investigator to find a general speed factor in a series of "mental ability" tests was DuBois (1932) who found a general factor in a series of speeded tests that had low correlations with number-correct on arithmetic reasoning and vocabulary tests. In an early study examining the relationship between speed and level effects, Tate (1948) had high school students individually tested with selected items, ranging widely in difficulty on four tests: arithmetic reasoning, number series completion, sentence completion, and spatial relations. Performance on each item was timed in seconds and converted to logarithmic units along with level scores. For each of the four tests, correlations between speed and level scores were negligible while correlations among the level scores and among the speed scores were more substantial. Myers (1952) in a study of the factorial composition of different speed portions of a nonverbal reasoning test found two orthogonal factors interpreted as the ability to answer problems correctly and the tendency to answer the problems quickly. In a reanalysis of Lord's (1956) study of speed factors in a series of tests, Carroll (1993) found a seven-factor principal factor solution which extracted two orthogonal second-order factors that could be defined as speed (first-order factors of numerical, perceptual, and verbal speed) and level (first-order factors of visualization, quantitative and arithmetic reasoning, and lexical knowledge) factors. In a reanalysis of Mangan's (1959) study on speed and power variables, Carroll (1993) also extracted two orthogonal second-order factors that could be defined as broad speediness at performing easy tasks and level in performing difficult tasks. Based on Thissen's (1980) work on estimating a latent trait model for speed and level parameters on items from three tests (the Progressive Matrices, a verbal analogies test, and a spatial ability test), Carroll (1980) displayed loadings in a varimax-rotated principal factor-analysis matrix on two uncorrelated factors (speed and level) that accounted for 77% of the variance between a six parameter correlation matrix (an ability and speed parameter for each test). Horn (1978; 1981) found that speed of thinking (both in terms of speed in producing correct and incorrect answers) and power of thinking were not highly correlated on intellectual problems of nontrivial difficulty. Even though some people were quicker than others in solving problems, this quickness of thinking was independent of the qualities of thinking represented by fluid and crystallized intelligence. However, the quickness of thinking factor on problems of nontrivial difficulty was separate from a scanning speediness factor. Kyllonen (1985) analyzed a series of more or less traditional psychometric tests that were administered to Air Force personnel by computer so that both speed (latency) and accuracy (percent correct) scores could be obtained. They reported that at the second-order, a general speed and general level factor were obtained that were virtually uncorrelated ($r = -.05$).

While the above results concerning "rate-of-test taking" measures of speed point to the distinction between speed and level constructs, the relationship between speed and level constructs is more complex, such that certain cognitive dimensions of abilities appear to show differential associations between speed and power. In other research involving scores of more elemental measures of general processing speed, relationships have been noted between speed and level. A variety of studies have found relationships between reaction time in simple tasks with little intellectual content and nonspeeded complex tests of reasoning ability (see Vernon, 1987 for a review). In general, individuals with higher scores on intelligence tests tend to apprehend, scan, retrieve, and respond to stimuli more quickly than individuals who score lower on intelligence tests. The theory behind the relationship highlights the neurological basis of intelligence based on how fast information is transmitted, processed, and held in working memory (Jensen, 1993). Common paradigms used include (a) same/different judgments on visual displays (Hunt, 1978), (b) choice reaction time where individuals hit the button of a target whose light is activated (Jensen, 1987), (c) inspection time where individuals view two lines and must judge which of the two is shorter (Deary & Stough, 1996; Nettelbeck, 1987), and (d) neurological measures such as visual evoked potentials measuring nerve conduction velocity or the speed with which electrical impulses are transmitted by the nervous system (Reed & Jensen, 1992). These speed measures appear to have small, but significant correlations with level abilities, such that the size of the correlations appear to be related to the complexity of information processing associated with the speeded task. For instance, complex reaction time measures will have higher correlations with intelligence than simple reaction time measures. However, such research does indicate that even with simple reaction time tasks, cognitive ability, a level construct, does have a significant relationship with measures of general processing speed

In summary, results of studies of the relationship between speed and level are more complex than the original proposition that speed and power scores were interchangeable. First, speed and level are logically and empirically distinct aspects of task performance with speed dealing with the rate at which tasks are performed and level relating to the level of task difficulty at which someone can perform. Equating test scores on speeded versus power versions of the test can be inappropriate based on the test-maker's purpose and the time-limit enforced. Second, while speed and level are distinct components, there does appear to be a small relationship between measures of speed and cognitive measures of level, particularly when the measure of speed increases in cognitive complexity. Given that speed is a distinct, yet related component of tasks outside of level constructs, the next question is whether the speed component is a general, unidimensional construct across tasks or a more multidimensional construct.

Dimensions of Speed

While speed can be seen as logically distinct from measures of level, the dimensions of speed assessed, whether multiple or unidimensional, need to be clarified. A large amount of research examining speed constructs in the domain of testing, particularly cognitive ability testing, has employed factor analytic methods to investigate the factor structure and content of speed variance in test scores. Some studies argue that different measures of speed could be well represented by a general factor, in a sense, a speed "g," accounting for a majority of the variance in measures of speed (Kyllonen, 1985; Levine, Preddy, & Thorndike, 1987; Lord, 1956; Miller & Vernon, 1992). Other studies have argued that speed is more multidimensional having factors such as decision time and movement time (Kranzler, 1990), cognitive speed and motor speed (Verster, 1983), reaction time, intellectual speed, speed of perception, and motor speed (Rimoldi, 1951), and attentive speediness and quickness in deciding on answers (Horn, 1985; 1988). However, such methods employed in both historical and more current studies have methodological shortcomings insofar as the establishment of a clear understanding of the dimensions of speed scores is concerned. The largest concern is the sample size to number of tests ratio, particularly for many of the early studies. In most studies, the typical procedure is to administer a large group of tests (cognitive ability and speed measures) to a sample of 75-100 university students. Such procedures fail to ensure that the groupings of factor structures are not simply effects of sampling error (Gorsuch, 1988; Nunnally & Bernstein, 1994). In addition, many of the measures of speed have been vastly different from reaction time to number of items finished in a time period. Therefore, a review of speed studies might give the clearest picture of the dimensionality of speed.

The most recent and comprehensive review of measures of speed was conducted in an examination of various measures of cognitive abilities by Carroll (1993). Carroll found that most of the variance in test scores could be partitioned into (a) level factors where probability for success decreases with task difficulties and (b) speed factors where probability of success increases when time permitted to perform the task increases. Such a classification is based on a conceptual analysis of the range of tasks that measure the factor to determine if variation is due to difficulty or to rate of performance.

In his review, Carroll (1993) examined the speed and level factors in various level domains of cognitive abilities and found a variety of speed factors (see Table 1). To examine whether these first-order factors represented different dimensions of speed or whether they represented a more general factor of "broad speediness," Carroll expanded upon this work by examining studies of second-order factors that could represent speed variance. In all, Carroll (1993) found 57 token higher-order speed factors from 52 data sets that were classified as broad speediness. In making further classifications of the factors listed, Carroll examined the similarity of the first-order factors that loaded on the second-order factor and postulated three higher-order factors of speed. The first category that represented most of the factors was an attentive speediness factor containing such first-order factors as perceptual speed, numerical facility, and speed of test-taking. This factor represents a quickness in identifying elements and distinguishing between elements, particularly when there is a pressure to maintain attention (Horn, 1988).

The second speed category tended to represent various kinds of reaction time tasks such as the Hick paradigm. Reaction times in these tasks are typically measured on very simple perceptual and cognitive tasks where individuals react to a stimulus by pressing the button that corresponds to the one in which a light is activated. This factor might be separate from the first category for two reasons. First, this factor could represent a more general or fundamental form of processing speed where cognition plays little to no role or involves a simple decision that is more neuropsychological in nature.

Table 1
Types of 1st-Order Speed Factors in Cognitive Ability Domains (Carroll, 1993)

DOMAIN	SPEED FACTORS
Language	*Reading Speed* *Rate of Work in Performing Verbal Tasks*
Reasoning	*Speed of Reasoning Factor* (similar to language's rate of work)
Learning and Memory	*Difficult to Separate Speed from Level*
Visual Perception	*Spatial Relations* (rate of performing rotation tasks) *Closure Speed* (rate at apprehending what is represented by a distorted visual presentation) *Closure Flexibility* (rate at finding a form embedded in another) *Perceptual Speed* (rate of search & comparison of visual forms)
Auditory Reception	*none*
Idea and Language Production	*Ideational Fluency* (rate at producing responses that fit criteria) *Naming Facility* (speed at naming pictures and objects) *Associational Fluency* (rate of producing responses that are drawn from restricted classes associated with given stimuli) *Expressional Fluency* (rate of producing meaningful discourse) *Word Fluency* (rate of producing different verbal responses) *Sensitivity to Problems* (rate of producing different ideas that are pertinent to real or imagined problems) *Figural Fluency* (rate of producing different figural designs) *Figural Flexibility* (rate of producing different hypotheses about figural and spatial problems)

Second, the similarity of the tasks (i.e., reaction time) loading on these factors could indicate that the method of measurement might be leading to higher relationships among these tests.

A final category of second-order speed factors could be interpreted as general psychomotor speed that is primarily concerned with finger, hand, and arm movements and is relatively independent of cognition (Carroll, 1993). Examples of tasks in this domain include arm movement time (Carlson, Jensen, & Widaman, 1983; Kranzler, 1990), and psychomotor tasks such as packing blocks, tapping, and card sorting (Clausen, 1966; Verster, 1983).

Research emphasis in this study will only be applied to the first and third dimensions of speed: (1) attentive/perceptual and (2) psychomotor speed, respectively. Focus on reaction time, while an important concept to the study of speed, will not be examined for several reasons. First, the dimension, as mentioned above, could be a by-product of the type of tasks that are employed in these measurement designs. Many of these reaction time tasks that load on this factor require a quick response to detect whether two lines are the same length, to detect which light is lit, etc.. Measurement is based on how fast individuals can detect differences or identify stimuli. While representing a more biological measure of speed or the efficiency of information movement, such tasks might not transfer as readily to the type of job performance that one would encounter in a work environment where a successful response to a task requires more time to conduct a series of movements/decisions than a simple reaction to a stimulus. Second, an unique aspect of measures of speed is that there are more opportunities to investigate relationships with more noncognitive factors such as the importance of maintained effort or persistence in task completion. Individuals need to perform the task at a certain rate in an extended time period to achieve a meaningful outcome. Reaction time tasks instead rely on short bursts of speed in response to stimuli, rather than engaging in speed over a time period. In speeded tests, noncognitive factors can be explored in relationship to measures of speed, and how an individual can maintain such speed over time. Such speeded tasks that require maintenance of a certain rate might have more relevance to work environments than a quick response to an initial stimulus. Third, issues of face validity and test-taker reactions in hiring situations have become an important factor to consider in the candidate review process (Rynes, 1993). Having job candidates complete reaction-time tasks where they react to lights or make judgments on the similarity of lines could open the organization to queries concerning the job-relevance of the test as well as fairness and legality. While not denying the reaction-time paradigm as a valid measure of speed, for this research, speed will only be assessed by examining only attentive and psychomotor speed tasks.

In summary, examining speeded performance on tasks seems to be represented by three dimensions of speed: attentive/perceptual speed, reaction time, and psychomotor speed. While all three are potentially meaningful, attentive and psychomotor speed dimensions seem to have the most relevance to work in which the maintenance of a speeded response over time is an important aspect of work performance. These two dimensions will be examined in the current research study. Before proceeding to the constructs with relationships to speeded performance, some time will be spent to examine various measurement concerns that can have a direct impact on the conceptual investigation of speeded test performance.

Measurement of Speed

As mentioned in the previous sections, a speed test in its purest sense is one where individuals of varying levels of ability are given low difficulty items to solve in a certain time period that is short enough so no one finishes the test. In an alternative way, speed can also be assessed by the amount of time it takes for an individual to complete a test comprised of items at low levels of difficulty. Other more non-traditional measures of speed are highlighted in research investigating the speed of information processing and general cognitive ability. These measures of speed include simple reaction time or other neurological measures such as nerve conduction velocity. While useful to investigating the relationship between general cognitive ability and speed, these measures will not be used in the investigation of speed in the current research study for various reasons highlighted in the previous section examining the dimensions of speeded performance.

In terms of traditional paper-and-pencil tests, some issues need to be considered prior to making an assessment of speed. Items on such tests can fall into four categories: (a) items marked correct, (b) items with incorrect answers, (c) items considered and left unmarked, and (d) unmarked items which the examinee had insufficient time to consider. Items that are marked wrong and items omitted after full consideration may be combined into one category because test-takers considered the item but were unable to derive a correct answer (Rindler, 1979). To assess speed, a separate test of speed rather than a time-limit test of another construct of interest is more useful. A single test administration of a different construct of interest is likely to yield an under-estimate of the speed factor containing systematic error deriving from three sources: (1) failure to properly account for items skipped over that individuals do not have sufficient time to consider, (2) failure to account for the number of difficult items subjects do not read, but rather fill in at random as time approaches its limit, and (3) failure to account for effects of cognizance of time limits on overall rates of response and consequent accuracy (Rindler, 1979).

Most traditional methods of assessing test speededness are insufficient for the present discussion because these methods view speed as a hindrance to measuring the trait of interest rather than an interesting phenomenon in and of itself. Methods such as *tau* (Cronbach & Warrington, 1951) and determinant analysis (Lord, 1971) compare the performance of the same subjects in timed and untimed administrations of parallel tests to estimate the extent to which the true standard scores or factor structures in the group would be changed if time limits were extended (Morrison, 1960). However, some of the methods used to assess speed as a byproduct can still be applicable to measuring speed. As mentioned above, giving individuals a test with a larger number of low difficulty items than can be finished in a certain time period would be an appropriate measurement of speed with the number of items completed representing speed.

An issue that arises with the measurement of speed occurs when all the items are not easily answered by examinees. Such difficulty could arise due to item content as well as time pressure instituted by the test examiner. In cases where error is caused by carelessness or time pressure rather than actual ability to successfully answer the item correctly, traditional measures of item difficulty such as p-values may be misleading as to the difficulty of an item by incorrectly indicating that an incorrect item is due to a lack of ability. If given a power version of the test, an individual might be able to easily solve all items and item difficulty would be minimal. When test items produce errors for individuals, speed versus accuracy issues need to be addressed. In this case, error becomes an issue due to the rise in the assessed difficulty (i.e., p-values) of the items in the test such that individuals trade accuracy for speed, thus generating more errors.

The question arises as to how to handle incorrect versus correct responses in speeded tests. When the rate of error is virtually non-existent, the issue of correct versus incorrect responses is not pertinent. However, when errors occur such as when there is an increase in time pressure or cognitive difficulty, the question of how to measure speed in light of incorrect responses becomes applicable. One group of researchers claim that the speed is more or less constant across incorrect and correct responses. Tate (1948) found a high correlation of speed for correct and incorrect items in a free-response Arithmetic test. Horn (1978, 1981) also found that speediness in obtaining correct answers is correlated positively with speediness in obtaining incorrect answers. In a major review of the domain of cognitive speed, Carroll (1993) found that speed factors can be obtained in tests measuring level constructs and that the linear independence of speed and level factors in such tests has been established.

The other side of the debate, led by David Lohman, has argued for the assessment of both speed of response and accuracy of response in relationship to speed-accuracy tradeoffs. In such tradeoffs, a participant, while under time pressure, would sacrifice the chance of getting the item correct (i.e., "trade-off") to answer more items in the time period. Such latency measures for incorrect responses might have complex determinants beyond ability (Audley, 1973; Lohman, 1979). For instance, if an individual was given unlimited time to finish a test, he/she would most likely be able to answer every item correctly. However, since there is a time constraint, the individual might take less time answering and double-checking items, thereby leading to more errors that are unrelated to the ability to answer the item correctly. Such an increase in errors can be small while the response time can be reduced substantially (Lohman, 1994). Other factors such as fatigue (within individuals), response style, and carelessness (between subjects) can affect such trade-offs (Lohman, 1994). In examining speed versus accuracy trade-offs (SATO), it has been found that normal SATO curves are generally monotonically decreasing and negatively accelerating (Lohman, 1986; Wickelgren , 1977). Lohman (1994) argues that this nonlinear relationship makes the investigation of speed in test performance without assessing accuracy inappropriate.

In summary, unless test performance is error-free, the assessment of speed should take differences in accuracy or inaccuracy into account. In measures of speed where errors occur, the above issues raised in speed-accuracy trade-offs should be addressed. For the current research, speed-accuracy issues will be addressed in several ways. The tests used to assess speeded performance will be error-free as much as possible to avoid any issues with applicants making trade-offs to complete more items. Also, research investigating speed-accuracy trade-offs is typically conducted in studies exploring individuals in test-taking situations and how they respond to time pressures while completing items on a test battery. While vitally important to the assessment of test reliability and validity, it is more micro-oriented than the current study investigating more stable general differences in speed among individuals. As such, the current research will attempt to control only those factors that most inhibit an accurate assessment of speed differences among individuals. First, while the author recognizes that within subject variance such as confidence and fatigue can affect test scores, the battery assessing speed in the current study will consist of measures requiring no more than 10 minutes of the applicant's time to reduce long-term within-subject effects from having a large relationship on measures of speed. In addition, the current study is more interested in investigating between-subject differences in speed rather than those at the within-subject level and as such will focus most of the measurement attention on between-subject factors. Second, between-subject factors, particularly ability to correctly solve problems and carelessness, can lead to a misinterpretation of measures of speed. As such, care will be taken to assess cognitive ability and conscientiousness while investigating relationships with speed. By incorporating and controlling for variance in speed due to those measures, it is the author's intention to get a more accurate measure of speed as well as determining, at least in a linear model, the relationships of speed with other measures. In addition, other constructs such as test-taking motivation, age, and perceived face validity of the test which may impact an assessment of speed will be assessed and controlled for in the current research study. By accounting for more of the determinants of test responses, I hope to increase the predictive validity of speeded tests (Ackerman & Humphreys, 1990). While both errors and latency will be considered in this research, focus will be maintained on the speed component of measures and its relationships with other factors.

Relationships with Measures of Speed

Traditional measures of speed have two key components. First, performance is based on how fast an individual can complete items or tasks of relatively low difficulty. Second, individuals have to persist in their task performance to get a higher score. For instance, individuals must maintain their pace over ten minutes to complete as many items as possible or they are timed on how long it takes to complete a series of simple tasks. Based on these components, measures of speed can be related to a wide range of factors from cognitive abilities to noncognitive factors. While cognitive ability typically is identified as an influence of speeded test scores, many researchers acknowledge that speed in test-taking or other situations can be affected by more than an individual's level of cognitive ability (e.g., Carlson & Widaman, 1987; Carroll, 1993; Jensen, 1980; Marr & Sternberg, 1987). Even early research postulated, and on some occasions minimally displayed, the effect of noncognitive measures on speeded performance (i.e., Himmilweit, 1946; Thurstone, 1937; Wesman, 1960). While generating early interest and postulating the effects of various constructs, empirical research examining these effects has been minimal. In this research, the examination of variables related to speed will focus first on cognitive variables, and then on important noncognitive variables to empirically verify whether or not such relationships exist. While not specifically going into the hypotheses of the current research proposal, the next section will outline and define the conceptual nature of those constructs that may influence scores on speeded tests.

Cognitive Influences: General Cognitive Ability

One of the most widely studied constructs in psychology is general cognitive ability, or intelligence, and its effects on life outcomes. Individual differences in intelligence are related to such things as the ability to understand complex ideas, to learn from experience, to adapt to the environment, and to engage in reasoning and thought (Neisser et al, 1996). In a study examining the Raven's Progressive Matrices Test (Raven, 1965), a well known intelligence test, Carpenter and colleagues (1990) found that most individuals use an incremental strategy for encoding and inducing the regularities in each problem, but higher scoring individuals were better able to induce abstract relations and dynamically manage a large set of problem-solving goals. Dating back to the early part of the century, Spearman (1904) proposed a two factor theory of abilities consisting of a general cognitive ability (*g*) and specific abilities (*s*). Spearman noticed that scores on tests measuring mental processes were all positively correlated such that total scores on different tests typically rank order persons in similar ways. Using factor analysis, Spearman found that a large proportion of variance among measures of complex cognitive abilities could be attributed to a general cognitive ability factor. Such findings are still typical in current testing situations (Jensen, 1992). This general ability factor has been given labels such as intelligence, general aptitude, learning potential, attentional resources, and cognitive abilities. For purposes of this proposal, the term general cognitive ability will be used. This ability can be broadly defined as the mental process whereby individuals learn from experience and adapt to their environment (Gregory, 1996). The strength of the correlations of *g* with such outcomes as job performance, skill acquisition, aptitudes, personal income, health and fitness, etc., has been well-documented (Ackerman, 1987, 1989; Brand, 1987; Hunter, 1986; Ree & Earles, 1992). In addition to general cognitive ability, a variety of noncognitive variables can also be related to speed.

Noncognitive Influences: Personality Traits

Questions have often been raised regarding the validity of noncognitive correlates of performance (e.g., Hunter & Hunter, 1984). However, personality traits have recently displayed incremental validity as a predictor in conjunction with ability tests in the prediction of performance (Baehr & Orban, 1989; Day & Silverman, 1989; McHenry, Hough, Toquam, Hanson, & Ashworth, 1990). Such results have generated new interest in using more work-related constructs of personality to predict important work-related outcomes in organizational settings (e.g., Guion, 1991). One possible explanation for this incremental validity is that personality characteristics might be related to aspects of the job performance dimension that are not associated with cognitive ability. Based in a large part by Project A, Campbell (1990) proposed an eight-factor taxonomy of job performance across jobs: (a) job-specific task proficiency, (b) nonjob-specific task proficiency, (c) written and oral communication tasks, (d) demonstrating effort, (e) maintaining personal discipline, (f) facilitating peer and team performance, (g) supervision, and (h) management/administration. In examining the criterion taxonomy, job performance dimensions of demonstrating effort and maintaining personal discipline seem to be most predictable by personality variables (Schneider & Hough, 1995). In Project A, personal discipline was better predicted with personality variables than cognitive variables (R = 0.32 versus R = 0.16) while effort was predicted equally well by both personality and cognitive variables (McHenry, Hough, Toquam, Hanson, & Ashworth, 1990). Contextual performance including non-role specific behavior such as persisting with extra effort when necessary, and following organizational rules and procedures even when it is personally inconvenient (Borman & Motowidlo, 1993) also seem to lend themselves to prediction by personality variables. Other research by Hough and colleagues (Hough, 1992; Hough et al, 1990) found personality being more predictive of commendable behavior and law abiding behavior (contextual performance) than it is of more typical measures of task and job performance. In particular, measures of potency, achievement, dependability, adjustment, and agreeableness tended to have the highest relationship with such criteria. Mumford and colleagues (1993) found that personality variables (low evaluation apprehension, high self-discipline, and high creative achievement) distinguished those individuals who scored highly on both ill-defined and well-defined tasks. Such emphasis on effort and discipline are similar to the sort of characteristics needed to score high on speeded tasks. Maintaining effort as well as performing rapidly are essential to high performance on such tasks. Noncognitive factors that should influence such criterion dimensions as effort, discipline, and rapid performance are examined in relationship to speeded test performance.

<u>Impatience/Irritability and Type A Behavior Pattern</u>. The manner in which individuals view time could have a profound effect on their behavior and the speed of that

behavior. Originating in the medical research, one of the more popular personality constructs in psychology is the Type A Behavior Pattern (TABP). Individuals who are considered Type A tend to be more concerned about time and are characterized as walking, eating, and talking rapidly, being impatient, striving for achievement and competitiveness, feeling time pressure, etc.. Recent researchers have found that TABP is not an unidimensional construct, but reflects the constellation of behaviors constituting the construct (Edwards, Baglioni, & Cooper, 1990; Spence, Helmreich, & Pred, 1987). Most research on Type A behavior patterns has used self-report scales, especially the Jenkins Activity Survey (Jenkins, Zyzanski, & Rosenman, 1979) and the Framingham scales (Haynes, Levine, Scotch, Feinleib, & Kannel, 1978). Edwards and colleagues (Edwards et al, 1990) examined three popular measures of TABP (the Framingham questionnaire, the Bortner questionnaire, and the Jenkins Activity Survey) and found that all three measures seem to tap different underlying constructs, contain ample measurement error, and fail to recognize the multidimensional nature of the construct. Such findings led Edwards et al (1990) to conclude that global measures of TABP be abandoned in favor of measures that recognize the multidimensionality of the construct, particularly those dimensions that are of interest to the researcher's question. In examining the Jenkins Activity Survey, Spence and colleagues (Spence et al, 1987) found that the measure revealed two independent factors: Achievement Strivings (AS) and Impatience-Irritability (II). In addition, they found that each factor had differential effects on performance and health with AS correlating with grade point average and II correlating with physical complaints.

A promising construct related to the TABP is the notion of time urgency which has been defined as individuals with an accelerated pace or individuals who consider time as a scarce resource and plan its use thoughtfully (Burnam, Peenebaker, & Glass, 1975; Landy, Rastegary, Thayer, & Colvin, 1991). Research has begun to investigate the multidimensional nature of time urgency. Edwards and colleagues (1990) identified seven dimensions of time urgency: (a) general speed, (b) doing many things at once, (c) eating fast, (d) putting words in the mouths of others, (e) impatience, (f) punctuality, and (g) time pressure. Research by Landy and colleagues (Conte, Landy, & Mathieu, 1995; Landy et al, 1991) have further refined the measurement of time urgency using behaviorally anchored rating scales (BARS). Landy and colleagues (1991) found that time urgency is a multidimensional construct that includes (a) time awareness, (b) eating behavior, (c) scheduling, (d) nervous energy, (e) list making, (f) speech patterns, and (g) deadline control using a multitrait-multirater approach with a sample of office and professional workers. In addition, measures of time urgency also displayed low intercorrelations with the State-Trait Anxiety Scale (Spielberger, Jacobs, Crane, Russell, Westberry, Barker, Johnson, Knoght, & Marks, 1979) and the Job Descriptive Index (Smith, Kendall, & Hulin, 1969) suggesting that the time urgency dimensions were not surrogates for constructs such as job satisfaction or anxiety. Conte et al (1995), using confirmatory factor analysis, found good fit indices for a five dimensional model of time urgency: (a) time awareness, (b) scheduling, (c) list making, (d) eating behavior, and (e) deadline control. In their study, time awareness, scheduling, list making, and deadline control were significantly associated with Spence et al.'s (1987) AS. Speech patterns, eating behavior, and nervous energy were significantly associated with II. Such relationships would perhaps demonstrate a higher order two-factor solution of AS and II as stipulated by Spence and colleagues (1987). While the II factor is well-defined in the above paragraphs, the notion of achievement strivings is outlined below in reference to notions of conscientiousness.

Conscientiousness. Recent personality literature has focused on the emergence of a five-factor model of all personality types (Digman, 1990; Goldberg, 1993). While debates emerge concerning whether or not the five factor model encompasses all personality traits or whether we should focus on personality types instead of traits (see Schneider & Hough, 1995, for a review), one of the most robust personality traits linked with important work-related outcomes is conscientiousness. Conscientiousness is associated with such descriptive terms as responsible, dependable, planful, organized, persistent, and achievement-oriented (Barrick, Mount, & Strauss, 1993).

In a series of studies, Barrick and Mount have demonstrated the consistency of the relationship of conscientiousness to work outcomes. In a meta-analysis on the relationship of the Big Five and performance criteria across occupational groups. Barrick and Mount (1991) found that conscientiousness is a valid criteria of job proficiency, training proficiency, and personnel data (true $r = 0.22$). In other studies, they examined the relationship between the Big Five and job performance in a sample of 146 first-line supervisors and mid-level managers and found that conscientiousness correlated significantly with supervisor ratings of job performance ($r = 0.25$, corrected $r = 0.35$). Finally, in a third study, Barrick, Mount, & Strauss (1993) tested a structural model relating conscientiousness to job performance in a sample of 91 sales representatives in an appliance manufacturing organization and found that autonomous goal setting and goal commitment mediated the relationships between conscientiousness and sales volume and supervisory ratings. In a different meta-analysis examining personality and job performance outcomes, Tett and colleagues (1991) found that conscientiousness had an estimated true r of 0.18, slightly less than the Barrick and Mount's (1991) meta-analysis.

In a separate line of research, Hough and colleagues (Hough 1989, 1992; Hough, Eaton, Dunnette, Kamp, & McCloy, 1990), using a nine-factor model of personality related "conscientiousness-type" personality measures of achievement and dependability to a variety of job and life criteria measures. Measures of achievement were significantly related to criterion measures of effort and leadership, personal discipline, and physical fitness and military bearing (Hough et al, 1990) and with job performance constructs of job proficiency, training success, educational success, commendable behavior, and law abiding behavior (Hough, 1992). Measures of dependability were significantly related to criterion measures of effort and leadership, personal discipline, and physical fitness and military bearing with mixed results for technical proficiency and general soldiering (Hough et al, 1990). In addition, dependability was correlated with job proficiency, training success, educational success, commendable behavior, and law abiding behavior (Hough, 1992). In similar work investigating models of supervisory job performance ratings, Borman and colleagues (1991) found that achievement orientation and dependability had small direct effects on ratings, but larger indirect effects in the prediction of supervisory ratings through its effects on awards and disciplinary actions, respectively.

Whereas some researchers investigate conscientiousness as a single variable (i.e., Barrick & Mount, 1991), other researchers consider such conscientiousness sub-dimensions as achievement and dependability as important factors to be considered instead of a general measure of conscientiousness (Borman et al, 1991; Hough, 1992). Achievement is similar to the AS factor in measuring the Type A behavior pattern and is defined as the tendency to strive for competence in one's work such that a person works hard, sets high standards, tries to do a good job, persists in the completion of a task, etc. (Hough, 1992). Dependability refers to such personal characteristics as being disciplined, well-organized, planful, honest, trustworthy, etc. (Hough, 1992). Acknowledging that all of these constructs are highly related, this research will isolate achievement and compare it with a general measure of conscientiousness to investigate potential differential relationships with speed. For example, while both constructs entail the notion of persistence, a person high in achievement may strive to work faster realizing that success is based on time. Likewise, achievement and conscientiousness may have differential relationship with the construct of impatience/irritability. Achievement may have a higher relationship with impatience irritability, thereby decreasing the amount of incremental validity added to the prediction of speed.

In addition to the personality characteristics associated with TABP, other personality-related characteristics could influence speeded test scores. In particular, an individual's temporal orientation toward the completion of tasks, and their level of self-monitoring in relationship to situational influences could influence speeded performance.

Temporal orientation. In addition to the above personality traits, individuals' attitudes, values, and beliefs about time can differ (Cottle, 1976) without incorporating the impatience/irritability aspects associated with type A behavior pattern. Such differences can influence the rate at which individuals perform tasks in a typical day and subsequently the rate at which a speeded task is performed. Two temporal orientations that can affect an individual's performance in speeded tasks are polychronic versus monochronic orientation and pace.

Work by Bluedorn and associates based on Hall's (1983) original work has examined monochronic versus polychronic orientation as a continuous variable that influences the way individuals approach life's work (Bluedorn & Denhardt, 1988; Bluedorn, Kaufman, & Lane, 1992). People who have a monochronic orientation approach tasks one at a time whereas individuals with a polychronic orientation are simultaneously involved in two or more activities. For instance, if a person had three activities to complete (1, 2, 3) and they had to complete 1 before they started 2, and had to complete 2 before they started 3, they would be displaying a monochronic orientation. However, if the individual does 1 for a while and then starts 2, and then goes back to 1, etc., such that they always make progress on each task, they are displaying a polychronic orientation. Characteristics of individuals with a monochronic orientation include being task-oriented, emphasizing promptness, and sticking to plans whereas characteristics of individuals with a polychronic orientation involve changing plans and emphasizing relationships over tasks (Hall, 1983).

The concept of pace or tempo has been defined in many ways including notions of rate (Lauer, 1981), speed (Amato, 1983), and velocity (Kelly, 1988; Warner, 1988). Operationally, measures of pace of life and pace of work have included walking speed (Amato, 1983; Bornstein, 1979), speed of post office transactions (Levine & Bartlett, 1984), speed of currency exchange (Amato, 1983), and speed of lunch consumption (Lucia, 1985). Pace of life differences have been noted across individuals, type of environment (urban versus rural), and nationalities (Levine, 1988). The concept of pace or "personal tempo" has been proposed to be a dimension of speed in timed performance tasks (i.e., Marr & Sternberg, 1987). While research has supported the existence of reliable individual differences in the rate of performing tasks, there is no clear empirical evidence that such differences are associated with personal tempo (Carroll, 1993). The hypothesis that such "in-grained" tendencies in the performance of activities could influence the outcomes in measures of speed has never been adequately investigated in an empirical fashion.

Self-monitoring. In a recent review of personality characteristics and work outcomes, a possible explanation provided for lower-than-expected validities for personality characteristics was the presence of moderators between the relationship of personality characteristics and work outcomes (Schneider & Hough, 1995). One possible moderator that could display interactive effects is self-monitoring. Self-monitoring represents the extent to which a person in a social situation pays attention to social cues and actively attempts to construct a pattern of behavior that is appropriate to that particular context (Snyder, 1979). Sources of information such as social norms, situational and interpersonal specifications of appropriateness on how to behave, social attitudes, and personal dispositions can be used as guides to the construction of behavioral patterns (Snyder & Ickes, 1985). However, individuals differ in the extent to which they rely on social cues to regulate their behavior. Individuals high in self-monitoring tend to monitor and regulate their behavior based on the behavioral requirements of situations, whereas individuals low in self-monitoring permit their behavior to be guided by their dispositional characteristics, thus ignoring the demands of the situation. Relationships between dispositions and behavior of individuals high in self-monitoring could be lower than for low self-monitoring individuals because the high self-monitoring individuals would pay more attention to situational and interpersonal cues of social appropriateness. The exception for high self-monitors would be in cases where it is socially desirable to act on one's true attitudes and dispositions (Snyder & Kendzierski, 1982). In contrast, individuals who are low in self-monitoring would have a more consistent and larger correspondence between dispositions and behavior such that their dispositions guide their behavior rather than being guided by information in the social situation (Snyder & Ickes, 1985). As such, it would be expected that measures of typical and maximum performance (Sackett et al, 1988) would be similar for individuals at a lower level of self-monitoring.

Empirically, self-monitoring is typically described as a personal moderating variable between dispositions and behaviors. Based on original research by Snyder

(1974), a 25-item scale was developed that demonstrated both convergent and divergent validity as well as internal consistency. Items endorsed by high self-monitors included such things as "I may deceive people by being friendly when I really dislike them" or "I would probably make a good actor," while items endorsed by low self-monitors included such things as "I can only argue for ideas which I already believe" and "I find it hard to imitate the behavior of other people" (Snyder, 1974). In later research based on the original scales, the Self-Monitoring Scale was reduced to 18 items, removing items from the original scale that had low item-total correlations (Gangestad & Snyder, 1985).

There have been some questions regarding what the self-monitoring scale actually measures. One major concern is that being a true-false scale, self-monitoring has lower inter-item correlations than desirable, but its length (18 or 25 items) raises the alpha level to acceptable standards for unidimensionality (Briggs & Cheek, 1988). Such claims of multidimensionality argue that the subscales should be treated separately (Briggs & Cheek, 1980; Lennox & Wolfe, 1984). In a systematic examination of the Self-Monitoring scale, Briggs and colleagues have identified two factors that seem to emerge from use of the scale: (1) social surgency dealing with exhibitionism, social potency, and extraversion, and (2) other-directedness dealing with shyness and lack of self-esteem (Briggs, Cheek, & Buss, 1980; Briggs & Cheek, 1986, 1988). In response to the criticisms, Snyder and Gangestad (1986) argue that the self-monitoring scale has demonstrated important relationships with many relevant criteria and even though interpretable factors result from rotation, most of the items also load on the first unrotated factor which reflects a single latent variable. While a resolution to the debate has never transpired, the utility of the scale as a predictor of interpersonal behavior has been supported by most researchers.

In addition to general cognitive ability and personality characteristics, situation-related factors can also potentially influence scores on speeded tests. Time of day influences and anxiety toward testing situations could affect an individual's level of awareness as well as the amount of effort being placed to the task at hand. Potential situational influences will be defined in the following sections.

Situational arousal. Another category of noncognitive factors that could influence speeded test performance involves measures of arousal induced through situational demands. Arousal can be characterized by an individual's level of alertness, vigor, and activation ranging from extreme excitement on one end to extreme drowsiness at the other end (Humphreys & Revelle, 1984). Indices for arousal can range from self-report measures to physiological measures such as heart rate, breathing rate, and skin conductance. In addition, whereas the relationship between arousal and performance has been curvilinear, a monotonic linear relationship between arousal and performance can occur when difficulty of the task is low (Humphreys & Revelle, 1984; McGrath, 1976) While personality traits such as impulsivity/irritability represent a more general "trait-like" notion of arousal, arousal induced through situational circumstances could add additional variance to the prediction of speeded test scores. For purposes of this research, two factors, circadian rhythms and comparative anxiety are examined.

It has been well-established that there are significant time-of-day effects in many types of human performance (Blake, 1967; Colquhoun, 1971; Kerkhof, 1985; Revelle, 1989). These effects have been attributed to variations in circadian arousal levels affecting the capacity and efficiency of working memory as well as more general notions of fatigue or alertness (Flokard, Wever, & Wildgruber, 1983). Some studies suggest that there are inter-individual differences in the time of day at which one reaches his/her peak or acrophase such that there are two clusters of individuals who reach their peak either early or later in the day (Horne & Ostberg, 1977). According to a review of the circadian rhythm literature, "morningness-eveningness" tends to be the most powerful interindividual difference variable related to biological, attitudinal, and behavioral differences on peak arousal (Kerkhof, 1985; Smith, Reilly, & Midkiff, 1989). Several measures have been developed to assess morningness and eveningness (i.e., Folkard, Monk, & Lobban, 1979; Horne & Ostberg, 1976; Torsvall & Akerstedt, 1980). In a recent review, Smith and colleagues (1989) re-evaluated the psychometric characteristics of various scales and found inter-item deficiencies in all of them. In response, they developed a composite scale that combined the best characteristics of the scales and found high internal consistency as well as relationships to external criteria associated with morningness and eveningness.

In a personnel selection context, a common concern between concurrent and predictive strategies is that current employees may not be equal to applicants in terms of motivational issues (Arvey, Strickland, Drauden, & Martin, 1990). Motivational differences between samples used in concurrent and predictive designs may act to distort and influence the estimates of validity or introduce random error (Barrett, Phillips, & Alexander, 1981; Cranny & Smith, 1982). Another major difference is that individuals may differ in terms of their anxiety toward tests and these differences might influence their test scores. Tests takers may experience profound emotions and feelings as a result of the situational pressure of taking tests which affect their future (Hashemian, 1978; Nevo & Svez, 1985). Such anxiety would interfere with their ability to concentrate on the task at hand (Kanfer & Ackerman, 1989), potentially influencing their ability to complete speeded tasks where time pressure is evident.

Therefore, influences on speeded test performance can come from a variety of sources: levels of general cognitive ability/efficiency, personality dispositions, and situational factors. Other characteristics can influence speeded test scores as well as these dimensions. However, these influences are not a focus in the present research due to restriction of range problems, namely individuals being studied will be similar on these characteristics. These characteristics include the age of the examinee (most participants are young) and various applicant reactions such as their test-taking motivation and interest in the job, and the perceived face validity of the tests.

Other Influences

Age. One of the more apparent antecedents of an individual's speed of behavior is an individual's age. When older and younger adults perform similar cognitive tasks, older individuals tend to perform more slowly than the younger adults. Age declines have been found in a wide variety of experiments (Birren & Fisher, 1995; Salthouse, 1985). Some research has attributed such slowing to a general factor of speed of the central nervous system (Birren, 1965; Birren, Woods, & Williams, 1980). In preliminary research, Brinley (1965) compared a group of older (mean age = 71.4, SD = 6.1; n = 51) and younger (mean age = 24, SD = 5.2; n = 60) adults on 21 tasks. He performed a regression of mean time scores for the elderly on the mean time scores for the young and found that age accounted for 98% of the variance in adult response time (old = 1.68(young) - .27; r = .99), supporting a generalized slowing across tasks. In other meta-analytic work that integrated data from studies using a wide range of information processing tasks, research has also found evidence supporting a general slowing hypothesis (Cerella, 1985; Cerella, Poon, & Williams, 1980; Hale, Myerson, & Wagstaff, 1987). Such a generalized slowing throughout the central nervous system is purported to be manifested in any task that requires higher levels of information processing.

An area in which age-related decrements have not been consistently demonstrated has been when the task differs in terms of the speed and knowledge required for its completion. If performance is mainly a function of speed, then age-related effects should be large, but if knowledge is an important aspect of the task, then age effects can be expected to be smaller (Salthouse, 1993; Schaie & Willis, 1993). Such a distinction is similar to that of Horn-Cattell fluid-crystallized intelligence distinction. Such outcomes were found in areas such as lexical vs. nonlexical tasks (Lima, Hale, & Myerson, 1991), and arithmetic tasks (Geary, French, & Wiley, 1993).

Applicant reactions and motivation. Another factor that can influence test scores is an applicant's reaction to the test (Arvey et al, 1990; Rynes, 1993; Smither, Reilly, Millsap, Pearlman, & Stoffey, 1993). Whereas applicants may have differential reactions to tests in terms of anxiety, most candidates should have high levels of motivation to do well on the task at hand such that restriction of range in predictive validity settings could become a major issue (Arvey et al, 1990). In a recent study, Chan and colleagues (Chan, Schmitt, DeShon, Clause, & Delbridge, 1997) found that test-taking motivation assessed after the completion of a first test affected subsequent performance on a parallel test after race and first test performance were controlled. Face validity assessed after the administration of first test also affected performance on a subsequent equivalent test, but only indirectly through test-taking motivation. However, the study examined test-taking motivation in a student sample, so restriction of range in terms of test-taking motivation was less of a concern than with an applicant sample where motivation to do well should be uniformly high. Such differences in motivation have been found in similar samples examining incumbents (Mean = 4.97, SD = 1.71) versus applicants (Mean = 6.08, SD = .71) on test-taking motivation (Arvey et al, 1990). A problem with test-taking motivation research is the difficulty in establishing causality (Arvey et al, 1990; Chan et al, 1996). It is still unclear as to whether an individual's level of motivation influences test scores or whether one's performance influences their attribution of motivation.

A similar motivational influence on test scores in an applicant setting is the candidate's actual interest in obtaining a position with an organization. Some candidates may be merely applying for a position because their parents, spouse, etc., are pressuring them to apply even if they have little interest in obtaining employment. Other candidates may be applying because they need to maintain government benefits and have to apply to so many positions each week/month. If the person is not really interested in obtaining employment with the organization, his/her level of effort may be reduced compared to someone who really wants the position. While this scenario is most likely a characterization of only a minority of actual job candidates, such an influence should be controlled in examining other factors.

In addition to motivation and interest, another potential influence on test scores is the candidate's perception of the face validity of the test. Face validity is defined as the extent to which examinees perceive the content of the selection procedure to be related to the content of the job (Smither et al, 1993). Individuals who perceive that the tests are unrelated to the job may react negatively and reduce the amount of effort expended, thus influencing test scores. In carefully created selection tests, the influence of negative face validity reactions should be minimized.

Overall, the variability on the above factors should be minimal with most candidates for entry level positions being of similar age with similar perceptions and motivations. However, these factors may influence test scores for a minority of actual job candidates. Therefore, age, motivation, and perceived face validity are measured and controlled in the research study.

After examining the relationships of factors to measures of speed, the research will switch focus to examine the second objective of the research investigating the influence of individual differences in measures of speed on broader measures of job performance. To adequately examine the relationship, attention will first be placed on the nature of performance using job performance as a basis. In examining the performance domain, consideration will be placed on those dimensions of performance that should be most highly related to individual differences in measures of speed. Finally, assessment centers, a method by which performance data will be collected in this study, will be highlighted in relationship to typical administration procedures and types of performance dimensions assessed.

Job Performance

Until now, the focus of the present research has been on investigating relationships with measures of speed. However, a second interest of the research is also to examine how measures of speed relate to broader measures of job performance, in addition to the relationship between cognitive ability and performance. To examine the criterion domain taking a construct-oriented approach, care must be taken to specify the multidimensional nature of the domain as well as specify the dimensions that should be most related to notions of speeded test performance compared to those dimensions most related to cognitive ability variables (Schneider & Hough, 1995).

Researchers have proposed various taxonomies of job performance. Campbell (1990), based on the work in Project A, suggested that the highest-level job performance dimensions include: (a) job-specific task proficiency, (b) non-job-specific task proficiency, (c) written and oral communication tasks, (d) demonstrating effort, (e) maintaining personal discipline, (f) supervision, and (g) management/administration. Borman and Brush (1993) denoted 18 managerial factors that could be summarized in four superfactors: (a) interpersonal dealings and communication, (b) leadership and supervision, (c) technical activities and the "mechanics of management," and (d) useful personal behaviors and skills. In a different twist, Borman and Motowidlo (1993) distinguish task performance from contextual performance. Contextual performance serves more of an environmental support role including such activities as volunteering, persisting with extra enthusiasm to complete a task, helping and cooperating, and supporting organizational objectives (Borman & Motowidlo, 1993).

Specifying the criterion space provides assistance in highlighting the type of criterion dimensions that are most readily predicted by personality and noncognitive variables (Schneider & Hough, 1995). Likewise, certain dimensions from the taxonomies listed above should have higher relationships with measures of speed than others. In terms of Campbell's taxonomy, criteria that emphasize persisting on tasks over time, such as the demonstration of effort and the maintenance of personal discipline, should be more related to measures of speed as exhibited in typical speeded tests (Borman et al, 1991; Hough et al, 1990; Hough, 1992; McHenry et al, 1990). In addition, non-job-specific task proficiency should also be related to measures of speed if speed of performance is necessary for success across multiple tasks that are not specific to one's job.

A measure of job performance can be obtained in many ways such as objective production measures, subjective ratings, etc.. One way in which such multidimensional measures of performance could be collected is through assessment center activities. Assessment centers are one of the more popular methods for selecting, developing, evaluating, or promoting individuals in work organizations (Gaugler, Rosenthal, Thornton, & Bentson, 1987). Typically, such devices require individuals to perform some group task where they are subsequently rated by assessors. Some of the defining characteristics of such centers include a high level of face validity (Schmidt, Greenthal, Hunter, Berner, & Seaton, 1977; Macan, Avedon, Paese, & Smith,1994), the use of multiple assessors to observe multiple assessees' behavior in exercises, and the rating of assessees on multiple dimensions including such skills as problem-solving, planning, organizing, delegation, or written communication (Schneider, 1992; Task Force on Assessment Center Standards, 1989). The typical procedure of an exercise is twofold. First, assessors observe assessees' behavior in either a live, videotaped, or written format. Second, assessors rate assessees on dimensions with the assistance of standardized scoring guidelines. Exercises are typically constructed based upon job analysis to mirror tasks that are performed on the job or to mirror critical aspects of the task domain (Schneider, 1992). In fact, such exercises are often considered "work samples" of activities that are displayed on the job that compare favorably with supervisor ratings and productivity measures of job performance (see Smith, 1991 for a review). In these group exercises, assessees perform in small groups, typically made up of other assessees, to solve organizational problems, generate plans, and manufacture mock products (Schneider, 1992). Using behaviorally anchored rating scales, assessors make ratings for each target person. Factor analysis studies of assessment center final ratings have commonly demonstrated a three factor solution for the constructs measured in assessment center activities: problem solving, interpersonal skills, and initiative/work orientation (Schmitt, 1977). Such dimensions should demonstrate differential relationships to measures of speed. Given the prior research highlighting the types of performance dimensions measures of speed should be most related to, it seems reasonable to assume that dimensions involving effort and discipline such as work orientation should have larger relationships with measures of speed than dimensions such as interpersonal and problem-solving skills.

Given a work sample/assessment center context to measure job performance, notions of the continuum of typical versus maximum performance (Sackett et al, 1988) need to be taken into account. In simple terms, maximum performance is typically associated with one's best effort on the job, whereas typical performance is more associated with behaviors that would most likely be exhibited on the job over extended periods of time. In terms of variables related to speed, general cognitive ability and reaction time measures would be most illustrative of a maximum characteristic given that most individuals in testing situations give their best efforts to try to solve problems or complete tasks in the time allotted, particularly in situations involving short time periods. Noncognitive variables such as temporal orientation and achievement would be more illustrative of a typical characteristic because you would expect an individual to display those traits more consistently over time. When dealing with measures of job performance, a construct can be measured across the continuum between typical and maximum performance. Maximum performance has three main characteristics (Sacket et al, 1988): (a) there must be explicit awareness that one is being evaluated, (b) there must be an awareness of and acceptance of instructions to maximize effort, and (c) performance must be measured over a short enough time duration that the performer's attention remains focused on the accepted goal of maximum performance. In assessment center/work sample situations, the precise point on the continuum from typical to maximum is unresolved, primarily due to issues of time. It can be argued that task length and task complexity can reduce candidate awareness of the evaluative aspect of the situation and produce a sample of typical job performance. However, it can also be argued that the situation heightens the candidate's level of effort and attention to be considered maximum performance. One objective of the current research is to investigate the incremental validity of measures of speed. Therefore, speed, which falls more on maximum side of the continuum, will be evaluated both against more maximum elements of job performance, where conceptually it should have a larger relationship, and more typical elements.

In summary, job performance dimensions involving a demonstration of effort, a maintenance of personal discipline, and nonjob-specific task proficiency across multiple tasks not specific to one's job should be most related to measures of speed. Primarily, this relationship should provide incremental validity in the prediction of job performance over that of general cognitive ability. Also, the nature of typical versus maximum performance in relationship to speed as an incremental predictor over general cognitive ability will be examined.

Research Study: Relationships with Measures of Speed

The following research study investigates the relationships of factors with measures of speed as well as its usefulness in predicting job performance. Using the literature cited above, the proposal outlines the hypotheses of the research in the following fashion. First, relationships with measures of speed are examined by highlighting general cognitive ability and noncognitive factors as important factors that can influence an individual's level of arousal and effort and subsequently their performance on measures of speed. Second, the incremental validity of measures of speed in the prediction of job performance, above and beyond the influence of cognitive ability, is examined.

General Cognitive Ability and Speed

Many recent studies have demonstrated that the speed with which simple perceptual and cognitive tasks are performed is correlated with psychometric intelligence (i.e., Ceci, 1990; Vernon, 1987). Research has demonstrated that individuals with higher scores on general cognitive ability tests tend to apprehend, scan, retrieve, and respond to stimuli faster than those with low scores on general cognitive ability tests (Neisser et al, 1996). The more complex the stimuli and the judgments required, the larger the relationship of speed with psychometric intelligence (Jensen, 1993).

The type of speeded task used to investigate this relationship has been varied from the typical paper-and-pencil test paradigm to more complex biological measures. Original work required participants to make same/different judgments regarding visual displays and found that the speed of response was correlated with psychometric verbal ability (Hunt, 1978; Jackson & McClelland, 1979). Other cognitive paradigms used to study speed include choice reaction time, inspection time, and neurological measures. In choice reaction time, the individual participant must move his/her finger from a "home" button to one of eight other buttons arranged in a semicircle around it. One of the lights is illuminated that indicates it as a target and the individual moves his/her finger and presses the button corresponding to the target (Jensen, 1987). Typically, reaction time correlates as high as -.4 to -.5 with intelligence test scores with more complex decision paradigms (e.g., odd-man-out, higher number of lights, etc.) exhibiting higher correlations (Jensen, 1993, Neisser et al, 1996). In this case, the negative correlation indicates the higher the intelligence, the less time it takes to react to a target stimulus.

Another paradigm for measuring processing speed is inspection time. In the standard version of the paradigm, two vertical lines are displayed very briefly on each trial, followed by a pattern mask. The subject is required to judge which of the two lines is shorter. For any given individual, inspection time is defined as the minimum exposure duration for which the lines must be displayed in order for the individual to meet a given level of accuracy, for example 71% or 85% (Deary & Stough, 1996; Nettelbeck, 1987). As opposed to choice reaction time, it is stimulus duration required by the participant to reach a given level of accuracy that is assessed, not the speed of a participant's response in making the discrimination, so inspection time is often referred to as the speed of intake of information (Deary & Stough, 1996). Like choice reaction time, inspection time is consistently correlated with psychometric intelligence. In a recent meta-analysis, Kranzler and Jensen (1989) found an overall correlation of -.30 between IQ and inspection time that rose to -.55 (longer times are associated with lower IQ scores) with measurement corrections and omissions of studies with serious methodological problems. Such measures of inspection time appear to be stronger with measures of performance or fluid intelligence (Deary & Stough, 1996) and have been replicated in post-meta-analysis studies (Bates & Eysenck, 1993, Deary, 1993).

A final category of speed measures are ones that examine more direct indices of neural processing including averaged evoked potentials (AEP), nerve conduction velocity (NCV), and cerebral glucose metabolism (CGM) which are usually thought to reflect and neural efficiency. Such research is relatively new in application. Vernon (1991) found that AEP, measuring length and amplitude of wavelengths, as well as other EEG measures was correlated with intelligence test scores for both adults and children. CGM measured by positron emission tomography (PET) scans, provide an index of the activity of the brain either at rest or when subjects are involved with some task (Vernon, 1991). Some preliminary research has found that cortical absolute CGM rates were correlated between -.50 and -.54 with better performance on mental ability tests associated with less cortical activity (Parks et al, 1988). Higher scoring subjects had to expend less energy than lower scoring subjects. NCV is essentially a measure of the speed with which electrical impulses are transmitted by the nervous system. In one study, NCVs correlated $r = .26$ (corrected for restriction of range $r = .37$) with scores on an unspeeded test of intelligence (Reed & Jensen, 1992). Overall, studies of biological measures of neural efficiency were related to psychometric intelligence.

Such research demonstrates a relationship between general cognitive ability and information processing speed in that individuals would be more efficient in processing information or have higher levels of arousal to attend to stimuli. While a relationship should be evident in this study as well, the size of the relationship could be reduced because speeded tests require the maintenance of speed over a certain time period instead of the maximum information processing speed paradigms (e.g., reaction time) that are assessed in the above research. Testing conditions in the current research should introduce a range of noncognitive influences that are not present in the above information processing speed research.

Hypothesis 1: Individuals with higher general cognitive ability scores should obtain higher scores on speeded tests.

Cognitive ability should be related to speeded performance through an increased efficiency or to apprehend, scan, retrieve, and respond to stimuli. As stated earlier, noncognitive factors should also have an influence on speeded test scores. Before examining the specific noncognitive constructs affecting speed, the proposal will highlight how noncognitive variables influence speed of response on tests by examining two specific mechanisms: the amount of effort devoted to on-task activities and the amount of arousal or alertness to stimuli.

Mechanisms of Noncognitive Influence

While the role of cognitive abilities in predicting learning and job performance is well documented (Ackerman, 1987; Hunter & Hunter, 1984), the role of noncognitive influences are relatively unexplored in relationship to measures of speed. In speeded tests, performance is determined by the amount of work that is completed in a set period of time or the amount of time required to complete a given task. In such scenarios, the difficulty of the items and/or tasks are low, thereby reducing the level of ability needed to correctly solve the problems. Such tasks should decrease the influence of cognitive ability on test scores by reducing the problem difficulty and relying on speed of performance.

Noncognitive factors can influence speeded test performance in a variety of ways. Using an information-processing framework, noncognitive factors can influence measures of speed through a resource allocation process (Naylor, Pritchard, & Ilgen, 1980; Kanfer & Ackerman, 1989). Individuals differ in the way they allocate their time and attentional effort to the achievement of a particular goal and the extent to which that attentional effort is maintained over time. Certain tasks require more attentional resources to be directed toward the task versus attentional resources directed to off-task activities. Another distinction is the influence of both distal and proximal processes in task performance (Kanfer & Ackerman, 1989). Distal motivational processes concern the choice to engage some part of one's resources to the attainment of a goal whereas proximal motivational processes determine the distribution of effort across on-task, off-task, and self-regulatory activities during task activity (Kanfer, 1992). In measures of speed, the difficulty of the task in terms of the ability to solve problems is low, but the nature of the testing situation forces individuals to remain on-task over time to complete as many problems as they can or complete the activity as quickly as possible.

In another model concerning the influence of information-processing and personality, Revelle and colleagues highlight the organization of personality and performance in a cognitive information-processing framework (Humphreys & Revelle, 1984; Revelle, 1989; Zinbarg & Revelle, 1989). Their model proposed a theory linking individual differences in Introversion-Extroversion, Achievement Motivation, and Anxiety to information processing components of complex task performance (Humphreys & Revelle, 1984). In their model, personality, in combination with situational moderators (e.g., time of day, fatigue, etc.), affect an individual's arousal and effort which in turn affect three components of performance: sustained information transfer, long-term memory, and short-term memory. In their model, on-task effort and arousal both increase the resources allocated for sustained information tasks or tasks whereby individuals are required to process a stimulus, associate an arbitrary response to the stimulus, and execute the response over an appreciable length of time (Humphreys & Revelle, 1984). On such tasks and similar tasks in prior research, the relationship between personality traits and performance should be enhanced because persistence is an important component for success (Helmreich, Sawin, & Carsrud, 1986; Schneider & Hough, 1995; Weiss & Adler, 1984).

Overall, noncognitive factors seem to influence performance on measures of speed through their impact on an individual's level of arousal and the amount of effort they put into the task at hand (Humphreys & Revelle, 1984). Arousal is the state of an individual that indicates how alert or active they are ranging from extreme drowsiness on one hand to extreme excitement on the other hand. Individuals high on arousal should be more alert to stimuli and respond more rapidly. Effort is a more general means of trying hard or being involved in a task. Individuals who try hard for various reasons (e.g., incentives, importance of task, etc.) should maintain focus on a task until its completion. Considering the effects of effort and arousal, such processes will be more explicitly examined when we discuss each of the individual noncognitive factors.

Impatience/Irritability (II). Individuals who are high on levels of II could be characterized as having more nervous energy, doing things rapidly, feeling time pressure, etc. (Conte et al, 1995; Edwards et al, 1990; Landy et al, 1991). II has been shown to be arousal-related such that individuals who are high on II display higher levels of alertness or arousal (Humphreys & Revelle, 1984). Such high levels of activity could characterize behaviors that are considered speeded. Particularly, in a speeded test scenario, an applicant's score depends on how quickly he or she can complete the task as well as how long he or she can maintain such speed. Individuals whose activity level is high based on levels of II should maintain a fast tempo throughout the testing condition and should strive to finish the task as quickly as possible.

Hypothesis 2: Individuals with higher levels of Impatience/Irritability should obtain higher scores on measures of speed

Conscientiousness. The positive relationship of conscientiousness and work performance has been demonstrated in numerous situations (Barrick & Mount, 1991; Barrick et al, 1993; Hough et al, 1990; Hough, 1992). In Project A, a large scale military selection project, Hough and colleagues found that measures of conscientiousness, achievement and dependability dimensions, were strongly related to performance measures that had effort and discipline components (Hough et al, 1990; Hough, 1992). Other work has demonstrated that individual differences in dispositions such as achievement motivation may influence variability in job performance where persistence is an important component of success (Helmreich et al, 1986; Weiss & Adler, 1984). These performance dimensions appear to be most related to successful performance in measures of speed where an applicant must maintain speed over a period of time, thus requiring effort as well as discipline over time. It is primarily through an increase in effort that conscientiousness will be related to measures of speed.

Hypothesis 3: Individuals with higher levels of Conscientiousness should obtain higher scores on measures of speed.

While conscientiousness, through effort and discipline over time, should have a relationship with speed, a potential conflict could be an individual's propensity to stay on task and to make sure assignments get completed with 100% accuracy. One could argue that such carefulness could slow down a highly conscientious individual in speeded tasks. However, a competing goal of an individual who is high in conscientiousness would be to complete as many items as possible or finish in the smallest amount of time to be successful. The question asks which is more important: being careful in test completion or finishing as many items as possible to be successful.

Previous researchers have criticized measures of conscientiousness as consisting of two constructs, achievement and dependability, instead of a general construct of conscientiousness with each component having different conceptual definitions and relationships with external variables (Borman et al, 1991; Hough, 1992). While both achievement and dependability should be highly related conceptually and empirically, they may display differential relationships when examining the speed-accuracy tradeoff in speeded test performance. In particular, the achievement component may display a relationship with how individuals treat errors in favor of completing more items. While both notions of achievement and dependability, as well as conscientiousness, represent notions of persistence, effort, and discipline, the speeded nature of the test situation may assist an individual who is high in achievement to recognize that the key to success in the speeded test scenario is how fast he/she can complete the task. This could reduce the amount of focus placed on the accuracy of the response in favor of completing more items to succeed. It is this component of achievement that may lead effort to be directed at favoring speed over the carefulness of checking errors

Hypothesis 4: Achievement should have a positive relationship with the number of errors committed on measures of speed.

Temporal orientation. Two constructs that are used to define an individual's temporal orientation are (1) monochronic vs. polychronic orientation, and (2) pace. Individuals with a monochronic orientation approach tasks one at a time whereas individuals with a polychronic orientation are simultaneously involved in two or more activities (Bluedorn et al, 1992). Individuals who are monochronic tend to be more task-oriented, prompt, and deadline/plan conscious whereas individuals with polychronic orientations are more relationship than task conscious. In speeded test scenarios, success might be more in line with individuals who favor the monochronic orientation. These individuals should have a predisposition to focus effort on the completion of the task at hand, which in the employment testing scenario is the measure of speed. Individuals with a polychronic orientation may be more concerned with other tasks they might need to complete, and thus divert their attention and effort to other tasks, thereby reducing their level on the measure of speed. Even though the testing scenario may force them to focus, their ability to do so through prior habits of diverging the effort may inhibit their success.

Hypothesis 5: Individuals with a polychronic orientation should perform worse on measures of speed than individuals with a monochronic orientation.

The concept of pace is similar to notions of impatience/irritability in terms of an individual's predisposition to perform tasks in a rapid fashion. However, pace could be construed as a tempo variable without the irritability aspect of II. While missing the irritability aspect, the element of arousal or activity level should still be high in individuals who maintain a quicker tempo in the performance of activities. Research has noted that pace of life differences have been documented across individuals (Levine, 1988) and has been proposed to be a dimension of speed in timed performance tasks (Marr & Sternberg, 1987). This connection to measures of speed has never been fully investigated empirically. In the speeded test scenario, individuals who have a quicker pace in the performance of their everyday activities should have higher arousal levels and be more alert to stimuli presented, make quicker decisions, and make quicker movements in responding.

Hypothesis 6: Individuals with a quicker life pace should obtain higher scores on measures of speed.

Self-monitoring. Self-monitoring is related to the extent to which a person in a social situation pays attention to social cues and actively attempts to construct a pattern of behavior that is appropriate to that particular context (Snyder, 1979). In the context of employment testing, particularly measures of speed, the situation cues applicants that to have an opportunity to obtain the job, they must exert maximum effort and work rapidly to be successful. Individuals who are high in self-monitoring should regulate their behavior to exert such effort while individuals who are low in self-monitoring should perform behaviors, be they high or low effort, that are similar to those in other situations outside the employment context. In that sense, the disposition-behavior relationship would be more consistent rather than situationally influenced when an individual is characterized as being low in self-monitoring.

In the speeded test scenario, the previous hypotheses propose disposition-behavior relationships between conscientiousness and polychronic orientation on measures of speed. In these situations, self-monitoring could serve as a moderating variable between disposition-behavior relationships in that individuals who are high in self-monitoring, but low on conscientiousness and possessing a polychronic orientation, may exhibit behaviors more characteristic with being high in conscientiousness and having a monochronic orientation. This would be the case particularly in situations whereby the mechanism of influence is the direction of effort. People who are high in self-monitoring would recognize the need to exert more effort and work at a faster pace to meet performance demands. Such a moderator should serve to reduce the relationship between the dispositions and speeded test performance for individuals who have high levels of self-monitoring. Other research investigating test-taking motivation also found that the criterion-related validity of personality tests was higher in samples with less test-taking motivation than samples with high test-taking motivation (Schmit & Ryan, 1992) which would similarly argue that the situation regulates behavior to a certain extent. A similar way of explaining the disposition-behavior relationship would view candidates as using a self-presentation strategy to maximize the possibility of employment (Sackett, Burris, &

Ryan, 1989). In their case, the characteristics and demands of the situation are vital to the prediction of behavior. With self-monitoring, such self-presentation strategies should be more unconscious in that individuals adapt to situational cues in a more automatic fashion. However, individuals with a low level of self-monitoring would behave consistently in these scenarios as they would in other situations, thus maintaining the validity between dispositions and behaviors.

Hypothesis 7-8: Self-monitoring should moderate the relationship between conscientiousness and monochronic orientation with performance on measures of speed such that individuals who are high on self-monitoring would have a lower relationship between dispositions and measures of speed than individuals with lower levels of self-monitoring. The nature of the hypothesized interaction is displayed in Figure 1.

<u>Circadian Rhythms</u>. Time-of-day has been demonstrated to have significant effects in many types of human performance (Blake, 1967; Colquhoun, 1971; Kerkhof, 1985; Revelle, 1989). These effects have been attributed to variation in circadian arousal levels affecting an individual's level of alertness or fatigue. If an individual is tested at the time when their arousal level is peaked, they should be more active, aroused, and alert. Such high levels of arousal should positively affect one's performance on speeded tests. The higher levels of arousal should allow one to be more alert, respond more quickly to stimuli, etc.. Individuals could be characterized as having peak times either in the morning or in the afternoon/evening (Bodenhausen, 1990). If the testing time (morning or afternoon/evening) corresponds to the time when an individual's level of

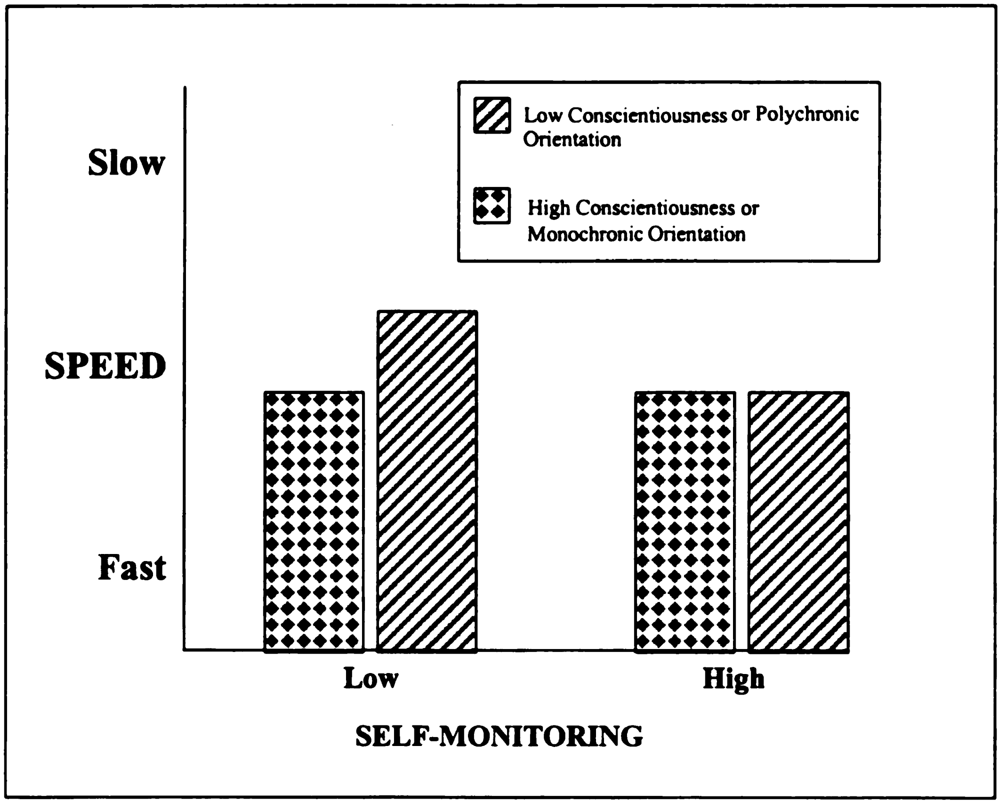

Figure 1
Hypothesized Interaction Between Self-Monitoring and Personality Characteristics on Measures of Speed

circadian rhythms is at a peak, the individual should have higher levels of alertness leading to higher performance on the speeded test.

Hypothesis 9: Individuals whose testing time (morning or afternoon/evening) matches the time when their circadian rhythm level is highest should perform better on measures of speed than individuals whose testing time does not match their peak level based on circadian rhythms.

Anxiety. The speeded test scenario has a definite time pressure component involved. In a way, individuals are "racing" against the clock to either complete as many tasks as possible in a limited time period or they are attempting to complete the task in as little time as possible. Such pressure could increase an individual's anxiety and thereby reduce the amount of on-task effort that is exerted on the completion of the measure of speed. Instead, individuals could be concerned about how well they are doing, how well others are doing, how much time is left, etc.. The more time pressure or the more difficult the task, the higher the levels of reported comparative anxiety and external attribution of poor scores (Arvey et al, 1990). Research by Arvey and colleagues (1990) found that comparative anxiety due to the testing situation was significantly related to scores on speeded tests of data comparisons ($r = -.213$, $p < .05$). A major problem with the relationship between anxiety and speeded test performance is the difficulty in determining causality (Chan et al, 1996). It is difficult to determine if the anxiety is causing poor performance or if poor performance is leading is external attributions of anxiety. Therefore statements of causality cannot be made with complete certainty.

However, in either case, a negative relationship between anxiety and performance on speeded tests is expected.

Hypothesis 10: Individuals who are high as opposed to low in reported anxiety should be associated with poorer performance on measures of speed.

Other Influences: Covariates

In addition to the above influences, age, test-taking motivation, and perceived face validity could have an influence on measures of speed. However, restriction of range in an applicant setting, most typically for entry level positions, could nullify the impact of each of the variables. Each of the variables will be assessed in the research but will serve as control variables.

Overall, the model for first research objective exploring the relationships of important factors with speed is highlighted in hypotheses 1-10 and displayed in Figure 2. Hypothesis 1 represents the effect of cognitive ability on measures of speed and hypotheses 2-6 represent the relationships of noncognitive personality characteristics (impatience/irritability, conscientiousness, monochronic/polychronic orientation, and pace) with speed. Of these six, only hypothesis 4 explores the relationship between a noncognitive measure (achievement) and errors committed on speeded tests. Hypotheses 7 and 8 highlight the interactive effects of self-monitoring with measures of speed. Hypotheses 9 and 10 examine the relationships between two person-situational influences (circadian rhythms and anxiety) on speeded test performance.

The preceding hypotheses encompass the first objective of the research investigating the relationships of important factors with measures of speed. The second

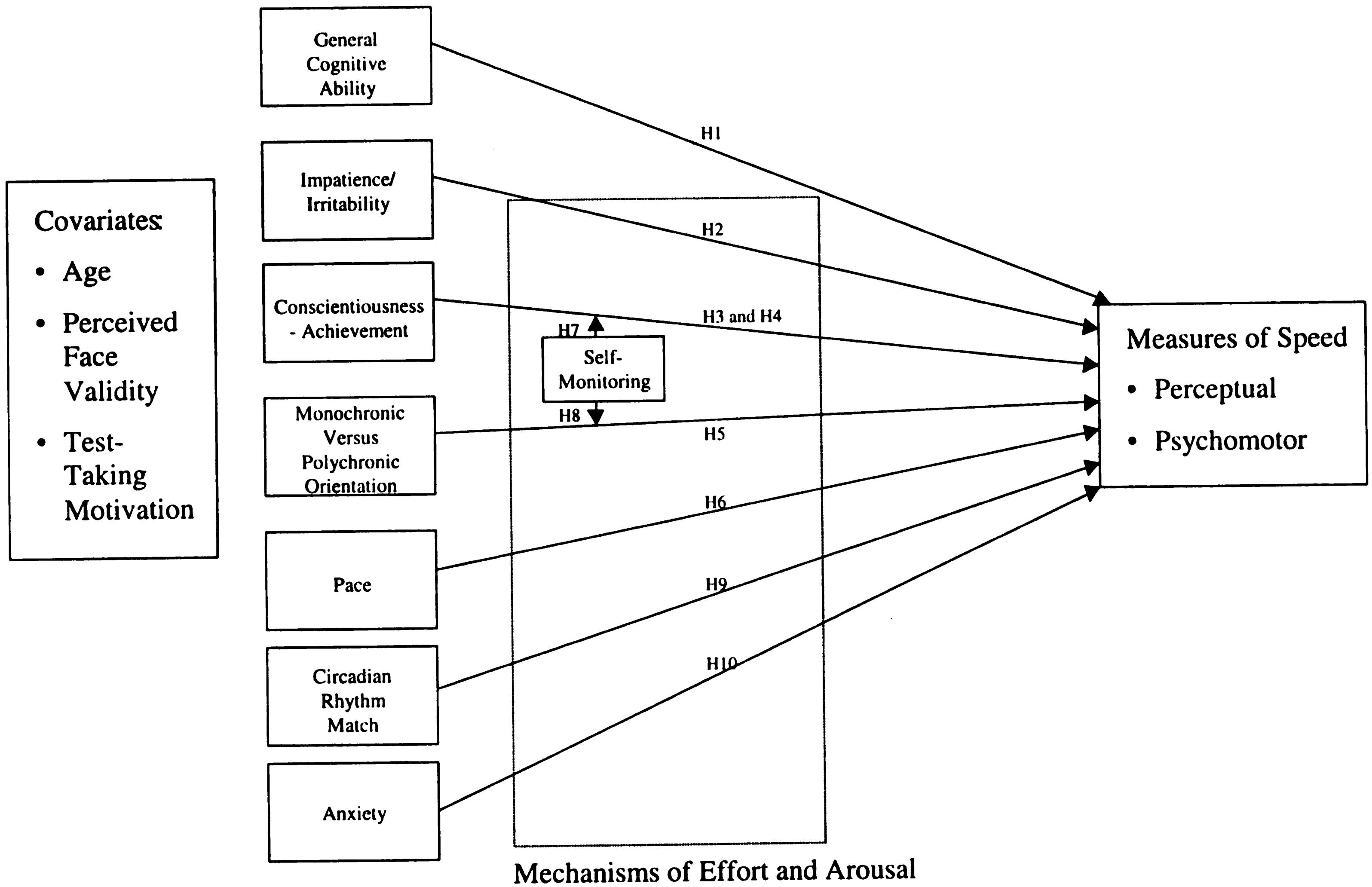

Figure 2:
Relationships with Measures of Speed

objective of the research is to examine the incremental validity of speeded test scores above and beyond cognitive ability on job performance and will be expanded upon in the following paragraphs.

Research Study: Incremental Validity of Speed on Job Performance

A second major question being asked by the current research is the relationship of measures of speed to measures of job performance. In other words, do differences in the speed by which individuals complete tasks influence overall job performance? Much research has demonstrated the relationship of cognitive ability and job performance across a wide range of jobs (e.g., Hunter & Hunter, 1984) with some researchers indicating that other variables might add little to the overall prediction of job performance above and beyond the predictability associated with general cognitive ability (e.g., Ree & Earles, 1992). While not directly the focus of the study, a relationship between cognitive ability and performance is expected.

Hypothesis 11: Individuals with higher measures of general cognitive ability should score higher on job performance measures.

However, the major question asked by the current research is whether or not measures of speed can add incremental validity after cognitive ability has been accounted for in predicting job performance. The criterion of performance is multidimensional in that certain dimensions of performance might be better predicted by cognitive ability while other dimensions of performance might be better predicted by other variables (Schneider & Hough, 1995). For instance, in Project A, criterion dimensions such as core technical proficiency were highly related to measures of cognitive ability, while criterion dimensions such as effort and discipline were highly related to personality constructs (McHenry et al, 1990). Measures of speed require individuals to work at a quick pace over a certain period of time. Criterion dimensions that might be related to speed include an individual's proficiency in meeting tight deadlines or working under pressure, demonstrating effort, and maintaining personal discipline. For these types of criterion dimensions of job performance, measures of speed might have the highest potential of adding incremental validity over cognitive ability. In scenarios measuring speed, individuals are completing tasks "against the clock" in such a way that time pressure is evident in the testing situations. Individuals who do well on these tasks can maintain effort and focus on the task and work at a quick pace. The tasks in a speeded test are at a low level of difficulty such that problem-solving activities and decision-making aspects of performance that are typically highly related to measures of general cognitive ability might be limited or reduced. When the level component (cognitive ability) is accounted for in performance measures, speed should still have an incremental effect on performance in these contexts, particularly with the criterion dimensions mentioned above that deal with meeting deadlines, maintaining deadlines, demonstrating effort, etc.

In addition to objective measures, subjective measures of performance provided by raters could be equally affected by individual differences in measures of speed. Some research has demonstrated that an individual's "implicit" theories of intelligence contain a notion that individuals who complete tasks faster are deemed more intelligent (Sternberg, 1985; Sternberg, Conway, Ketron, & Bernstein, 1981). Ratings of performance could be driven by the salience of viewing individuals working at a faster pace than others, even if they are performing the task incorrectly, or of viewing individuals developing solutions to problems faster than others, even if others would have come up with similar solutions. Therefore, speed might be viewed positively from raters in such a way that individuals who perform and discuss issues more quickly than others may be viewed more positively. While it is expected that measures representing effort would have a higher relationship with speed than other dimensions, general impressions and method effects from the assessment center will probably increase the relationship with speed as well (Gaugler et al, 1987).

Hypothesis 12: Measures of speed should add positive incremental validity, particularly with job performance measures that emphasize demonstrating effort, working under pressure, and meeting deadlines in job performance (work orientation ratings, number of units completed, and proportion of errors-quality) as opposed to performance measures which are non-effort based (e.g., team skills and problem solving ratings)

METHOD

Participants

The original sample consisted of 912 job applicants for an entry-level production position at a large manufacturing company. This sample was reduced using various data cleaning steps to eliminate individuals who did not appear to take the data collection seriously. First, three individuals were eliminated for failing to respond to more than 10% of the items on the additional research questionnaire. An additional 37 individuals were eliminated for not providing a response to the question involving age, a critical covariate in the study. An additional 18 individuals were eliminated for indicating that they were either neutral or had little interest in attaining the position for which they were applying. While failing to fully complete the items on the additional research questionnaire or indicating they had little interest in the job eliminated these applicants from this research, it did not have any effect on their employment eligibility. Finally, one individual was eliminated for not completing the measure of psychomotor speed to bring the final sample to 853 job applicants. In terms of the demographic characteristics of the sample, 54% were men, and 67% were white with the next largest minority group being African American (25%). In terms of age, 50% were less than 30 years old, 30% were between the ages of 31 and 40, 16% were between the ages of 41 and 50, and 4% were between the ages of 51 and 60. This sample exceeded the requirement of 348 applicants (see Appendix A) needed to detect small effect sizes ($\Delta R^2 = .03$) for the interactions at a power level of .80 and $\alpha = .05$ (Cohen, 1988). Of the 853 applicants, only 531 passed the cutoff established in the first phase of the selection process. Therefore, questions concerning incremental validity were based on that sample rather than the full sample of 853.

Measures Investigating Relationships with Speed

General cognitive ability. General cognitive ability was a composite of two tests measuring quantitative and reasoning abilities. The two tests, *Practical Arithmetic* (24 items) and *Following Policies and Procedures* (25 items), are each administered under time limits. Due to copyright and proprietary restrictions, these tests are not available for reproduction in the appendices. However, a controlled review of the instruments is available through the author. Such administration conditions are a concern in relationship to examining speed versus power issues by questioning the extent to which the relationship between cognitive ability and speed might be elevated due to the speeded nature of the cognitive ability tests. To alleviate such concerns, the Educational Testing Service (ETS) uses a "rule of thumb" approach whereby a test is considered speeded if less than 80% of the examinees finish the items (Peterson, 1993). In a study examining the speededness of the tests, it was found that 16% of a sample of examinees for an entry-level production job failed to finish the *Practical Arithmetic* test, and 20% failed to finish the *Following Policies and Procedures* test (n=2615). However, 96% of the examinees finished the first 18 items of *Practical Arithmetic* test and 95% of the examinees finished the first 20 items of the *Following Policies and Procedures* test. Using a conservative estimate in relationship to ETS's standard, the general cognitive ability measure will be a total score of those 38 items. 63 undergraduates from a large midwestern university completed both instruments along with the Wonderlic Personnel Test (1992), a well documented measure of general cognitive ability. A substantial relationship ($r = .83$; p <

.05) between the 38 item total score and scores on the Wonderlic were found after correcting for restriction of range due to differences between university (n=63) and job applicant (n=2615) samples. Further corrections for measurement error using a conservative estimate of reliability (.94) for the Wonderlic (Wonderlic, 1992) and a coefficient alpha of .88 for cognitive ability in the current research sample, found a "true" relationship of $r = .91$; $p < .05$.

Impatience/Irritability. A five-item measure based on the work by Spence and colleagues (1987) was used (see Appendix B). A coefficient alpha of .63 was found in the current research sample.

Conscientiousness. Two scales were used to assess conscientiousness. The first scale is a seven-item measure of achievement strivings (see Appendix C) based on the work of Spence and colleagues (1987) with a coefficient alpha of .64 in the current research. The second scale is a 23-item measure of conscientiousness using background information related to work from the *Work Experience and Interest Inventory*, a product of Aon Consulting which generated a coefficient alpha of .60 in the current research sample. Due to copyright and proprietary restrictions, these tests are not available for reproduction in the appendices. However, a controlled review of the instruments is available through the author.

Polychronic vs. monochronic orientation. A five-item scale based on the work of Kaufman and colleagues (1991) and Tuttle (1996) was used with higher scores representing polychronic orientation and lower scores representing monochronic orientation (see Appendix D). Current research found a coefficient alpha of .81.

Pace. A five-item scale based on the work of Tuttle (1996) was used with higher scores representing faster pace of life (see Appendix E). The current research sample found a coefficient alpha of .67.

Self-monitoring. Two options are present in measuring self-monitoring as conceptualized by Snyder: the original 25-item scale (Snyder, 1974) and a revised scale (Gangestad & Snyder, 1985) that contained 18 of the original items. Gangestad and Snyder (1985) removed seven items from the original scale that had low item-total correlations. Since all the items in the revised scale are contained in the original scale, the original scale will be used to assess proper coverage of the self-monitoring construct domain (see Appendix F). The current research found similar mean interitem intercorrelations between the two scales, therefore, the 25 item scale was used (coefficient alpha = .62).

Circadian rhythms match. A 13-item scale constructed by Smith and colleagues (1989) using the best characteristics of other circadian rhythm scales will be used in the current study (see Appendix G) High internal consistency estimates (α= .87, .83 on different samples of college students) and relationships to external criteria associated with morningness and eveningness have been reported for this scale. The current research sample found a coefficient alpha of .85. Using suggestions by Smith et al (1989), the scores of the scale were divided into three categories based on a 10-90 split. The top 10th percentile was equated with being a Morning Type, the bottom 10th percentile was equated with being an Evening Type, and the middle 80% were deemed Intermediate. Based on that categorization and the time of day individuals took the test (7:30 am, 1:30 pm) a circadian rhythms match variable was created. If a person was a

Morning Type and took the various measures in the morning or was an Evening Type and took the various measures in the afternoon, they were given a score of 3. If the reverse occurred (Morning & pm; Evening & am), individuals were given a score of 1. All other combinations received a score of 2.

Anxiety. The ten-item scale measuring comparative anxiety that was developed by Arvey and colleagues (1990) was used in the current study (see Appendix H). The scale displayed a high coefficient alpha (.85) in the current sample.

Covariate Measures

In addition to the above measures, 17 items (see Appendix I) were used to reflect various covariates including the following: (1) age (one item), (2) motivation consisting of interest in obtaining the job (one item) and test motivation (ten items from Arvey et al, 1990), and (3) perceived face validity (five items from Smither and colleagues (1993)). The test motivation and perceived face validity scales displayed high coefficient alphas (.83 and .81, respectively) in the current sample.

Measures of Speed

Attentive/Perceptual speed. Individuals completed the 60 item *Data Comparison Test*. Due to copyright and proprietary restrictions, these tests are not available for reproduction in the appendices. However, a controlled review of the instruments is available through the author. Individuals were presented with two lists, a list to be checked and a correct list. Each test contained four lists with 15 items per list. Participants determined whether any of the information in the two lists did not match exactly. Individuals had 10 minutes to work on the test. In a study examining the speededness of the tests, it was found that 98% of examinees for an entry-level production job failed to finish the test, providing sufficient basis to conclude that the test is highly speeded (n=2615). Scores were obtained on both how many items the participants finished and the proportion of correct answers obtained on those items (see Hypothesis 4).

Psychomotor speed. Participants took two similar forms of a test measuring psychomotor speed. In the first test (parts transfer), individuals were timed when moving a series of parts from one side of the testing kit to the other. In the second test (small parts), individuals were required to switch the order of a series of small pegs, so the bottom peg was on the top peg and vice versa. Individuals practiced both tests prior to testing to assure that they understand the nature of the exercise. Scores were obtained on both tests in terms of how long it took the participants to finish and how many errors were committed. However, errors on these tests were minimal. An average score representing the amount of time required to complete the two tests was used (coefficient alpha = .60).

Measures of Job Performance

In an assessment center exercise, participants worked individually to assemble "cam boxes" to supply a fictitious Install Team. Each participant produced cam box assemblies according to pre-determined instructions and put their completed units into a common bin. The group then discussed how to improve their efficiency. Then, participants began a second assembly session to test improvements. In this procedure, several performance dimensions were assessed. A more complete overview of the assessment phase is found in the procedure section that follows.

Subjective measures. Two raters provided ratings on behavioral checklists for three dimensions: work orientation, problem solving, and team skills, factors that are similar to those commonly found in assessment center activities (Schmitt, 1977). Due to copyright and proprietary restrictions, these tests are not available for reproduction in the appendices. However, a controlled review of the instruments is available through the author. Work orientation is defined as the willingness to accept personal responsibility for one's actions and performance and to recognize the importance of productivity and specific procedures. It also includes the ability to perform repetitive tasks and operations, including the ability to work without close supervision. Problem solving is the ability to learn, understand, and improve on ideas, systems, or processes, and to generate new ideas and techniques to solve problems or improve operations. Team skills represent the ability to interact effectively with others whether in a team or in one-to-one situations. This includes the ability and willingness to create and maintain cooperative relationships and to be sensitive to others' points of view as well as to tactfully deal with disagreements and demonstrate self-assurance and a positive point of view. All raters took a two-day course on how to administer and make ratings on the exercise and all passed a certification test to ensure they were able to correctly perform the task. In terms of the actual ratings, most applicants completed the assessment phase in groups of six. Each rater rated only four people, thereby allowing an overlap rating on 33% of the candidates. A final measure of each dimension was based on an average of the two ratings. If only one rating was provided, that rating was used as the final measure of the dimension. Interrater reliability estimates for work orientation, problem solving, and team skills were .40, .48, and .56 respectively (n=232).

Objective measures. In addition to the subjective measures, two objective measures were assessed. Participants were given instructions and a modeling display on how to create "cam boxes" and practiced constructing two of these devices following specific guidelines. To build the product, participants had to follow specific instructions. After that time, participants had 10 minutes to construct as many "cam boxes" as they could without having any construction errors or including defected parts in the box. In the exercise, participants placed their finished products in a common bin, unaware that their boxes were marked to identify the individual who constructed the box. Measures were assessed both in terms of how many assembles were created and how many errors were made in the construction of the boxes. Measures of objective output were only taken after the first assembly period to control for any group effects that might have enhanced productivity in subsequent assembly periods.

Procedure

Testing phase. Participants applying for entry-level jobs with a large manufacturing company are part of a multiple hurdle selection process. At the first phase, applicants took a series of paper-and-pencil tests in the following order: (1) psychomotor speed, (2) *Following Policies and Procedures,* (3) *Practical Arithmetic*, and (4) *Data Comparison Test*. Halfway through the above tests, participants received a short break. After those tests were completed, paper-and-pencil questionnaires containing many of the above measures were administered. Participants were instructed that the results of the questionnaire are for research purposes only and that the results would not affect their status as a candidate. In addition, they completed a consent form before the questionnaire was administered explaining the nature of the study. Testing occurred in a group setting either in the morning or in the afternoon. Participants were randomly assigned to sessions or in cases of time conflicts, assigned to sessions based on their availability. In addition, applicants completed a series of applications and reference check forms as required by the manufacturing company and for system tracking reasons.

Assessment phase. After the testing phase was completed, individuals proceeded to the assessment phase of the selection process if their test scores were above the cutoffs set. Only 62% of the 853 applicants passed the cut scores of the testing phase, thereby, reducing the sample to 531 applicants. The assessment phase took place several days after the testing phase.

Assessment took place in groups of four to six individuals. Participants were seated in an assigned work station containing an assembly stand, a parts bin containing unassembled parts, a defects bin to place defected parts, and an example cam box. Participants were told not to handle any of the exercise materials. To begin the exercise, participants were welcomed and given a description of the day's activities. They were told that they would be given exercises that would simulate situations they might encounter on the job. In addition, applicants were told that the exercises were not a competition, so everyone could potentially do well. Next, participants were told that it was important to participate in the exercise and that by not participating they could be hurting their chance for employment. Participants were then asked to reply that they understand this. They also were told that all instructions would be read from a script by the raters and other than that, the observers would not participate during the exercise. At the conclusion of the introduction, participants were given a chance to ask questions.

After the instructions phase, participants were given an introduction to the nature of the exercise. They were told that they were a member of an assembly team for a company that manufactures "cam boxes," and that the company is facing tough competition and needs to improve its productivity and quality to stay profitable and the company is counting on the employees to help with this. They were also told that the company knows some of its assembly processes are inefficient and that the employees needed to suggest better ways of doing things. In the exercise, they were told that they must first assemble products according to specific instructions. Then the group would meet to come up with better ways of assembling boxes. They were told that they could completely change the way they were first told to work unless the instructions specifically tell them they can't. So, for the first part of the exercise, they must follow instructions exactly and for the second part they can change and improve the way they do work. Participants were then asked if they understand this. Some specific instructions they were told to follow for the exercise include the following: (1) immediately pick up any parts that you drop, (2) keep your work area neat, and (3) no running. They were also told that they could talk to each other anytime instructions were not being given or when questions were being answered. Finally, they were told that they did not need to know anything about assembly to do well in the exercise and that they would be provided with all the instructions they need. In addition, they were told that they would be provided handouts that they must read and follow closely. If a decision is not covered in the instructions or handouts, they were free to make it. At this point, participants were given time to ask questions.

After the introduction, participants were taken through a mini-training course on how to perform the task. They were introduced to their work station, the parts that would be used to assemble the boxes, the work aid sheet in front of them that outlined the procedures to follow in building cam boxes, and an example cam box that was correctly constructed. Next, participants were told that they must examine parts for defects and were visually given examples of each kind of defect. An outline of the defects was provided on their handout as well. Next, one rater provided a visual example of how to construct a box by going through all the required steps. Participants followed the process exactly and assembled a cam box while the rater demonstrated the process. At the end of the assembly demonstration, every participant placed their completed units in the same common bin in the center of their work stations. At the end of the demonstration, the participants were asked if they had any questions. After all questions were answered, participants were given a summary of the steps required to build cam boxes and then were told to complete two more cam boxes according to the process that was just demonstrated to them. They were also provided with a reproduction of the steps on the handout at each station. While building the two extra units, raters walked around the stations providing feedback to ensure that the participants understood the proper assembly process.

At the end of the training, participants began the exercise and were told they had 10 minutes to assemble boxes. They were told that they had been requested to make 60 boxes if they were a group of six participants, 50 boxes if they were a group of five participants, and 40 boxes if they were a group of four participants. Once again, they were told they must follow the assembly process steps exactly and were asked if they had any questions. They were also told that they would be notified when there were two minutes left and that they were free to talk to each other. At the end of ten minutes, participants were told to stop and disassemble any partially assembled units and place the parts back in their parts bin. When finished, each individual was given a suggestion sheet and three minutes to write down their own ideas for improving the cam box production. At the end of the three minutes, they were to hand the sheet to the rater.

During the first team meeting, the participants were told that they needed to report about their production during the first assembly session. They also were given a memo that stated exactly what they needed to do during the meeting. The rater passed out the memo and went over each step verbally with the participants. During the meeting, the participants checked the quality of the cam boxes produced using gauges, filled out a productivity chart outlining how many units were correctly assembled, and calculated the ratio of correctly built cam boxes compared to total cam boxes. In addition, the participants discussed how they would change their assembly methods to build more and better cam boxes. They were told that they could change anything to improve quality and productivity except one thing: each participant had to assemble their own cam boxes at their own station using their own parts. At the end of the discussion, the participants decided on a goal for the next 10-minute assembly session and using the productivity chart, they circled the number of units they would correctly assemble in the next session. They were also told that the company would use all of the cam boxes they could get. During the team meeting, they were notified that there were two things they could not do: (1) they could not move the unassembled parts, and (2) they could not disassemble or change any of the completed assemblies. They were told they would have 10 minutes to conduct the meeting, asked if they had any questions, and informed that they would be reminded when there were two minutes left. At the end of 10 minutes, they handed in all completed materials and cam boxes from the first assembly period.

After the team meeting, participants were given three minutes to set up their work stations for the next assembly period and asked if they had any questions. The only things they could not do were to begin to assemble units and check parts for defects. Once again, they were asked if they had any questions. At the end of the three minute set-up, the next ten-minute assembly period began with participants placing all completed boxes during the assembly period in the common bin again. Once again, participants were reminded when there were two minutes left and at the end of ten minutes, they were instructed to stop and disassemble any partially assembled cam boxes and put all unused parts away.

At the end of the second assembly period, participants conducted another team meeting where they repeated the activities that occurred in the first meeting. Once again they were reminded not to move unassembled parts or to disassemble or change completed assemblies. Participants were given ten minutes to conduct the meeting, asked if they had any questions, and told to begin. With two minutes remaining in the exercise, participants were reminded that they only had two minutes left. At the end of the ten minutes, participants were told to stop and return all the completed cam boxes and materials in the center bin. Participants at that point were told that the exercise was completed and thanked for their time.

After the participants left, raters scored the assembly units by placing each completed cam box assembly at the appropriate work station. Each cam box was identif

detect

each a

statio

inclu

Both

meas

rated

(pro

Da

dov

the

inv

of

C

co

th

n

t

p

identified using a UV light to read the station marker on the cam box. In addition, each defected part included in the cam boxes was identified using the UV light. Each box for each assembly session was assessed in terms of how many boxes were produced at each station, how many boxes were incorrectly assembled, and how many defected parts were included in cam boxes for the objective measures of performance (quantity and quality). Both quantity and quality measures were assessed for each assembly period, so separate measures could be obtained. At the end of the exercise, the two raters also individually rated the four candidates in the group on the three subjective dependent variables (problem solving, work orientation, and team skills) using behavioral checklists.

Data Analysis

To test and analyze the hypotheses in the current research, the results were broken down into two parts corresponding with the dual purposes of the present research. For the first part of the research, investigating relationships with measures of speed, the investigation of various relationships of cognitive and noncognitive factors on measures of speed is examined both for measures of psychomotor and perceptual speed (Data Comparison). This analysis was conducted in a series of steps. First, zero-order correlations and simple regressions (minus the covariates) were conducted to examine if there were any relationships between the measures of speed and the noncognitive measures and which of the noncognitive measures added the most predictive efficiency to the measures of speed. Second, the first group of covariates (age, test motivation, and perceived face validity) were added to the analysis to control for demographic and motivational differences of applicants. Partial correlations investigating bivariate relationships between the noncognitive measures and measures of speed with the covariates as controls were computed. Then hierarchical regression was used to control for the covariates prior to examining the noncognitive relationships. Finally, general cognitive ability, a well proven measure of speed, was added as a covariate in a second step to determine which noncognitive measures maintained their relationship to measures of speed after variance was accounted for by general cognitive ability and age, test motivation, and perceived face validity. Once again, three analyses were conducted using partial correlations and hierarchical regression with the covariates entered in the first two steps. These analyses satisfied the requirements for tests for hypotheses 1-3, 5-10. In each of these analyses, the product term between conscientiousness and self-monitoring (H7) and the product term between polychronic orientation and self-monitoring (H8) were added as the final step of the hierarchical regressions. This allowed the research to detect the role of self-monitoring as a potential moderator. Hypothesis 4, examining the relationship between measures of achievement and proportion correct in perceptual speed was examined using a similar series of analyses using proportion correct as the dependent variable rather than time or number completed.

The second section examines the research question investigating how much incremental validity do measures of speed add to the prediction of job performance above and beyond that of cognitive ability. To test the second major research question (H11 and H12), partial correlations and hierarchical multiple regression were used. The contribution of each individual measure of speed, perceptual and psychomotor, was assessed using partial correlations. Next, separate hierarchical multiple regressions were used to examine the contribution of both speed measures on the five measures of job performance. Larger relationships were expected on measures requiring effort, arousal, and maintaining discipline, performance constructs hypothesized to be most related to measures of speed. These measures include the total number of assemblies produced, the proportion of defects built into the assemblies, and work orientation. Two hierarchical multiple regressions were also performed on performance ratings of problem solving and team skills, dimensions that should not be as highly related to measures of speed.

RESULTS

Relationships with Measures of Speed

Bivariate relationships. Descriptive statistics and zero-order correlations between variables are presented in Table 2. In examining the matrix, significant positive relationships were found between general cognitive ability (H1), conscientiousness (H3), and pace (H6), with perceptual speed such that higher levels of measures of these constructs led to completing more items. A significant negative relationship was found between polychronic orientation (H3) and comparative anxiety (H10) with perceptual speed such that someone who was more oriented toward multiple activities and had more comparative anxiety completed less items than those with a more monochronic, singular focus and less anxiety. In addition, significant negative relationships were found between general cognitive ability (H1), conscientiousness (H3), and pace (H6), with psychomotor speed such that higher levels of these constructs were related to more time required to complete the task. A significant positive relationship was found between polychronic orientation (H3) and comparative anxiety (H10) with psychomotor speed such that someone who oriented toward multiple tasks and someone with higher levels of anxiety took more time to complete the task providing some initial support for those hypotheses.

Next stepwise hierarchical regression was utilized on perceptual speed and the results are presented in Table 3. Given the strong relationship between general cognitive ability and measures of speed, it was omitted from this analysis to determine the nature of the relationship of noncognitive measures with speed in the absence of such a factor.

Table 2
Summary of Means Standard Deviations, Reliabilities, and Zero-Order Intercorrelations Investigating Relationships to Measures of Speed

Variables		Mean	SD	01	02	03	04	05	06	07
01	General Cognitive Ability	26.56	6.63	(.88)						
02	Impatience/ Irritability	2.27	.53	-.02	(.63)					
03	Achievement	3.90	.46	.12*	-.29*	(.64)				
04	Conscientiousness	20.68	2.06	.28*	-.22*	.31*	(.60)			
05	Polychronic Orientation	3.14	.77	-.16*	.11*	-.21*	-.18*	(.81)		
06	Pace	3.75	.55	.10*	-.02	.36*	.14*	-.26*	(.67)	
07	Self-Monitoring	3.35	.31	-.04	-.21*	.06	.14*	.07*	-.08*	(.62)
08	Morningness	41.72	6.51	-.11*	-.31*	.32*	.21*	-.12*	.08*	.19*
09	Circad. Rhythm Match	2.06	.47	-.02	.03	.06	.00	.06	.02	.05
10	Comparative Anxiety	2.57	.68	-.45*	-.31*	-.18*	-20*	.10*	-.15*	.02
11	Age (Categorical)	1.74	.88	-.25*	.04	-.10*	.07*	.01	-.23*	.20*
12	Test Motivation	4.47	.43	.13*	-.19*	.34*	.23*	-.01	.22*	.10*
13	Perceived Face Validity	3.86	.67	.21*	-.20*	.28*	.23*	-.15*	.19*	.03
14	Perceptual Speed (Data Comparison)	31.19	7.69	.41*	-.01	.07*	.10*	-.11*	.12*	-.05
15	Perceptual Speed - Proportion Correct	.80	.13	.53*	-.02	.06	.20*	-.12*	.04	-.03
16	Psychomotor Speed (Average Time)	121.1	17.6	-.41*	.05	-.13	-.14*	.12*	-.16*	04
17	Total Assemblies	8.24	1.24	.01	-.03	-.02	.07	-.09*	.03	-.02
18	Proportion of Defective Parts	.088	.049	-.17*	-.06	.00	.05	-.07	-.03	.00
19	Problem Solving	4.98	1.15	.16*	.02	.07	-.03	-.05	.00	-.09*
20	Team Skills	5.45	1.17	.12*	-.02	.15*	.06	-.19*	.05	-.04
21	Work Orientation	5.29	.87	.19*	.06	.08	.03	-.04	.05	-.06

*p<.05; Reliabilities in the diagonal
n=853 for variables 1-16 (n=531 for means, SDs, & intercorrelations with variables 17-21)

Table 2 (cont'd)

	Variables	Mean	SD	08	09	10	11	12	13	14
01	General Cognitive Ability	26.56	6.63							
02	Impatience/ Irritability	2.27	.53							
03	Achievement	3.90	.46							
04	Conscientiousness	20.68	2.06							
05	Polychronic Orientation	3.14	.77							
06	Pace	3.75	.55							
07	Self-Monitoring	3.35	.31							
08	Morningness	41.72	6.51	(85)						
09	Circad. Rhythm Match	2.06	.47	.09*	---					
10	Comparative Anxiety	2.57	.68	-.07*	.00	(.85)				
11	Age (Categorical)	1.74	.88	.23*	.07*	.20*	---			
12	Test Motivation	4.47	.43	.09*	.07*	-.22*	-08*	(.83)		
13	Perceived Face Validity	3.86	.67	.12*	.08*	-.39*	-.10*	.33*	(.81)	
14	Perceptual Speed (Data Comparison)	31.19	7.69	-.06	-.02	-.31*	-.28*	.10*	.13*	---
15	Perceptual Speed - Proportion Correct	.80	.13	-.07*	.07	-.26*	-.18*	.13*	.15*	.17*
16	Psychomotor Speed (Average Time)	121.1	17.6	.08*	-.05	.24*	.39*	-09*	-.08*	-.29*
17	Total Assemblies	8.24	1.24	-.06	-.09*	-.03	-.13*	.02	.02	.22*
18	Proportion of Defective Parts	.088	.049	.04	.00	-.04	.13*	.01	.03	.05
19	Problem Solving	4.98	1.15	.04	.03	-.04	.05	.00	.00	.05
20	Team Skills	5.45	1.17	.09*	.00	-.05	.07	.00	.00	.08
21	Work Orientation	5.29	.87	.01	-.12*	-.02	-.03	-.09*	-.05	.11

*p<.05;
n=853 for variables 1-16 (n=531 for means, SDs, & intercorrelations with variables 17-21)
NOTE: reliabilities are in the diagonal

Table 2 (cont'd)

Variables		Mean	SD	15	16	17	18	19	20	21
01	General Cognitive Ability	26.56	6.63							
02	Impatience/ Irritability	2.27	.53							
03	Achievement	3.90	.46							
04	Conscientiousness	20.68	2.06							
05	Polychronic Orientation	3.14	.77							
06	Pace	3.75	.55							
07	Self-Monitoring	3.35	.31							
08	Morningness	41.72	6.51							
09	Circad. Rhythm Match	2.06	.47							
10	Comparative Anxiety	2.57	.68							
11	Age (Categorical)	1.74	.88							
12	Test Motivation	4.47	.43							
13	Perceived Face Validity	3.86	.67							
14	Perceptual Speed (Data Comparison)	31.19	7.69							
15	Perceptual Speed - Proportion Correct	.80	.13	---						
16	Psychomotor Speed (Average Time)	121.1	17.6	-.32*	---					
17	Total Assemblies	8.24	1.24	.08	-.20*	---				
18	Proportion of Defective Parts	.088	.049	-.07	.18*	.12*	---			
19	Problem Solving	4.98	1.15	-.01	-.11*	-.08	.00	(.48)		
20	Team Skills	5.45	1.17	.02	-.04	.00	.04	.39*	(.56)	
21	Work Orientation	5.29	.87	-.04	-.15*	-.06	-.05	.27*	.31*	(.40)

*p<.05;
n=853 for variables 1-16 (n=531 for means, SDs, & intercorrelations with variables 17-21)
NOTE: reliabilities are in the diagonal

Table 3
Result of Simple Regression Predicting Perceptual Speed (No Covariates)

Variable	Step Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Impatience/Irritability	.10*	.10				
Conscientiousness	.04	-.32				
Polychronic Orientation	-.07*	.09				
Pace	.05	.05				
Circadian Rhythm Match	-.02	-.02				
Comparative Anxiety	-.32*	-.32				
Self-Monitoring	-.02	-.30	16.12	.34	.12*	
Step 2						
Self Monitoring X Conscientiousness	.53	.53				
Self-Monitoring X Polychronic Orientation	-.17	-.17	12.66	.34	.12*	.00

*$p < .05$
n=853
NOTE: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

In the first step, impatience/irritability, conscientiousness, polychronic orientation, pace, circadian rhythm match, comparative anxiety, and self monitoring were entered as a block resulting in a significant R^2 of .12 ($p < .05$). At this step, impatience/irritability (H2) displayed a significant positive relationship with perceptual speed such that individuals who were more impatient/irritable completed more items on the Data Comparison test. Also, polychronic orientation (H5) and comparative anxiety (H10) displayed significant negative relationships with number of items completed on the perceptual speed measure such that a person who typically focused on multiple activities or had higher levels of anxiety completed less items on a perceptual speed measure than those with a more monochronic orientation or possessing lower levels of anxiety. At the second step, the interactions between self-monitoring and conscientiousness (H9) and self-monitoring and polychronic orientation (H10) failed to provide a significant change in R^2 providing no support for these hypotheses.

Next stepwise hierarchical regression was utilized on psychomotor speed and the results are presented in Table 4. Once again, general cognitive ability was omitted from this analysis to determine the nature of the relationship of noncognitive measures with speed in the absence of such a strong factor. In the first step, impatience/irritability, conscientiousness, polychronic orientation, pace, circadian rhythm match, comparative anxiety, and self monitoring were entered as a block resulting in a significant R^2 of .09 ($p < .05$). At this step, conscientiousness (H3), and pace (H6) and displayed significant negative relationships with psychomotor speed such that higher levels of these constructs resulted in

Table
Resu

Var

Ste
Imp

Con

Pol

Pac

Cir

Co

Sel

Ste
Sel
Co

Sel
Or

*p <
n=8
NO

Table 4
Result of Simple Regression Predicting Psychomotor Speed (No Covariates)

Variable	Step Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Impatience/Irritability	-.03	-.03				
Conscientiousness	-.08*	-.13				
Polychronic Orientation	.06	.73				
Pace	-.10*	-.10				
Circadian Rhythm Match	-.05	-.05				
Comparative Anxiety	.21*	.21				
Self-Monitoring	.03	.24	11.39	.29	.09*	
Step 2						
Self Monitoring X Conscientiousness	.06	.06				
Self-Monitoring X Polychronic Orientation	-.74	-.74	9.27	.30	.09*	.00

*p < .05
n=853
NOTE: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

less time required to complete the psychomotor task. Comparative anxiety (H10) displayed a significant positive relationship with psychomotor speed such that the more anxiety experienced, the longer it took to complete the psychomotor tasks. At the second step, the interactions between self-monitoring and conscientiousness (H9) and self-monitoring and polychronic orientation (H10) failed to provide a significant change in R^2 providing no support for these hypotheses.

Covarying out age, test motivation, and perceived face validity. Partial correlations between variables are presented in Table 5 after controlling for variance accounted for by the applicant's age, level of test motivation, and perceived face validity. In examining the matrix, significant positive relationships were found between conscientiousness (H3) with perceptual speed such that higher levels of conscientiousness was related to completing more items. Significant negative relationships were found between polychronic orientation (H3) and comparative anxiety (H10) with perceptual speed such that someone who was more oriented toward multiple activities or had higher with levels of anxiety completed less items than those with a more monochronic, singular focus or lower anxiety. In addition, significant negative relationships were found between conscientiousness (H3), pace (H6), and circadian rhythm match (H9) with psychomotor speed such that higher levels of these constructs were related to less time required to complete the task. Significant positive relationships were found between polychronic orientation (H3) and comparative anxiety (H10) with psychomotor speed such that someone who oriented toward multiple tasks or had higher anxiety took more time to complete the task, providing some initial support for those hypotheses.

Table 5
Summary of Partial Correlations Investigating Relationships to Measures of Speed Controlling for Age, Test Motivation and Perceived Face Validity

Variables		01	02	03	04	05	06	07	08	09
01	Impatience/ Irritability	(.63)								
02	Conscientiousness	-.16*	(.60)							
03	Polychronic Orientation	.09*	-.16*	(.81)						
04	Pace	.04	.10*	-.25*	(.67)					
05	Self-Monitoring	-.21*	.10*	.07*	-.06*	(.62)				
06	Circadian Rhythm Match	.05	-.04	.07	.02	.03	---			
07	Comparative Anxiety	.24*	-.12*	.05	-.04	.01	.02	(.85)		
08	Perceptual Speed	.03	.10*	-.10*	.03	.00	-.01	-.25*	---	
09	Psychomotor Speed (Average Time)	.02	-.17*	.12*	-.07*	-.04	-.07*	.17*	-.19*	---

*p < .05
n=853
NOTE: Reliabilities are displayed in the diagonal

Next stepwise hierarchical regression was utilized on perceptual speed and the results are presented in Table 6. Given the strong relationship between general cognitive ability and measures of speed, it was omitted from this analysis to determine the nature of the relationship of noncognitive measures with speed in the absence of such a strong factor. In the first step, age, test motivation and perceived face validity were entered as a block resulting in a significant R^2 of .09 ($p < .05$). At this step, age displayed a significant negative relationship such that the younger the applicant the more items completed on the Data Comparison test. Perceived face validity also displayed a significant positive relationship with perceptual speed such that people who thought the tests were more face valid completed more items on the Data Comparison test. At the second step, impatience/irritability, conscientiousness, polychronic orientation, pace, circadian rhythm match, comparative anxiety, and self monitoring were entered as a block resulting in a significant ΔR^2 of .08 ($p < .05$). At this step, impatience/irritability (H2), and conscientiousness (H3) displayed significant positive relationships with perceptual speed such that higher levels of these constructs resulted in the completion of more items on the Data Comparison test. Also, polychronic orientation (H5) and comparative anxiety (H10) displayed significant negative relationships with number of items completed on the perceptual speed measure such that a person who typically focused on multiple activities or who had higher levels of anxiety completed less items on a perceptual speed measure than those with a more monochronic orientation or lower levels of anxiety. At the third step, the interactions between self-monitoring and conscientiousness (H9) and self-monitoring and

Table 6
Result of Simple Regression Predicting Perceptual Speed Controlling for Age, Test Motivation, and Perceived Face Validity

Variable	Step Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Age	-.27*	-.24				
Test Motivation	.04	.03				
Perceived Face Validity	.09*	-.01	29.05	.30	.09*	
Step 2						
Impatience/Irritability	.11*	.11				
Conscientiousness	.07*	-.34				
Polychronic Orientation	-.08*	.02				
Pace	-.01	-.01				
Circadian Rhythm Match	.00	.00				
Comparative Anxiety	-.28*	-.28				
Self-Monitoring	.02	-.32	17.15	.41	.17*	.08*
Step 3						
Self Monitoring X Conscientiousness	.60	.60				
Self-Monitoring X Polychronic Orientation	-.11	-.11	14.39	.41	.17*	.00

*p < .05
n=853
NOTE: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

polychronic orientation (H10) failed to provide a significant change in R^2 providing no support for these hypotheses.

Next stepwise hierarchical regression was utilized on psychomotor speed and the results are presented in Table 7. Given the strong relationship between general cognitive ability and measures of speed, it was again omitted from this analysis. In the first step, age, test motivation and perceived face validity were entered as a block resulting in a significant R^2 of .16 ($p < .05$). At this step, age displayed a significant positive relationship such that the older the applicant the more time was required to complete the psychomotor task. At the second step, impatience/irritability, conscientiousness, polychronic orientation, pace, circadian rhythm match, comparative anxiety, and self monitoring were entered as a block resulting in a significant ΔR^2 of .06 ($p < .05$). At this step, conscientiousness (H3) and circadian rhythm match (H9) displayed significant negative relationships with psychomotor speed such that higher levels of these constructs resulted in the less time required to complete the psychomotor task. Also, polychronic orientation (H5) and comparative anxiety (H10) displayed significant positive relationships with the time required to complete the psychomotor task such that a person who typically focused on multiple activities or with higher levels of anxiety required more time to complete the task than those with a more monochronic orientation or lower levels of anxiety. At the third step, the interactions between self-monitoring and conscientiousness (H9) and self-monitoring and polychronic orientation (H10) failed to provide a significant change in R^2. However, the product term between self-monitoring and polychronic orientation demonstrated a significant negative beta weight ($\beta = -.82$, $p < .05$). The interaction term

Table 7
Result of Simple Regression Predicting Psychomotor Speed Controlling for Age, Test Motivation, and Perceived Face Validity

Variable	Step Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Age	.38*	.38				
Test Motivation	-.05	-.01				
Perceived Face Validity	-.02	.08	51.98	.39	.16*	
Step 2						
Impatience/Irritability	-.05	-.05				
Conscientiousness	-.13*	-.13				
Polychronic Orientation	09*	.83				
Pace	-.02	-.02				
Circadian Rhythm Match	-.08*	-.08				
Comparative Anxiety	.16*	.16				
Self-Monitoring	-.04	.24	23.08	.46	.22*	.06*
Step 3						
Self Monitoring X Conscientiousness	.00	.00				
Self-Monitoring X Polychronic Orientation	-.82*	-.82	19.71	.47	.22*	.00

*$p < .05$
n=853
NOTE: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

(H10) demonstrated that performance differences on the psychomotor task attributable to polychronic orientation (favoring monochronic orientation) decreased as levels of self-monitoring increased providing some support for the hypothesis (see Figure 3).

Covarying out age, test motivation, perceived face validity, and general cognitive ability. Partial correlations between variables are presented in Table 8 after controlling for variance accounted for by the applicant's age, level of test motivation, perceived face validity, and general cognitive ability. In examining the matrix, significant negative relationships were found only between comparative anxiety (H10) with perceptual speed such that lower levels of anxiety led to completing more items. However, significant negative relationships were found between conscientiousness (H3), pace (H6), and circadian rhythm match (H9) with psychomotor speed such that higher levels of these constructs were related to less time required to complete the task and a significant positive relationship was found between polychronic orientation (H3) and psychomotor speed such that someone who oriented toward multiple tasks took more time to complete the task, providing some initial support for those hypotheses.

Next, stepwise hierarchical regression was utilized on perceptual speed and the results are presented in Table 9. In the first step, age, test motivation and perceived face validity were entered as a block resulting in a significant R2 of .09 ($p < .05$). At this step, age displayed a significant negative relationship such that the younger the applicant the more items completed on the Data Comparison test. Perceived face validity also displayed significant a positive relationship with perceptual speed such that people who thought the tests were more face valid completed more items on the Data Comparison test. At the

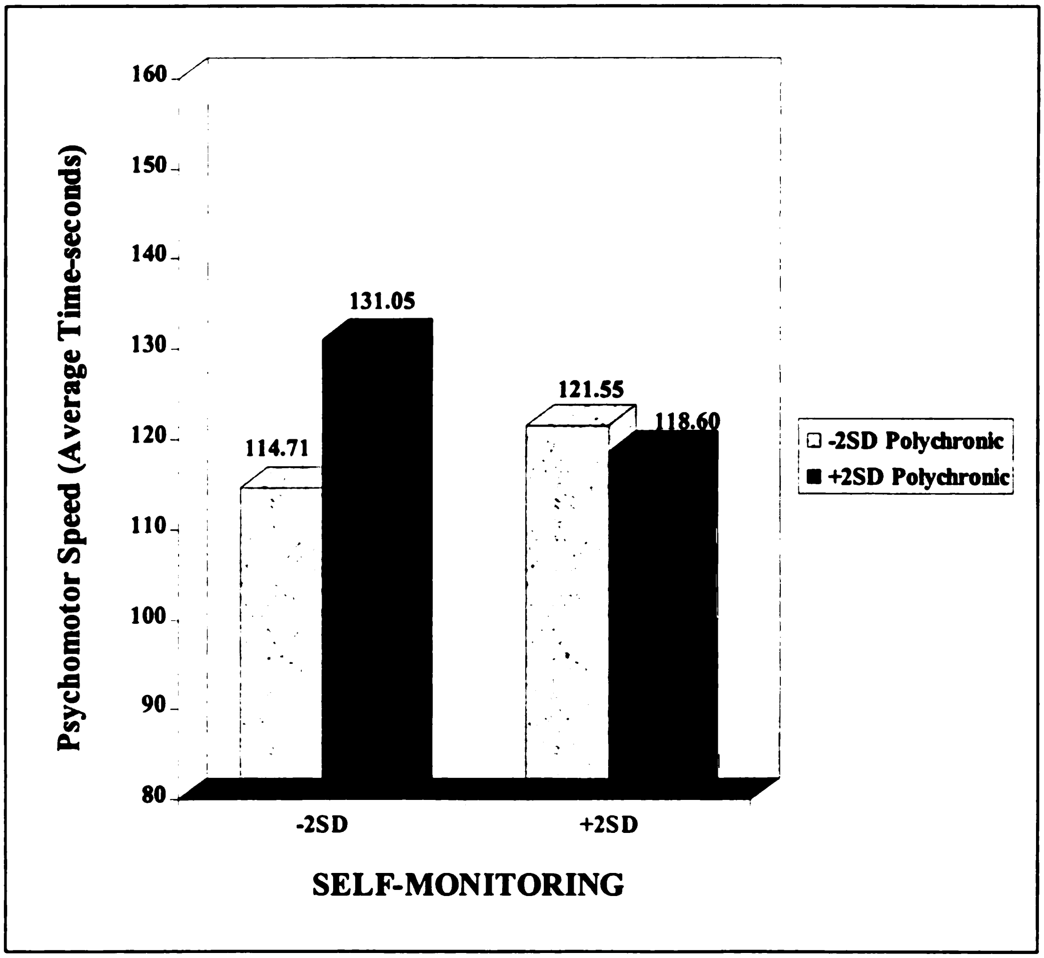

Figure 3:
Interaction Between Polychronic Orientation and Self-Monitoring on Psychomotor Speed

Table 8
Summary of Partial Correlations Investigating Relationships to Measures of Speed Controlling for Age, Test Motivation, Perceived Face Validity, and Cognitive Ability

	Variables	01	02	03	04	05	06	07	08	09
01	Impatience/ Irritability	(.63)								
02	Conscientiousness	-.18*	(.60)							
03	Polychronic Orientation	.10*	-.13*	(.81)						
04	Pace	.04	.11*	-.25*	(.67)					
05	Self-Monitoring	-.21*	.10*	.07*	-.06*	(.62)				
06	Circadian Rhythm Match	.05	-.03	.06	.02	.03	---			
07	Comparative Anxiety	.28*	-.02	.00	-.04	.01	.01	(.85)		
08	Perceptual Speed	.01	.00	-.05	.03	.00	.00	-.14*	---	
09	Psychomotor Speed (Average Time)	.04	-.08*	.08*	-.07*	-.04	-.09*	.05	-.08*	---

*p < .05
n=853
NOTE: Reliabilities are displayed in the diagonal

Table 9
Result of Simple Regression Predicting Perceptual Speed Controlling for Age, Test Motivation, Perceived Face Validity, and General Cognitive Ability

Variable	Step Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Age	-.27*	-.18				
Test Motivation	.04	.02				
Perceived Face Validity	.09*	-.02	29.05	.30	.09*	
Step 2						
General Cognitive Ability	.36*	.29	55.38	.46	.21*	.12*
Step 3						
Impatience/Irritability	.06	.06				
Conscientiousness	.00	-.29				
Polychronic Orientation	-.05	.16				
Pace	.01	.01				
Circadian Rhythm Match	.00	.00				
Comparative Anxiety	-.16*	-.16				
Self-Monitoring	.02	-.17	22.43	.48	.23*	.02*
Step 4						
Self Monitoring X Conscientiousness	.42	.42				
Self-Monitoring X Polychronic Orientation	-.24	-.24	19.05	.48	.23*	.00

*p < .05
n=853
NOTE: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

second step, general cognitive ability (H1) was entered resulting in a significant ΔR^2 of .12 ($p < .05$), such that individuals with higher levels of general cognitive ability completed more items on the perceptual speed test. At the third step, impatience/irritability, conscientiousness, polychronic orientation, pace, circadian rhythm match, comparative anxiety, and self monitoring were entered as a block resulting in a significant ΔR^2 of .02 ($p < .05$). At this step, only comparative anxiety (H10) displayed a significant negative relationship with perceptual speed such that those individuals with lower levels of anxiety completed more items on the Data Comparison test. At the fourth step, the interactions between self-monitoring and conscientiousness (H9) and self-monitoring and polychronic orientation (H10) failed to provide a significant change in R^2, providing little support for these hypotheses.

Next stepwise hierarchical regression was utilized on psychomotor speed and the results are presented in Table 10. In the first step, age, test motivation and perceived face validity were entered as a block resulting in a significant R^2 of .16 ($p < .05$). At this step, age displayed a significant positive relationship such that the older the applicant the more time was required to complete the psychomotor task. At the second step, general cognitive ability (H1) was entered resulting in a significant ΔR^2 of .10 ($p < .05$) such that individuals with higher levels of general cognitive ability required less time to complete the psychomotor task. At the third step, impatience/irritability, conscientiousness, polychronic orientation, pace, circadian rhythm match, comparative anxiety, and self monitoring were entered as a block resulting in a significant ΔR^2 of .02 ($p < .05$). At this step, only circadian rhythm match (H9) displayed a significant negative relationship with psychomotor speed

Table 10
Result of Simple Regression Predicting Psychomotor Speed Controlling for Age, Test Motivation, Perceived Face Validity, and General Cognitive Ability

Variable	Step Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Age	.38*	.32				
Test Motivation	-.05	.00				
Perceived Face Validity	-.02	.08	51.98	.39	.16*	
Step 2						
General Cognitive Ability	-.34*	-.30	73.53	.51	.26*	.10*
Step 3						
Impatience/Irritability	.01	.01				
Conscientiousness	-.06	-.19				
Polychronic Orientation	.06	.69				
Pace	-.04	-.04				
Circadian Rhythm Match	-.08*	-.08				
Comparative Anxiety	.04	.04				
Self-Monitoring	.04	.08	29.29	.53	.28*	.02*
Step 4						
Self Monitoring X Conscientiousness	.18	.18				
Self-Monitoring X Polychronic Orientation	-.69	-.69	25.17	.53	.28*	.00

*$p < .05$
n=853
NOTE: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

such

com

spe

(HS

cha

con

Tal

co

ac

tes

co

.0

hy

th

In

v

c

z

r

c

such that those individuals whose circadian rhythm style better matched the time they completed the testing phase required less time to complete the measure of psychomotor speed. At the fourth step, the interactions between self-monitoring and conscientiousness (H9) and self-monitoring and polychronic orientation (H10) failed to provide a significant change in R^2 providing no support for these hypotheses. A summary of the various analyses conducted to investigate the relationships of factors to measures of speed is displayed in Table 11 and will be discussed more fully in the Discussion section.

In addition, the relationship between achievement (H4) and number of errors completed was also examined. Results found that the zero-order intercorrelation between achievement and percentage correct ($r = .06$), the partial correlation controlling for age, test motivation, and perceived face validity ($r = -.02$), and the partial correlation controlling for age, test motivation, perceived face validity, and cognitive ability ($r = -.03$) all were nonsignificant ($p > .05$), thereby providing no support for the fourth hypothesis that achievement would be negatively related to proportion of correct items in the perceptual speed measure.

Incremental Validity of Measures of Speed

The second major purpose of this research was to investigate the incremental validity of these measures of speed over that of the relationship between general cognitive ability and job performance. Table 12 summarizes the descriptive statistics and zero-order correlations between variables. General cognitive ability displayed significant relationships with all measures of job performance with the exception of total assemblies completed, thus providing support for hypothesis 11. Individuals with higher levels of

Table 11
Hypothesis Summary Investigating Relationships to Measures of Speed

	Zero-Order Correlations and Hierarchical Regression Without Covariates		
	Table 2	Table 3 Perceptual	Table 4 Psychomotor
H2: Cognitive Ability	Support	N/A	N/A
H2: Impatience/Irritability	No Support	Support	No Support
H3:Conscientiousnes	Support	No Support	Support
H5: Polychronic Orientation	Support	Support	No Support
H6: Pace	Support	No Support	Support
H7: Self-Monitoring X Conscientiousness	N/A	No Support	No Support
H8: Self-Monitoring X Polychronic Orientation	N/A	No Support	No Support
H9: Circadian Rhythm Match	No Support	No Support	No Support
H10: Comparative Anxiety	Support	Support	Support

Table 11 (cont'd)

	Partial Correlations and Hierarchical Regression Covarying Out Age Test Motivation, and Perceived Face Validity		
	Table 5	Table 6 Perceptual	Table 7 Psychomotor
H1: Cognitive Ability	N/A	N/A	N/A
H2: Impatience/Irritability	No Support	Support	No Support
H3:Conscientiousnes	Support	Support	Support
H5: Polychronic Orientation	Support	Support	Support
H6: Pace	Partial Support (Psychomotor Only	No Support	Support
H7: Self-Monitoring X Conscientiousness	N/A	No Support	No Support
H8: Self-Monitoring X Polychronic Orientation	N/A	No Support	Support
H9: Circadian Rhythm Match	Partial Support (Psychomotor Only	No Support	No Support
H10: Comparative Anxiety	Support	Support	Support

Table 11 (cont'd)

	Partial Correlations and Hierarchical Regression Covarying Out Age, Test Motivation, Perceived Face Validity, and Cognitive Ability		
	Table 8	Table 9 Perceptual	Table 10 Psychomotor
H1: Cognitive Ability	N/A	Support	Support
H2: Impatience/Irritability	No Support	No Support	No Support
H3:Conscientiousnes	Partial Support (Psychomotor Only)	No Support	No Support
H5: Polychronic Orientation	Partial Support (Psychomotor Only)	No Support	No Support
H6: Pace	Partial Support (Psychomotor Only)	No Support	No Support
H7: Self-Monitoring X Conscientiousness	N/A	No Support	No Support
H8: Self-Monitoring X Polychronic Orientation	N/A	No Support	No Support
H9: Circadian Rhythm Match	Partial Support (Psychomotor Only)	No Support	Support
H10: Comparative Anxiety	Partial Support (Perceptual Only)	Support	No Support

Table 12
Summary of Means, Standard Deviations, Reliabilities, and Zero-Order Intercorrelations Investigating the Incremental Validity of Speed

Variables		Mean	SD	01	02	03	04	05	06	07	08
01	General Cognitive Ability	29.35	4.23	(.88)							
02	Perceptual Speed (Data Comparison)	33.06	6.81	.17*	---						
03	Psychomotor Speed (Average Time)	113.20	11.21	-.08	-.12*	(.60)					
04	Total Assemblies	8.24	1.24	.01	.22*	-.20*	---				
05	Proportion of Defective Parts	.088	.049	-.17*	.05	.18*	.12*	---			
06	Problem Solving Rating	4.98	1.15	.16*	.05	-.11*	-.08	.00	(.48)		
07	Team Skills Rating	5.45	1.17	.12*	.08	-.04	.00	.04	.39*	(.56)	
08	Work Orientation Rating	5.29	.87	.19*	.11*	-.15*	-.06	-.05	.27*	.31*	(.40)

*$p < .05$
n=531
NOTE: Reliabilities are displayed in the diagonal

general cognitive ability had a lower proportion of defective parts, and higher ratings of problem solving, team skills, and work orientation. Perceptual speed displayed significant validity with two measures of performance, total number of assemblies completed and work orientation. However, these two measures were ones that most emphasized demonstrating effort, working under pressure, and meeting deadlines. Psychomotor speed displayed significant validity with all the measures of job performance with the exception of team skills. All but problem solving were dimensions that most emphasized demonstrating effort, working under pressure, and meeting deadlines.

Partial correlations between variables are presented in Table 13 after controlling for the variance accounted for by general cognitive ability. In examining the matrix, perceptual speed only demonstrated significant positive relationship with total units built such that individuals who completed more items on the Data Comparison test were able to build more assemblies. However, perceptual speed failed to display significant relationships with proportion of defective parts and work orientation, thereby only providing partial support for the incremental validity of perceptual speed. Psychomotor speed continued to display significant relationships with all the performance measures with the exception of team skills. In addition, the relationship between psychomotor speed and the rating of problem solving displayed the lowest validity ($r = -.10$, $p < .05$) of the four significant validities. Therefore validity was maintained even after variability incognitive ability was controlled with the strongest relationships being exhibited in performance dimensions related to effort and discipline.

Table 13
Summary of Partial Correlations Investigating the Incremental Validity of Speed Controlling for Cognitive Ability

	Variables	01	02	03	04	05	06	07
01	Perceptual Speed (Data Comparison)	---						
02	Psychomotor Speed (Average Time)	-.11*	(.60)					
03	Total Assemblies	.22*	-.20*	---				
04	Proportion of Defective Parts	.08	.17*	.12*	---			
05	Problem Solving Rating	.02	-.10*	-.08	.03	(.48)		
06	Team Skills Rating	.06	-.03	.00	.07	.38*	(.56)	
07	Work Orientation Rating	.08	-.14*	-.07	-.02	.25*	.30*	(.40)

*$p < .05$
n=531
NOTE: Reliabilities are displayed in the diagonal

Next, hierarchical multiple regression were conducted on each of the five measures of job performance. First, regressions were performed on the three measures where significant incremental validity was expected (proportion of defects, total assemblies built, and work orientation). Second, regressions were performed on two measures where significant incremental validity was not expected (problem solving, team skills).

Relationships with performance dimensions related to effort and discipline. The first stepwise hierarchical multiple regression examined the incremental validity in the prediction of proportion of defects and is displayed in Table 14. In the first step, general cognitive ability resulted in a significant R^2 of .03 ($p < .05$). At this step, general cognitive ability displayed a significant negative relationship such that the higher level of general cognitive ability, the lower the proportion of defects in built units, thus providing support for hypothesis 11. At the second step, perceptual speed and psychomotor speed were entered resulting in a significant ΔR^2 of .04 ($p < .05$) At this step, perceptual speed displayed significant positive relationships with proportion of defects such that higher levels of perceptual speed resulted in a higher proportion of defects. Also the time required to complete the psychomotor task also displayed a significant positive relationship with proportion of defects such that people who took less time to complete the psychomotor tasks also had a lower proportion of defects in their built units, providing some support for the twelfth hypothesis.

The second stepwise hierarchical multiple regression examined the incremental validity in the prediction of total number of assemblies and is displayed in Table 15. In the first step, general cognitive ability resulted in a nonsignificant R^2, thus providing a lack of

Table 14
Result of Simple Regression Predicting Proportion of Defects Built Controlling for Cognitive Ability

Variable	Step Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Cognitive Ability	-.17*	-.18	15.95	.17	.03*	
Step 2						
Psychomotor Speed	.18*	.18				
Perceptual Speed	.10*	.10	12.77	.26	.07*	.04*

*$p < .05$
n=531

Note: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

Table 15
Result of Simple Regression Predicting Total Assemblies Built Controlling for Cognitive Ability

Variable	Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Cognitive Ability	.01	-.04	.073	.01	.00	
Step 2						
Psychomotor Speed	-.18*	-.18				
Perceptual Speed	.21*	.21	15.68	.29	.08*	.08*

*p < .05
n=531

Note: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

support for hypothesis 11 in relationship to the prediction of total number of assemblies built. At the second step, perceptual speed and psychomotor speed were entered resulting in a significant ΔR^2 of .08 ($p < .05$) At this step, perceptual speed displayed significant relationships with total number of assemblies such that higher levels of perceptual speed resulted in a higher number of assemblies built. Also the time required to complete the psychomotor task displayed a negative relationship with total number of assemblies built such that people who took less time to complete the psychomotor tasks were able to build more assemblies, providing some support for the twelfth hypothesis.

The third stepwise hierarchical multiple regression examined the incremental validity in the prediction of work orientation and is displayed in Table 16. In the first step, general cognitive ability resulted in a significant R^2 of .04 ($p < .05$). At this step, general cognitive ability displayed a significant positive relationship such that the higher level of general cognitive ability, the higher the rating of work orientation, providing support for hypothesis 11. At the second step, perceptual speed and psychomotor speed were entered resulting in a significant ΔR^2 of .02 ($p < .05$) At this step, perceptual speed did not display a significant relationship with the rating of work orientation. Psychomotor speed displayed a significant negative relationship with the rating of work orientation such that people who took less time to complete the psychomotor tasks also had a higher rating of work orientation, providing some support for the twelfth hypothesis.

Relationships with performance dimensions unrelated to effort and discipline. The fourth stepwise hierarchical multiple regression examined the incremental validity in the

Table 16
Result of Simple Regression Predicting Performance Rating of Work Orientation Controlling for Cognitive Ability

Variable	Step Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Cognitive Ability	.19*	.16	18.99	.18	.04*	
Step 2						
Psychomotor Speed	-.13*	-.13				
Perceptual Speed	.06	.06	10.61	.24	.06*	.02*

*p < .05
n=531
Note: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

prediction of problem solving and is displayed in Table 17. In the first step, general cognitive ability resulted in a significant R^2 of .03 ($p < .05$). At this step, general cognitive ability displayed a significant positive relationship such that the higher level of general cognitive ability, the higher the rating of problem solving, providing support for hypothesis 11. At the second step, perceptual speed and psychomotor speed were entered resulting in a significant ΔR^2 of .01 ($p < .05$) At this step, perceptual speed did not display a significant relationship with the rating of problem solving. Psychomotor speed displayed a significant relationship with the rating of problem solving such that the people who took less time to complete the psychomotor tasks also had a higher rating of problem solving.

The fifth stepwise hierarchical multiple regression examined the incremental validity in the prediction of team skills and is displayed in Table 18. In the first step, general cognitive ability resulted in a significant R^2 of .01 ($p < .05$). At this step, general cognitive ability displayed a significant positive relationship such that the higher level of general cognitive ability, the higher the rating of work orientation, thus providing support for hypothesis 11. At the second step, perceptual speed and psychomotor speed were entered resulting in a nonsignificant ΔR^2. In general, changes in R^2 were significant for the step involved with speed only for those dimensions hypothesized to involve effort and discipline (i.e., proportion of defects, total assemblies built, and work orientation rating). Five significant differences comparing incremental validity (see Table 12) for effort-based versus non-effort-based correlations by speed measure (see Table 19). In this table, tests of significance were performed between each row partial correlation and each column partial

Table 17
Result of Simple Regression Predicting Performance Rating of Problem Solving Controlling for Cognitive Ability

Variable	Step Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Cognitive Ability	.16*	.15	13.96	.16	.03*	
Step 2						
Psychomotor Speed	-.10*	-.10				
Perceptual Speed	.01	.01	6.48	.19	.04*	.01

*p < .05
n=531
Note: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

Table 18
Result of Simple Regression Predicting Performance Rating of Team Skills Controlling for Cognitive Ability

Variable	Step Beta	Final Beta	F	R	R^2	ΔR^2
Step 1						
Cognitive Ability	.12*	.10	7.49	.12	.01*	
Step 2						
Psychomotor Speed	-.02	-.02				
Perceptual Speed	.06	.06	3.33	.14	.02*	.01

*p < .05
n=531
Note: Step Beta weights refer to the standardized regression weights assigned for each step of the regression equation

Table 19
Significant Differences Incremental Validity Coefficients for Effort-Based versus Non-Effort Based Performance Dimensions[1]

Perceptual Speed Partial Correlations	Proportion of Defective Parts ($r = .08$)	Total Assemblies ($r = .22$)	Work Orientation ($r = .08$)
Team Skills ($r = .06$)	n.s.	s.d. ($t = -2.6$, $p < .05$)	n.s.
Problem Solving ($r = .02$)	n.s.	s.d. ($t = -3.2$, $p < .05$)	n.s.

Psychomotor Speed Partial Correlations	Proportion of Defective Parts ($r = .17$)	Total Assemblies ($r = -.20$)	Work Orientation ($r = -.14$)
Team Skills ($r = -.03$)	s.d. ($t = -2.4$, $p < .05$)	s.d. ($t = 2.8$, $p < .05$)	s.d. ($t = 2.2$, $p < .05$)
Problem Solving ($r = -.10$)	n.s.	n.s.	n.s.

n.s. = no significant difference ($p > .05$)

s.d. = significant difference ($p < .05$)

[1] based on formula by Steiger (1980) to test the significance of the difference between dependent r's:

$$t = \frac{(r_{xy} - r_{vy}) \sqrt{[(n-1)(1 + r_{xv})}}{\sqrt{[2((n-1)/(n-3)) \, |\mathbf{R}| + r^2(1-r_{xv})^3]}}$$

where $r = (r_{xy} + r_{vy}) / 2$ and $|\mathbf{R}| = 1 - r^2_{xy} - r^2_{vy} - r^2_{vx} + 2\, r_{xy}\, r_{vy}\, r_{xv}$

correlation. These tests represent twelve separate tests of Hypothesis 12. These five significant differences provide additional support for Hypothesis 12.

Correction for criterion unreliability and restriction of range. Based on interrater reliability estimates of the ratings of work orientation, team skills, and problem solving and the selection ratio of .62 between the testing and assessment phase, various corrections were made to the partial intercorrelations (see Table 13) of perceptual and psychomotor speed with the various performance measures (see Table 20). Perceptual speed estimates for related dimensions (work orientation, proportion of defects, and total assemblies) ranged from .09 to .27 whereas estimates for unrelated dimensions (team skills, problem solving) ranged from .03 to .09. Psychomotor speed estimates were higher for proportion of defects ($r = .28$), total assemblies ($r = -.33$), and work orientation ($r=-.36$) and lower for unrelated dimensions such as team skills ($r = -.06$) and problem solving ($r= - .23$), providing additional evidence to the types of performance dimensions most likely to be related to measures of speed.

Table 20
Corrected Incremental Validity Over Cognitive Ability Between Measures of Speed and Job Performance Measures

	Perceptual Speed			**Psychomotor Speed**		
Job Performance Measure	Uncorrected Partial Validity	Corrected Partial Validity (Criterion Unreliability)	Corrected Partial Validity (Criterion Unreliability & Restriction of Range)	Uncorrected Partial Validity	Corrected Partial Validity (Criterion Unreliability)	Corrected Partial Validity (Criterion Unreliability & Restriction of Range)
Proportion of Defects	.08	n/a	.09	.17*	n/a	.28
Total Assemblies	.22*	n/a	.27	-.20*	n/a	-.33
Problem Solving Rating	.02	.03	.03	-.10*	-.14	-.23
Team Skills Rating	.06	.08	.09	-.03	-.04	-.06
Work Orientation Rating	.08	.13	.16	-.14*	-.22	-.36

*$p < .05$
n=531
NOTE: Using interrater reliability estimates in Table 12 (n=232)

DISCUSSION

The purpose of the present study was to examine both the relationships of a variety of variables to measures of speed and to examine the incremental validity of speed on broader measures of job performance. The discussion is divided up into three sections. The first section provides a summary of the findings and the implications of the results. The second section highlights some of the limitations of the study and the impact of those limitations on the results. The third section addresses future research directions.

Summary and Implications of Major Findings

Relationships with measures of speed. Table 11 presents a summary of the evidence examining the relationships of cognitive and noncognitive factors to measures of speed and this summary will follow both that evidence as well as the order of the results. Three covariates used in the study but not direct focus of the hypotheses included age, test motivation, and perceived face validity. Of these three, age displayed a strong relationship with an individual's speed, both perceptual and psychomotor. This finding was consistent with previous research (e.g., Birren & Fisher, 1995). Even though a large variation in terms of age wasn't expected with a predominantly younger applicant group, the strong effect continued to be present. Test motivation displayed little effect on measures of speed, probably due to the fact that most applicants were highly motivated to do well in the testing phase (Mean = 4.47, SD = .43). Perceived face validity added incremental prediction over age with the measure of perceptual speed such that the more the individual thought the testing phase was face valid, the more items completed on the perceptual speed measure (Data Comparison Test). However, such a relationship may be stronger with the perceptual speed measure than the psychomotor speed measure because the position being applied for is in manufacturing where psychomotor skills are likely to be deemed more important. The effort applied in the paper-and-pencil test may have been reduced because individuals may have viewed the perceptual speed measure containing text as somewhat irrelevant.

The first hypothesis of the study postulated that general cognitive ability would be related to measures of speed and the research study found strong support across both speed measures for such an effect. Such a relationship was not only pervasive across multiple stages of analysis, but is well documented in the research literature (i.e., Carroll, 1993; Vernon, 1987).

The next series of hypotheses focused upon noncognitive factors in relationship to measures of speed. Going in order of hypotheses, the first factor examined was Impatience/Irritability (hypothesis 2). It was hypothesized that individuals who had a higher level of Impatience/Irritability would subsequently have higher levels of arousal and display higher levels of speed. However, results provided limited support for the construct in relationship to measures of speed. Using hierarchical regression, Impatience/ Irritability added some significant incremental prediction in relationship to measures of perceptual speed, both without the covariates and covarying out age, perceived face validity, and test motivation. However, bivariate relationships in those two situations (zero-order and partial correlations) did not demonstrate any significant relationships until variance was accounted for by the other noncognitive factors in the regression equations. The predictive setting of the study could have had an effect on this relationship. Applicants attempting to do well in the selection system might not want to claim to be impatient and irritable which may have resulted in a slightly lower mean and standard deviation (Mean = 2.27, SD = .53) than has been found in non-selection studies using undergraduates (e.g., Conte et al, 1995).

The third hypothesis investigated the relationship between conscientiousness and measures of speed. It was hypothesized that individuals who were higher in conscientiousness would devote more effort over time to completing the measures of speed. Results provide some reasonable support for this hypothesis, primarily for measures of psychomotor speed where significant bivariate, and partial correlation relationships were discovered both with and without covariates. In addition, significant incremental prediction was found when age, perceived face validity, and test motivation were controlled for and other noncognitive variables were included in the regression equation. However, this relationship was nonsignificant once cognitive ability was added to the regression equation even though the partial correlation between psychomotor speed and conscientiousness was significant. Relatedly, the fourth hypothesis examined if achievement would be related to number of errors on the perceptual speed measure (the psychomotor speed measures had virtually no errors) such that achievement-oriented individuals would think that success was based on speed and, therefore, trade accuracy for speed. However, no relationship was discovered either for zero-order correlations or after controlling for the variance attributed to covariates. In terms of the prediction of perceptual and psychomotor speed by achievement, a similar series of analyses were run as those listed in Table 10 but achievement was added as a subsequent step after the group of noncognitive variables were entered. Only one significant finding was discovered: a negative significant relationship between achievement and psychomotor speed after controlling for conscientiousness ($r = -.09$, $p < .05$). All other analyses failed to provide support that achievement would add anything to the prediction of measures of speed above that of a general measure of conscientiousness.

The fifth hypothesis proposed that individuals who held a more polychronic orientation towards activities would have lower levels of speed than those who had a monochronic orientation. People with a monochronic orientation were proposed to have higher levels of speed because they could focus their effort to completing the task at hand rather than an orientation where effort is often divided among multiple activities which is more characteristic of individuals with a polychronic orientation. The hypothesis received reasonable support such that polychronic orientation displayed significant negative relationships across multiple lines of analysis including zero-order correlations, hierarchical regressions without any covariates (perceptual speed only), and when the covariates of age, perceived face validity, and test motivation were accounted for (both partial-correlations and regressions). When variance associated with cognitive ability was accounted for, only the partial-correlation between polychronic orientation and psychomotor speed was significant. However, overall evidence tended to support the notion that the orientation (single task versus multiple task) generally had a fairly stable polychronic relationship with measures of speed and could serve as a meaningful variable.

The sixth hypothesis proposed that an individual whose orientation towards activities was faster paced would have higher levels of speed through higher levels of arousal. Analyses, found that pace displayed significant positive relationships with measures of speed, particularly psychomotor speed. This bivariate relationship with psychomotor speed continued after controlling for age, test motivation, and perceived face validity, and it continued when cognitive ability was controlled for as well. However, in hierarchical regressions with the other noncognitive variables, pace failed to account for any significant incremental efficiency in predicting measures of speed. So, while a relationship seems to exists between self-reports of pace and measures of speed, its incremental prediction in light of other noncognitive factors proved weaker.

The seventh and eighth hypotheses examined self-monitoring as a moderator between the relationship of conscientiousness with measures of speed (H7) and polychronic orientation with measures of speed (H8). Hypothesis seven proposed that the relationship between conscientiousness and measures of speed would be strongest for individuals who had lower levels of self-monitoring. At higher levels of self-monitoring, individuals with lower levels of conscientiousness would change their orientation to meet the speed demands of the task, thereby reducing the relationship between conscientiousness and speed. However, no relationships were discovered in any analyses to support this hypothesis. Hypothesis eight proposed a similar relationship occurring with self-monitoring acting as a moderator between the polychronic orientation and speed such that the relationship between polychronic orientation and measures of speed would be strongest for individuals who had lower levels of self-monitoring. At higher levels of self-monitoring, individuals with a more polychronic orientation would change their orientation to meet the speed demands of the task, thereby reducing the relationship between polychronic orientation and speed. Results provided some evidence for the hypothesis. After controlling for age, test motivation, and perceived face validity, the interaction added significant incremental prediction (Figure 3) that matched the hypothesis when psychomotor speed was the dependent variable. This interaction was nonsignificant but approached significance once cognitive ability was added as a covariate to the hierarchical regression equation ($p = .054$) predicting psychomotor speed. Perhaps the relationship was stronger with polychronic orientation than with conscientiousness due to impression management constraints. As such, the items measuring conscientiousness may have been more socially desirable in terms of what response would most likely result in employment. Items measuring monochronic (tend to one task before starting another) and polychronic (tend to do multiple activities) may have been less transparent, leading to more accurate responding.

Hypothesis nine proposed that individuals whose circadian rhythm style better matched the actual time they took the speed measures would perform at higher levels of speed due to higher levels of arousal. Little support was found for this relationship until the various covariates were added to the prediction of speed. Both when controlling for age, test motivation, and perceived face validity, and when controlling for cognitive ability as well, relationships began to emerge between the matching of circadian rhythms and actual testing time with psychomotor speed. Both partial correlations displayed significant relationships with psychomotor speed and after controlling for all covariates, the variable added incremental prediction to the other noncognitive factors in predicting psychomotor speed.

Hypothesis ten proposed that the comparative anxiety felt by individuals in the testing phase would be negatively related to measures of speed due to a deflection of effort away from the task at hand toward comparing one's efforts to others. Results provided ample support for this hypothesis across multiple steps in the analysis. The only area where support was not found was in relationship to psychomotor speed when all the variance attributed to the covariates (age, test motivation, perceived face validity, and cognitive ability) was accounted for.

In summary, all the hypotheses with the exception of the interaction between self-monitoring and conscientiousness received some support in the analyses. However, certain variables tended to display more consistent and more incremental evidence across various analyses. In terms of covariates, age and general cognitive ability continued to display their well-documented relationship with measures of speed. In terms of the noncognitive relationships, the results demonstrated that the hypotheses involving conscientiousness, polychronic orientation, and comparative anxiety, variables influencing the measurement of speed primarily through a proposed effort mechanism, tended to have the most stable and most consistent relationships with measures of speed. In particular, relationships with psychomotor speed tended to be more prevalent than those with perceptual speed even though the Multiple R examining the prediction of speed with noncognitive predictors (.34 perceptual (Table 3) & .30 psychomotor (Table 4)) and the correlation with general cognitive ability (.41 perceptual & -.41 psychomotor) tended to be similar. Perhaps, the psychomotor speed measure with its two trials and lack of errors provided a more robust measure in relationship to noncognitive relationships whereas perceptual speed relationships were dominated by its relationship with comparative anxiety ($r = -.31$).

<u>Incremental validity of measures of speed over cognitive ability</u>. The second major purpose of the research was to examine whether or not measures of speed were related to broader measures of job performance, particularly job performance dimensions

emphasizing behaviors such as demonstrating effort, maintaining discipline, etc. This research hypothesized that speed would provide significant prediction beyond the strong association between cognitive ability and job performance which is often reported to encompass any predictive power that speed may have (e.g., Ree & Earles, 1992). The analyses conducted to examine this hypothesis used five measures of performance. Speed was hypothesized to provide significant incremental validity over general cognitive ability in three of the job performance measures that more emphasized dimensions involving effort, and discipline: Number of assemblies built, the number of errors built into the assemblies (quality), and a rating on the dimension of work orientation. The other two measures, ratings of problem solving and team skills, were examined to see if the null hypothesis was found since they did not emphasize such dimensions involving demonstrating effort. First, the 11^{th} hypothesis proposed that general cognitive ability would have a significant relationship with the job performance measures and it did with all but number of assemblies built, providing support for this hypothesis consistent with previous literature (e.g., Hunter and Hunter, 1984).

Hypothesis 12 proposed that speed would add incremental validity over cognitive ability and was examined for the five measures of performance in two ways. First, partial correlations between each measure of speed (perceptual and psychomotor) and the measures of performance were examined after controlling for cognitive ability. Second, hierarchical regression was used with each measure of performance to control general cognitive ability prior to examining the incremental validity of the two speed measures when added as a group. In terms of partial correlations, results supported the 12^{th} hypothesis. Perceptual speed displayed its highest correlations with the three hypothesized dimensions (.22, .08, .08) and its lowest correlations with the two measures proposed to be most unlikely to affected by speed (.02, .06). However, only the incremental validity with total assemblies proved to be significant. In terms of psychomotor speed, the pattern of correlations was consistent with perceptual speed in that the dimensions proposed to receive incremental validity from measures of speed were higher (-.20, .17, -.14) than those not proposed to receive incremental validity (-.03, -.10). In addition, all three dimensions involving effort and discipline were significant.

In terms of hierarchical regression results, similar results were obtained with significant incremental validity for the step where perceptual and psychomotor speed were entered only occurring with total assemblies built, number of errors in assemblies, and work orientation. In terms of individual patterns of relationships, psychomotor speed added incremental validity to all three dimensions and perceptual speed added incremental validity to total assemblies built and proportion of errors in assemblies. In addition, psychomotor speed added incremental validity to the problem solving rating even though the step as a whole failed to add to overall validity. The most unexpected result occurred with the measure of perceptual speed displaying significance in the opposite direction in relationship to proportion of errors such that the higher one's level of perceptual speed, the higher the percentage of errors built into assemblies. This was opposite to what was expected. While the relationship was small, one potential rationale is that the perceptual speed test had a higher than desired rate of error (Mean item difficulty = .8) in the testing phase and speed accuracy tradeoffs were transferred to the next phase. However, the correlation between the number of perceptual speed items completed in the testing phase was positive with percentage of items correct ($r = .17$, $p <$

.05) in the same phase. A further examination into the influence of error levels for a speed test of this type could produce more meaningful results.

Overall, the incremental validity evidence for speed measures in the prediction of job performance over general cognitive ability was strong, particularly for psychomotor speed and particularly for dimensions where relationships were proposed to occur (total assemblies built, proportion of errors in assemblies, and work orientation rating). A potential argument against this result was that the performance dimensions only provided a parallel test for the speed measures. While the argument can be made that total number of assemblies is somewhat of a parallel measure, this would not explain the incremental validity with the work orientation rating, which was virtually uncorrelated with total number of assemblies. In addition, work orientation represents a more "typical" measure of performance rather than a more "maximum" measure of performance such as total assemblies built, yet it displayed some of the strongest relationships with the speed measures.

Practical and theoretical implications. An important hypothesis in the work by Carroll (1993) was that speed was a viable construct and not just a measurement byproduct of cognitive ability tests. He encouraged research that would continue to demonstrate the separateness of the constructs and the current research demonstrates that this statement appears to be true. Both incremental validity in the prediction of job performance and relationships between speed and noncognitive factors were displayed in the current research. Particularly stable relationships between speed and different types of noncognitive measures including those associated with stable personality traits (e.g., conscientiousness), temporal orientations (e.g., monochronic orientation) and situational factors (e.g., comparative anxiety) were also found. Primarily, these relationships were proposed to occur through an increase in concentrated effort on the task at hand rather than higher arousal levels. However, further research should be conducted to better specify that it is effort that helps to mediate the relationship with speed.

Some research has even begun to explore the relationship of constructs across three trait domains: personality, ability, and interests (Ackerman & Heggestad, 1997) in search of sources of commonality. In particular, Ackerman and Heggestad (1997) have proposed that a trait complex entitled Clerical/Convential show positive commonalities among dimensions such as perceptual speed, control, and conscientiousness. In their proposed research, the development of these individual differences may fall along causal lines such that the successful performance of certain tasks may increase one's level of interest or personality. Future research can continue to explore the nature of relationships among these constructs.

Effort is a critical component to examine in assessing the viability of speed as a useful construct. Two of the three second-order factors of speed in Carroll's (1993) research, psychomotor and perceptual speed, were utilized in the current research. Such tasks required not only speed in completing task, but persistence to complete the task over the time period required. As such, these speed tasks may be construed as motivational tasks rather than measures of ability. However, the rank order of scores on speed measures should be consistent in highly motivated situations (such as the current research) as they are in less highly motivated situations. In highly motivated situations, the level of the scores may just be higher. More simple measures of speed such as the third second-order speed factor examined in Carroll's research, reaction time, may not display similar relationships as those found in the current study, yet these measures may represent even purer measures of speed than those used in the current research. However, the maintenance of speed over time may be a more important predictor of overall job performance. Whereas quickly reacting to a problem in a work setting is important, the series of steps that follow that reaction and the speed at which those steps are completed and maintained can become the critical component to success in the job situation.

Beyond the incremental validity of speed measures is a question of their practical utility. Table 19 presents some corrected partial-correlations after controlling for variance attributed to cognitive abilities and correcting for criterion unreliability and range restriction. Correlations between psychomotor speed and total assemblies, proportion of errors in assemblies, and work orientation rating were -.33, .28, and -.36 respectively. The levels of these relationships are not only statistically significant, but practically important in relevance to the prediction of job performance both with measures that are considered indicies of maximum performance (total assemblies built) and those that are considered measures of typical performance (work orientation rating).

In addition, the practical utility of the results slightly favors using measures of speed that are more closely aligned with the definition of a pure speed measure, one in which the difficulty of attempted items is near 1.0 (Anastasi, 1988). In the current research, the measure of psychomotor speed tended to produce more favorable results than the measure of perceptual speed. This may be due to an absence of errors in its measurement. Perhaps establishing a measure where everyone finishes a simple task and time is the criterion may provide less of an opportunity for other factors to influence the measurement of speed, such as guessing. Completing a number of items completed in a set time period may provide a higher chance of guessing, thereby raising the difficulty level of the test. Therefore, choosing a more stable and pure measure of speed that still requires displaying speed over a time period can have a positive impact on incremental predictive efficiency.

Other practical implications of the results include the nature of the criterion, namely job performance. In the current research setting, participants were keenly aware that they were working "against the clock." Speed demonstrated incremental validity in the prediction of performance in this setting, primarily for those dimensions expressing the demonstration of effort. However, the current research doesn't proclaim that measures of speed will be practically useful in every type of job. In those positions where time pressure becomes salient, a measure of speed could provide additional validity. Other positions where speed is not critical to completing job tasks, speed may not provide incremental validity over other measures. However, given that job forecasts predict a change from a mass production to a service economy (Heneman & Heneman, 1994), an increase pressure on providing goods and services in a timely manner (Carnevale, 1991), and an increased workload due to downsizing, measures of speed could become more important in identifying successful candidates for an increased number of positions.

Study Limitations

The potential limitations with current research fall into four major categories: (a) determination of causality, (b) global perceived face validity, (c) errors in perceptual speed, (c) measurement of typical performance.

Determination of causality. To move beyond investigating relationships of variables with measures of speed would be to begin to make causal attributions. However, sample constraints prevented the research from making strong causal statements concerning the relationships because the completion of the survey containing many of the measures occurred after the performance on the measures of speed. For instance, the strongest noncognitive factor, comparative anxiety, may have been seen as higher by individuals because they were attributing poor performance in the measures of speed to outside pressure. Further research similar to that by Chan and colleagues (1997) that examines test-taking motivation on subsequent performance could lend more support to causal relationships.

Perceived face validity. The current measurement of perceived face validity also could fall into the causality trap mentioned above. This could result from individuals who perceive themselves doing poor on the test attributing their poor performance to lack of face validity. In addition, another limitation of the current study was that only a global measure of perceived face validity was obtained for the testing phase. A more specific measure of perceived face validity strictly for the measures of speed might have been more appropriate. Perhaps perceived face validity was higher for the psychomotor speed measure given the manufacturing context than the perceptual speed measure and could have produced different results.

Errors in perceptual speed measure. The number of errors produced in the perceptual speed measure were higher than desired. While a speed-accuracy tradeoff effect did not seem to occur (i.e., number of items finished was positively correlated with percentage of items correct), a cleaner measure of speed could have produced different results. However, relationships with measures of general cognitive ability were virtually identical with perceptual speed as they were with psychomotor speed even though virtually no errors were produced in this measure of speed.

Measurement of typical performance. Maximum performance has three main characteristics (Sacket et al, 1988): (a) there must be explicit awareness that one is being evaluated, (b) there must be an awareness of and acceptance of instructions to maximize effort, and (c) performance must be measured over a short enough time duration that the performer's attention remains focused on the accepted goal of maximum performance. Whereas assessment center ratings over the length of the exercise are more typical than a quick ten-minute assembly process, other performance measures could be construed as better representing "typical" performance. That is, participants in this research were all keenly aware that they were being evaluated throughout the assessment center task, hence their performance may be more accurately characterized as maximal than, typical. Therefore the general ability of the researcher's results to prime measures of "typical" performance could still use further investigation. In addition, the task in the current design was fairly specific to manufacturing jobs and may not be fully applicable to every different measure of job performance across different types of jobs.

Directions for Future Research

Future research could take a number of directions. First, subsequent research could begin to better specify causality in terms of relationships of factors to speed. To better define whether these factors lead to differential performance on measures of speed through different samples and research designs could bring further clarity to these relationships. While the current research situation likely ensured maximized motivation to do well on the job, subsequent research samples could provide more opportunity to explore these casualty issues. Other research situations might be devised to create more variance on factors such as impatience/ irritability; it is unlikely that participants in this study would admit to II. Additional research should also measure and investigate the mechanisms of effort and arousal. While the current research used these constructs as theoretical mechanisms to explain various relationships with measures of speed, subsequent research could build these concepts into research models and measure their actual mediating effect. A possible model for such research includes that of Barrick and colleagues (1993) who investigated the mediation effects of goal setting between the conscientiousness-job performance relationship.

Second, research on the performance side of the incremental validity equation could expand. Future research investigating the incremental validity of measures of speed against performance measures that are further towards the "typical" end of the maximum vs. typical continuum could provide additional evidence as to the practical utility of using measures of speed to predict important organizational behaviors. In addition, how speed is taken into account in a performance rating context could also use further research. Marr and Sternberg (1987) found some evidence that people who perform activities quickly are often perceived as being more intelligent. Research using policy capturing methodology could provide some evidence as to how individuals weigh speed in relationship to overall performance judgments. Perhaps research in impression management could provide a useful framework for how subordinates "look busy" to obtain higher ratings of performance.

Third, if speed has incremental validity and is considered an important aspect of performance, various adverse impact concerns could come into play. For instance, age had a dramatic effect on measures of speed such that if speed is an integral part of organizational decision-making, older individuals could be adversely impacted. In addition, research on other minority groups, either race or gender, could be conducted to determine if speed could have an adverse impact in a similar way to how general cognitive ability impacts African Americans.

APPENDICES

APPENDIX A

Power Analyses

For each of the following power analyses, the desired power was fixed at .80 and α was fixed at .05. Expected effect sizes were construed as "small" effect sizes (Cohen, 1988).
H7-H8:

> H7-H8 tests the unique variance accounted for by the Self-Monitoring X Personality Characteristics over and above the set of covariates, cognitive ability, and noncognitive influences. A small ΔR^2 of .03 was arbitrarily expected for interaction effects. The expected R^2 of .15 (Set A + Interactions) was arbitrarily fixed at a value of .15. Using Cohen and Cohen's (1983) formula for effect size:
>
> $$\begin{aligned} f^2 &= \Delta R^2/(1- R^2) \\ &= .03/(1-.15) \\ &= .035 \end{aligned}$$
>
> According to Cohen (1988), a f^2 value of .035 is construed as a small effect size. Cohen and Cohen's (1983) formula for required sample size n* is as follows:
>
> $$n^* = (L/f^2) + k + 1$$
>
> k refers to df for unique source of variance. The current proposal has k = 4. From the table of L values in Cohen (1988), we have a L = 12.00. Therefore, the required n is:
>
> $$\begin{aligned} n^* &= (L/f^2) + k + 1 \\ &= (12/.035) + 4 + 1 \\ &= 347.86 \end{aligned}$$

APPENDIX B

Impatience/Irritability Measure - Spence, Pred, & Helmreich (1987)

1. When a person is talking and takes too long to come to the point, how often do you feel like hurrying the person along? (very frequently to almost never)

2. Typically, how easily do you get irritated? (extremely easily to not at all easily)

3. Do you tend to do most things in a hurry (definitely true to not at all true)

4. How is your "temper" these days? (very hard to control to I seldom get angry)

5. When you have to wait in line such as at a restaurant, the movies, or the post office, how do you usually feel (accept calmly to feel very impatient and refuse to stay long)

APPENDIX C

Achievement Strivings Measure - Spence, Pred, & Helmreich (1987)

1. How much does work "stir you into action?" (much less to much more than others)

2. Nowadays, do you consider yourself to be (very hard-driving to very relaxed and easy going)

3. How would your best friends or others who know you well rate your general level of activity? (too slow to very active, should slow down)

4. How seriously do you take your work? (much more to much less than most)

5. How often do you set deadlines or quotas for yourself in courses or other activities (very often to almost never)

6. Compared with my peers, the amount of effort I put forth is (much more to much less)

7. Compared with my peers, I approach life in general (much more to much less seriously)

APPENDIX D

Monochronic versus Polychronic Orientation - Kaufman, Lane, & Lindquist (1991); Tuttle (1996)

1. I prefer to do one thing at a time

2. When I work by myself, I usually work on one project at a time

3. I am comfortable doing several things at the same time

4. When I sit down to do work, I usually do one project at a time

5. I do not like to juggle several activities at a time

Scored on a 1 - 5 scale (strongly disagree - strongly agree)

APPENDIX E

Pace of Life - Tuttle (1996)

1. I prefer to move quickly throughout the day
2. Fast moving activities are my favorite
3. Slow moving activities are my favorite
4. I do things faster than most people
5. I prefer to move slowly throughout the day

Scored on a 1 - 5 scale (strongly disagree - strongly agree)

APPENDIX F

Self-Monitoring - Snyder (1974)

1. I find it hard to imitate the behavior of other people
2. My behavior is usually an expression of my true inner feelings, attitudes, and beliefs
3. At parties and social gatherings, I do not attempt to do or say things that others will like
4. I can only argue for ideas which I already believe
5. I can make impromptu speeches even on topics about which I have almost no information
6. I guess I put on a show to impress or entertain people
7. When I am uncertain how to act in a social situation, I look to the behavior of others for cues
8. I would probably make a good actor
9. I rarely need the advice of my friends to choose movies, books, or music
10. I sometimes appear to others to be experiencing deeper emotions than I actually am.
11. I laugh more when I watch comedy with others than when alone
12. In a group of people I am rarely the center of attention
13. In different situations and with different people, I often act like very different persons
14. I am not particularly good at making other people like me
15. Even if I am not enjoying myself, I often pretend to have a good time
16. I'm not always the person I appear to be
17. I would not change my opinions (or the way I do things) in order to please someone else or win their favor
18. I have considered being an entertainer

19. In order to get along and be liked, I tend to be what people expect me to be rather than anything else.

20. I have never been good at games like charades or improvisational acting

21. I have trouble changing my behavior to suit different people and different situations

22. At a party I let others keep the jokes and stories going

23. I feel a bit awkward in company and do not show up quite so well as I should

24. I can look anyone in the eye and tell a lie with a straight face (if for a right end)

25. I may deceive people by being friendly when I really dislike them

Scored on a 1 - 5 scale (strongly disagree - strongly agree)

APPENDIX G

Circadian Rhythm Scale - Smith, Reilly, & Midkiff (1989)

1. Considering only your own "feeling best" rhythm, at what time would get up if you were entirely free to plan your day
   - A. 5:00-6:30 a.m. (5)
   - B. 6:30-7:45 a.m. (4)
   - C. 7:45-9:45 a.m. (3)
   - D. 9:45-11:00 a.m. (2)
   - E. 11:00a.m.-12:00 (noon) (1)

2. Considering your own "feeling best" rhythm, at what time would you go to bed if you were entirely free to plan your evening?
   - A. 8:00-9:00 p.m. (5)
   - B. 9:00-10:15 p.m. (4)
   - C. 10:15-12:30 a.m. (3)
   - D. 12:30-1:45 a.m. (2)
   - E. 1:45am-3:00 a.m. (1)

3. Assuming normal circumstances, how easy do you find getting up in the morning? (check one)
   - A. Not at all easy (1)
   - B. Slightly easy (2)
   - C. Fairly easy (3)
   - D. Very easy (4)

4. How alert do you feel during the first half hour after having awakened in the morning? (check one)
   - A. not at all alert (1)
   - B. slightly alert (2)
   - C. fairly alert (3)
   - D. very alert (4)

5. During the first half hour after having awakened in the morning, how tired do you feel? (check one)
   - A. very tired (1)
   - B. fairly tired (2)
   - C. fairly refreshed (3)
   - D. very refreshed (4)

6. You have decided to engage in some physical exercise. A friend suggests that you do this one hour twice a week and the best time for him/her is 7:00-8:00am. Bearing in mind nothing else but your own "feeling best" rhythm, how do you think you would perform?
   - A. would be in good form (4)
   - B. would be in reasonable form (3)
   - C. would find it difficult (2)
   - D. would find it very difficult (1)

7. At what time in the evening do you feel tired and, as a result, in need of sleep?
   - A. 8:00-9:00 pm (5)
   - B. 9:00-10:15 pm (4)
   - C. 10:15-12:30 am (3)
   - D. 12:30-1:45 am (2)
   - E. 1:45am-3:00 am (1)

8. You wish to be at your peak performance for a test which you know is going to be mentally exhausting and lasting for two hours. You are entirely free to plan your day, and considering only your own "feeling best" rhythm, which ONE of the four testing time would you choose?
   - A. 8:00-10:00 am (4)
   - B. 11:00am-1:00pm (3)
   - C. 3:00-5:00 pm (2)
   - D. 7:00-9:00 pm (1)

9. One hears about "morning" and "evening" types of people. Which ONE of these types do you consider yourself to be?
   - A. definitely a morning type (4)
   - B. more a morning than an evening type (3)
   - C. more an evening than a morning type (2)
   - D. definitely an evening type (1)

10. When would you prefer to rise (provided you have a full day's work - 8 hours) if you were totally free to manage your time?
   - A. before 6:30 am (4)
   - B. 6:30-7:30 am (3)
   - C. 7:30-8:30 am (2)
   - D. 8:30 am or later (1)

11. If you always had to rise at 6:00 am, what do you think it would be like?
    A. very difficult and unpleasant (1)
    B. rather difficult and unpleasant (2)
    C. a little unpleasant but no great problem (3)
    D. easy and not unpleasant (4)

12. How long a time does it usually take before you "recover your senses" in the morning after rising from a night's sleep?
    A. 0-10 minutes (4)
    B. 11-20 minutes (3)
    C. 21-40 minutes (2)
    D. more than 40 minutes (1)

13. Please indicate to what extent you are a morning or evening *active* individual.
    A. pronounced morning active (morning alert and evening tired) (4)
    B. to some extent, morning active (3)
    C. to some extent, evening active (2)
    D. pronounced evening active (morning tired and evening alert) (1)

APPENDIX H

Comparative Anxiety Scale - Arvey, Strickland, Drauden, & Martin (1990)

1. I probably didn't do as well as most of the other people who took these tests
2. I am not good at taking tests
3. During the testing, I often thought about how poorly I was doing
4. I usually get very anxious about taking tests
5. I usually do pretty well on tests
6. I expect to be among the people who score really well on this test
7. My test scores don't usually reflect my true abilities
8. I very much dislike taking tests of this type
9. During the test or tests, I found myself thinking of the consequences of failing
10. During the testing I got so nervous I couldn't do as well as I should have

Scored on a 1 - 5 scale (strongly disagree - strongly agree)

APPENDIX I

Covariate Measures

Background

What is your age?

A. Younger than 30
B. 31-40
C. 41-50
D. 51-60
E. 61 or older

I really am interested in getting hired for the job for which I am applying for?

A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

How many paper-and-pencil tests like the sort used here have you taken in the last three years?

A. Zero
B. One
C. Two
D. Three
E. Four or more

On the tests where there was time pressure, what describes your approach in trying to complete the test?

A. Completely ignore quality in favor of speed
B. Check quality occasionally
C. Slow down pace a bit to double-check items
D. Ensure that every item has the best answer before moving to the next one

Perceived Face Validity - Smither, Reilly, Millsap, Pearlman, & Stoffey. (1993).

1. I did not understand what the tests I just took had to do with the job
2. I could not see any relationship between the tests I just took and what is required on the job
3. It would be obvious to anyone that the tests I just took are related to the job
4. The actual content of the tests I just took was clearly related to the job
5. There was no real connection between the tests that I went through and the job

Scored on a 1 - 5 scale (strongly disagree - strongly agree)

Test Motivation - - Arvey, Strickland, Drauden, & Martin (1990)

1. Doing well on this test (or these tests) is important to me.
2. I wanted to do well on this test or tests.
3. I tried my best on this test or tests.
4. I tried to do the very best I could to on this test or tests.
5. While taking this test or tests, I concentrated and tried to do well
6. I want to be among the top scores on these tests.
7. I pushed myself to work hard on this test or these tests.
8. I was extremely motivated to do well on this test or tests.
9. I just didn't care how I did on this test or tests.
10. I didn't put much effort into this test or tests.

Scored on a 1 - 5 scale (strongly disagree - strongly agree)

<u>Social Desirability Items</u> - Paulhus (1986)

1. I sometimes tell lies if I have to
2. I never cover up my mistakes.
3. There have been occasions when I have taken advantage of someone
4. I never swear.
5. I sometimes try to get even rather than forgive and forget.
6. I always obey laws, even if I'm unlikely to get caught.
7. I have said something bad about a friend behind his or her back
8. When I hear people talking privately, I avoid listening
9. I have never dropped litter on the street.
10. I sometimes drive faster than the speed limit.
11. I have done things that I don't tell other people about.
12. I never take things that don't belong to me
13. I have never damaged a library book or store merchandise without reporting it.
14. I have some pretty awful habits.
15. I don't gossip about other people's business.

Scored on a 1 - 5 scale (very true - very untrue)

BIBLIOGRAPHY

BIBLIOGRAPHY

Ackerman, P.L. (1987). Individual differences in skill learning: An integration of psychometric and information processing perspectives. Psychological Bulletin, 102, 3-27.

Ackerman, P.L. (1989). Individual differences in skill acquisition. In P.L. Ackerman, R.J. Sternberg, & R. Glaser (Eds.), Learning and individual differences (pp. 164-217). New York: Freeman.

Ackerman, P.L., & Heggestad, E.D. (1997). Intelligence, personality, and interests: Evidence of overlapping traits. Psychological Bulletin, 121, 219-245.

Amato, P.R. (1983). The effects of urbanization on interpersonal behavior. Journal of Cross-Cultural Psychology, 14, 353-367.

Anastasi, A. (1988). Psychological Testing (6th Ed.). Macmillan: New York.

Arvey, R.D., Strickland, W., Drauden, G., & Martin, C. (1990). Motivational components of test taking. Personnel Psychology, 43, 695-716.

Audley, R.J. (1973). Some observations on theories of choice reaction time: Tutorial review. In S. Kornblum (Ed.), Attention & Performance IV. New York: Academic Press.

Baehr, M.E., & Orban, J.A. (1989). The role of intellectual abilities and personality characteristics in determining success in higher-level positions. Journal of Vocational Behavior, 35, 270-287.

Barrett, G., Phillips, J., & Alexander, R. (1981). Concurrent and predictive validity designs: A critical analysis. Journal of Applied Psychology, 67, 239-244.

Barrick, M.R., & Mount, M.K. (1991). The Big Five personality dimensions and job performance: A meta-analysis. Personnel Psychology, 44, 1-26.

Barrick, M.R., & Mount, M.K. (1993). Autonomy as a moderator of the relationships between the Big Five and job performance. Journal of Applied Psychology, 78, 111-118.

Barrick, M.R., Mount, M.K., Strauss, J.P. (1993). Conscientiousness and the performance of sales representatives: Tests of the mediating effects of goal setting. Journal of Applied Psychology, 78, 715-722.

Bates, T.C., & Eysenck, H.J. (1993). Intelligence, inspection time, and decision time. Intelligence, 17, 523-531.

Baxter, B.N. (1941). An experimental analysis of the contributions of speed and level in an intelligence test. Journal of Educational Psychological Bulletin, 96, 72.

Birren, J.E. (1965). Age changes in speeded behavior: Its central nature and physiological correlates. In A.T. Welford & J.E. Birren (Eds.), Behavior, aging and the nervous system (pp. 191-216). Springfield, IL: Charles C. Thomas.

Birren, J.E., & Fisher, L.M. (1995). Aging and speed of behavior: Possible consequences for psychological functioning. Annual Review of Psychology, 46, 329-353.

Birren, J.E., Woods, A.M., & Williams, M.V. (1980). Behavioral slowing with age: Causes, organization, and consequences. In L.W. Poon (Ed.) Aging in the 1980s: Psychological issues (pp. 293-308). Washington D.C.: American Psychological Association.

Blake, M.J.F. (1967). Time of day effects on performance in range of tasks. Psychonomic Science, 9, 349-350.

Bluedorn, A.C., & Denhardt, R.B. (1988). Time and organizations. Journal of Management, 14, 299-320.

Bluedorn, A.C., Kaufman, C.F., & Lane, P.M. (1992). How many things do you like to do at once? An introduction to monochronic and polychronic time. Academy of Management Executive, 6, 17-26.

Bodenhausen, G.V. (1990). Stereotypes as judgmental heuristics: Evidence of circadian rhythms in discrimination. Psychological Science, 1, 319-322.

Borman, W.C., & Brush, D.H. (1993). More progress toward a taxonomy of managerial performance requirements. Human Performance, 6, 1-21.

Borman, W.C., & Motowidlo, S.J. (1993). Expanding the criterion space to include elements of contextual performance. In N. Schmitt & W.C. Borman (eds.), Personnel Selection in Organizations (pp. 71-98). San Francisco, CA: Jossey Bass.

Borman, W.C., White, L.A., Pulakos, E.D., & Oppler, S.H. (1991). Models of supervisory job performance ratings. Journal of Applied Psychology, 76, 863-872.

Bornstein, M.H. (1979). The pace of life: Revisited. International Journal of Psychology, 14, 83-90.

Brand, V.C. (1987). The importance of general intelligence. In S. Modgil & C. Modgil (Eds.), Arthur Jensen: Consensus and controversy. New York: Falmer.

Briggs, S.R., Cheek, J.M., & Buss, A.H. (1980). An analysis of the self-monitoring scale. Journal of Personality and Social Psychology, 38, 679-686.

Briggs, S.R., & Cheek, J.M. (1988). On the nature of self-monitoring: Problems with assessment, problems with validity. Journal of Personality and Social Psychology, 54, 663-678.

Briggs, S.R., & Cheek, J.M. (1986). The role of factor analysis in the development and evaluation of personality scales. Journal of Personality, 54, 106-147.

Brinley, J.F. (1965). Cognitive sets, speed and accuracy of performance in the elderly. In A.T. Welford & J.E. Birren (eds.) Behavior, aging, and the nervous system (pp. 114-149). Springfield, IL: Thomas.

Burnam, M.A., Pennebaker, J.W., & Glass, D.C. (1975). Time consciousness, achievement striving, and the Type A coronary prone behavior pattern. Journal of Abnormal Psychology, 84, 76-79.

Campbell, J.P. (1990). Modeling the performance prediction problem in industrial and organizational psychology. In M.D. Dunnette & L.M. Hough (Eds.), Handbook of industrial and organizational psychology (2nd ed., Vol. 1, pp. 687-732). Palo Alto, CA: Consulting Psychologists Press.

Carlson, J.S., Jensen, C.M., & Widaman, K.F. (1983). Reaction time, intelligence, and attention. Intelligence, 7, 329-344.

Carlson & Widaman (1987). Elementary cognitive correlates of G: Progress and prospects. In P.A. Vernon (Ed.), Speed of information-processing and intelligence (pp. 69-99). Norwood, NJ: Ablex.

Carnevale, A.P. (1991). America and the New Economy (pp. 24-33). American Society for Training and Development, U.S. Department of Labor: Washington, D.C.

Carpenter, P.A., Just, M.A., & Shell, P. (1990). What one intelligence test measures: A theoretical account of the processing in the Raven Progressive Matrices Test. Psychological Review, 97, 404-431.

Carroll, J.B. (1980). Discussion. In D.J. Weiss (Ed.), Proceedings of the 1979 Computerized Adaptive Testing Conference (pp. 278-283, 449-452). Minneapolis, MN: Computerized Adaptive Testing Laboratory, Psychometric Methods Program, Department of Psychology, University of Minnesota.

Carroll, J.B. (1993). Human cognitive abilities: A survey of factor-analytic studies (pp. 440-509). Cambridge: New York.

Ceci, S.J. (1990). On intelligence...more or less: A bioecological treatise on intellectual development. Englewood Cliffs, NJ: Prentice-Hall.

Ceralla, J. (1985). Information processing rates in the elderly. Psychological Bulletin, 98, 67-83.

Ceralla, J. (1991). Age effects may be global, not local: Comment on Fisk and Rogers (1991). Journal of Experimental Psychology: General, 120, 215-223.

Cerella, J., Poon, L.W., & Williams, D.M., (1980). Age and the complexity hypothesis. In L.W. Poon (Ed.), Aging in the 1980s: Psychological issues (pp. 332-340). Washington D.C.: American Psychological Association.

Chan, D. (1996). Video-based versus paper-and-pencil method of assessment in situational judgment tests: Subgroup differences in performance and examinee reactions. Unpublished master's thesis. Michigan State University.

Chan, D., Schmitt, N., DeShon, R.P., Clause, C.S., & Delbridge, K. (1997). Reactions to cognitive ability tests: The relationships between race, test performance, face validity perceptions, and test-taking motivation. Journal of Applied Psychology, 82, 300-310.

Clausen, J. (1966). Ability structure and subgroups in mental retardation. Washington, DC: Spartan Books.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum.

Cohen, J., & Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral sciences (2nd ed.). Hillsdale, NJ: Erlbaum.

Colquhoun, W.P. (1971). Circadian variations in mental efficiency. In W.P. Colquhoun (Ed.), Biological rhythms and human performance. London: Academic Press.

Conte, J.M., Landy, F.J., & Mathieu, J.E. (1995). Time urgency: Conceptual and construct development. Journal of Applied Psychology, 80, 178-185.

Cottle, T.J. (1976). Perceiving time: A psychological investigation with men and women. New York: Wiley.

Cronbach, L.J., & Warrington, W.G. (1951). Time limit tests: Estimating their reliability and degree of speeding. Psychometrika, 14, 167-188.

Data comparison. Detroit, MI: Aon Consulting.

Davidson, W.M., & Carroll, J.B. (1945). Speed and level components in time-limit scores. A factor analysis. Educational & Psychological Measurement, 5, 411-427.

Day, D.V., & Silverman, S.B. (1989). Personality and job performance: Evidence of incremental validity. Personnel Psychology, 42, 25-36.

Deary, I.J. (1993). Inspection time and WAIS-R IQ subtypes: A confirmatory factor analysis study. Intelligence, 17, 223-236.

Deary, I.J., & Stough, C. (1996). Intelligence and inspection time: Achievements, prospects, and problems. American Psychologist, 51, 599-608.

Digman, J.M. (1990). Personality structure: Emergence of the five-factor model. Annual Review of Psychology, 41, 417-440.

DuBois, P.H. (1932). A speed factor in mental tests. Archives of Psychology, 22 (Whole No. 141).

Edwards, J.R., Baglioni, A.J., Jr., & Cooper, C.L. (1990). Examining relationships among self-report measures of Type A behavior pattern: The effects of dimensionality, measurement error, and differences in underlying constructs. Journal of Applied Psychology, 75, 440-454.

Folkard, S., Monk, T., & Lobban, M. (1979). Towards a predictive test of adjustment to shift work. Ergonomics, 22, 79-91.

Flokard, S., Wever, R.A., & Wildgruber, C.M. (1983). Multi-oscillatory control of circadian rhythms in human performance. Nature, 305, 223-226.

Following policies and procedures. Detroit, MI: Aon Consulting.

Gangestad, S., & Snyder, M. (1985). On the nature of self-monitoring. In P. Shaver (Ed.) Review of personality and social psychology: Vol. 6: Self, situations, and social behavior (pp. 65-86). Beverly Hills, CA: Sage.

Gaugler, B.B., Rosenthal, D.B., Thornton, G.C. III, & Bentson, C. (1987). Meta-analysis of assessment center validity. Journal of Applied Psychology, 72, 493-511.

Geary, D.C., French, P.A., & Wiley, J.G. (1993). Simple and complex mental subtraction: Strategy choice and speed-of-processing differences in younger an older adults. Psychology and Aging, 8, 242-256.

Goldberg, L.R. (1993). The structure of phenotypic personality traits. American Psychologist, 48, 26-34.

Gorsuch, R.L. (1988). Exploratory factor analysis. In J.R. Nesselroade & R.B. Cattell (Eds.), Handbook of Multivariate Experimental Psychology. New York: Plenum.

Gregory, R.J. (1996). Psychological Testing (2nd ed.). Allyn & Bacon: Needham Heights, MA.

Guion, R.M. (1991). Personnel assessment, selection, and placement. In M.D. Dunnette & L.M. Hough (eds.), Handbook of industrial and organizational psychology, (2nd ed., Vol. 2, pp. 327-397). Palo Alto, CA: Consulting Psychologists Press.

Guion, R.M., & Cranny, C.J. (1982). A note on concurrent and predictive validity designs: A critical reanalysis. Journal of Applied Psychology, 66, 1-6.

Hale, S., Myerson, J., & Wagstaff, D. (1987), General slowing and nonverbal information processing: Evidence for a power law. Journal of Gerontology, 42, 131-136.

Hall, E.T. (1983). The dance of life: The other dimension of time. Garden City, NY: Anchor Press.

Hartigan, J.A., & Wigdor, A.K. (1989). Fairness in Employment Testing. Washington: National Academy Press.

Hashemian, K. (1978). An experimental investigation of the relationship between test anxiety and memory processes under different motivation conditions (University of Florida, 1977). Dissertation Abstracts International, 38, (7-A), 4046.

Haynes, S.G., Levine, S., Scotch, N., Feinleib, M., Kannel, W.B. (1978). The relationship of psychosocial factors to coronary heart disease in the Framingham study: I. Methods and risk factors. American Journal of Epidemiology, 107, 362-383.

Helmreich, R.L., Sawin, L.L., & Carsrud, A.L. (1986). The honeymoon effect in job performance: Temporal increases in the predictive power of achievement motivation. Journal of Applied Psychology, 71, 185-188.

Heneman, H.G., III, & Heneman, R.L. (1994). Staffing Organizations. Middleton, WI: Mendota House.

Himmilweit, H.T. (1946). Speed and accuracy of work as related to temperament. British Journal of Psychology, 36, 132-144.

Horn, J.L. (1978). Individual differences in cognitive development: Final report. Betheseda, Maryland: National Science Foundation.

Horn, J.L. (1981). Age differences in human abilities: Final report. Betheseda, Maryland: National Institute of Aging.

Horn, J.L. (1988). Thinking about human abilities. In J.R. Nesselroade & R.B. Cattell (Eds.), Handbook of multivariate experimental psychology (2nd ed., pp. 645-685). New York: Plenum.

Horne, J.A., & Ostberg, O. (1976). A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. International Journal of Chronobiology, 4, 97-110.

Horne, J.A., & Ostberg, O. (1977). Individual differences in human circadian rhythms. Biological Psychology, 5, 179-190.

Hough, L.M. (1989). Development of personality measures to supplement selection decisions. In B.J. Fallon, H.P. Pfister, & J. Brebner (Eds.), Advances in industrial organizational psychology (pp. 365-375).

Hough, L.M. (1992). The "Big Five" personality variables-construct confusion: Description versus prediction. Human Performance, 5, 139-155.

Hough, L.M., Eaton, N.K., Dunnette, M.D., Kamp, J.D., & McCloy, R.A. (1990). Criterion-related validities of personality constructs and the effect of response distortion on those validities. Journal of Applied Psychology, 75, 581-595.

Humphreys, M.S., & Revelle, W. (1984). Personality, motivation, and performance: A theory of the relationship between individual differences and information processing. Psychological Review, 91, 153-184.

Hunt, E. (1978). Mechanics of verbal ability. Psychological Review, 85, 109-130.

Hunter, J.E. (1986). Cognitive ability, cognitive aptitudes, job knowledge, and job performance. Journal of Vocational Behavior, 29, 340-362.

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

Jackson, M., & McClelland, J. (1979). Processing determinants of reading speed. Journal of Experimental Psychology: General, 108, 151-181.

Jenkins, C.D., Zyzanski, S.J., & Rosenman, R.H. (1979). Jenkins Activity Survey manual (Form C). New York: Psychological Corporation.

Jensen, A.R. (1981). Bias in mental testing. New York: The Free Press.

Jensen, A.R. (1987). Individual differences in the Hick paradigm. In P.A. Vernon (Ed.), Speed of information processing and intelligence (pp. 101-175). Norwood, NJ: Ablex.

Jensen, A.R. (1992). Commentary: Vehicles of g. Psychological Science, 3, 275-278.

Jensen, A.R. (1993). Why is reaction time correlated with psychometric g? Current Directions in Psychological Science, 2, 53-56.

Kanfer, R. (1992). Work motivation: New directions in theory and research. In C.L. Cooper & T. Robertson (Eds.), International Review of Industrial and Organizational Psychology (Vol. 7, pp. 1-53). London: John Wiley & Sons, Ltd.

Kanfer, R., & Ackerman, P.L. (1989). Motivation and cognitive abilities: An integrative/aptitude-treatment interaction approach to skill acquisition [Monograph]. Journal of Applied Psychology, 74, 657-690.

Kaufman, C.F., Lane, P.M., & Lindquist, J.D. (1991). Exploring more than 24 hours a day: A preliminary investigation of polychronic time use. Journal of Consumer Research, 18, 392-401.

Kelly, J.R. (1988). Entrainment in individual and group behavior. In J.E. McGrath's (Ed.) The social psychology of time (pp. 89-112) Newbury Park, CA: Sage.

Kendall, L.M. (1964). The effects of varying time limits on test validity. Educational and Psychological Measurement, 24, 789-800.

Kerkhof, G. (1985). Inter-individual differences in the human circadian system: A review. Biological Psychology, 20, 83-112.

Kranzler, J.H. (1990). The nature of intelligence: A unitary process or a number of independent processes? Unpublished doctoral dissertation. University of California at Berkeley.

Kranzler, J.H., & Jensen, A.R. (1989). Inspection time and intelligence: A meta-analysis. Intelligence, 13, 329-347.

Kyllonen. P.C. (1985). Dimensions of information processing speed. Brooks Air Force Base, TX: Air Force Systems Command, AFHRL-TP-84-56.

Landy, F.J., Rastegary, H., Thayer, J., & Colvin, C. (1991). Time urgency: The construct and its measurement. Journal of Applied Psychology, 76, 644-657.

Lauer, R.H. (1981). Temporal man: The meaning and uses of social time. New York: Praeger.

Lennox, R.D., & Wolfe, R.N. (1984). Revision of the self-monitoring scale. Journal of Personality and Social Psychology, 46, 1349-1364.

Levine, G., Preddy, D., & Thorndike, R.L. (1987). Speed of information processing and level of cognitive ability. Personality and Individual Differences, 8, 599-607.

Levine, R.V. (1988). The pace of lie across cultures. In J.E. McGrath's (Ed.) The social psychology of time (pp. 39-60). Newbury Park, CA: Sage.

Levine, R.V., & Bartlett, K. (1984). Pace of life, punctuality, and coronary heart disease in six countries. Journal of Cross-Cultural Psychology, 15, 233-255.

Lima, S.D., Hale, S., & Myerson J. (1991). How general is general slowing? Evidence from the lexical domain. Psychology and Aging, 6, 416-425.

Lohman, D. (1979). Spatial ability: A review and reanalysis of the correlational literature (Tech. Rep. No. 8). Aptitude Research Project, Stanford University, School of Education, Stanford, CA.

Lohman, D. (1986). The effect of speed-accuracy tradeoff on sex differences in mental rotation. Perception & Psychophysics, 39, 427-436.

Lohman, D. (1994). Implications of cognitive psychology for ability testing: Three critical assumptions. In M.G. Rumsey, C.B. Walker, & J.H. Harris (Eds.), Personnel selection and classification (pp. 145-171). Hillsdale, NJ: Erlbaum.

Lord, F.M. (1956). A study of speed factors in tests and academic grades. Psychometrika, 21, 31-50.

Lord, F.M. (1971). Testing if two measuring procedures measure the same psychological dimension. RB-71-36. Educational Testing Service: Princeton, NJ.

Lucia, M. (1985). Effect of season, day of week, and the degree of urbanization on pace of life. Unpublished master's thesis. California State University, Fresno.

Macan, T.H., Avedon, M.J., Paese, M., & Smith, D.E. (1994). The effects of applicants' reactions to cognitive ability tests and an assessment center. Personnel Psychology, 47, 715-738.

Mangan, G.L. (1959). A factorial study of speed, power, and related temperament variables. British Journal of Educational Psychology, 29, 144-154.

Marr & Sternberg (1987). The role of mental speed in intelligence: A triarchic perspective. In P.A. Vernon (Ed.), Speed of information-processing and intelligence (pp. 271-294). Norwood, NJ: Ablex.

McGrath, J.E. (1976). Stress and behavior in organization. In M.D. Dunnette (Ed.), Handbook of industrial and organizational psychology (pp. 1351-1395). New York: John Wiley.

McGrath, J.E., & Rothchrod, N.L. (1983). Time and behavior in organizations. Research in Organizational Behavior, 5, 57-101.

McHenry, Hough, Toquam, Hanson, & Ashworth, (1990). Project A validity results: The relationship between predictor and criterion domains. Personnel Psychology, 43, 335-354.

Miller, L.T., & Vernon, P.A. (1983). The general factor in short-term memory, intelligence, and reaction time. Intelligence, 16, 5-29.

Morrison, E.J. (1960). On test variance and the dimensions of the measurement situation. Educational and Psychological Measurement, 20, 231-250.

Muchinsky, P.M. (1997). Psychology applied to work (5th ed.). Brooks/Cole: Pacific Grove, CA.

Mumford, M.D., Baughman, W.A., Threlfall, K.V., Uhlman, C.E., & Constanza. D.P. (1993). Personality, adaptability, and performance: Performance on well-defined and ill-defined problem-solving tasks. Human Performance, 6, 241-285.

Myers, C.T. (1952). The factorial composition and validity of differentially speeded tests. Psychometrika, 17, 347-352.

Naylor, J.C., Pritchard, R.D., & Ilgen, D.R. (1980). A theory of behavior in organizations. New York: Academic Press.

Neisser, U., Boodoo, G., Bouchard, T.J., Jr., Boykin, A.W., Brody, N., Ceci, S.J., Halpern, D.F., Loehlin, J.C., Perloff, R., Sternberg, R.J., Urbina, S. (1996). Intelligence: Knowns and unknowns. American Psychologist, 51, 77-101.

Nettelbeck, T. (1987). Inspection time and intelligence. In P.A. Vernon (Ed.), Speed of processing and intelligence (pp. 295-346) Norwood, NJ: Ablex.

Nevo, B., & Sfez, J. (1985). Examinees' feedback questionnaires. Assessment and Evaluation in Higher Education, 10, 236-249.

Nunnally, J.C., & Bernstein, I.H. (1994). Psychometric theory (3rd ed.). New York: McGraw-Hill.

Parks, R.W., Loewenstein, D.A., Dodrill, K.L., Barker, W.W., Yoshii, F., Chang, J.Y., Emran, A., Apicella, A., Shermata, W.A., & Duara, R. (1988). Cerebral metabolic effects of a verbal fluency test: A PET scan study. Journal of Clinical and Experimental Neuropsychology, 10, 565-575.

Paulhus, D.L. (1986). Self-deception and impression management in test responses. In A. Angleitner & J.S. Wiggins (Eds.), Personality assessment via questionnaires (pp. 143-165). Berlin: Springer-Verlag.

Peterson, N.G. (1993). Review of issues associated with speededness of GATB tests. American Institutes for Research: Washington, D.C.

Practical arithmetic. Detroit, MI: Aon Consulting.

Raven, J.C. (1965). Advanced Progressive Matrices, Sets I and II. London: H.K. Lewis.

Ree, M.J., & Earles, J.A. (1992). Intelligence is the best predictor of job performance, Current Directions in Psychological Science, 1, 86-89.

Reed, T.E., & Jensen, A.R. (1992). Conduction velocity in a brain nerve pathway of normal adults correlates with intelligence. Intelligence, 16, 259-272.

Revelle, W. (1989). Personality, motivation, and cognitive performance. In R. Kanfer, P.L. Ackerman, R. Cudeck (Eds.), Abilities, motivation, and methodology: The Minnesota symposium on learning and individual differences (pp. 297-341). Hillsdale, NJ: Erlbaum.

Rindler, S.E. (1979). Pitfalls in assessing test speediness. Journal of Educational Measurement, 16, 261-270.

Rynes, S.L. (1993). Who's selecting whom? Effects of selection practices on applicant attitudes and behavior. In N. Schmitt & W.C. Borman (Eds.), Personnel selection in organizations (pp. 240-274). San Francisco: Jossey-Bass.

Sackett, P.R., Burris, L.R., & Ryan, A.M. (1989). Coaching and practice effects in personnel selection. In C.I. Cooper & I. Robertson (Eds.), International review of industrial and organization psychology (pp. 145-163).

Sackett, P.R., Zedeck, S., & Fogli, L. (1988). Relations between typical and maximum job performance. Journal of Applied Psychology, 73, 482-486.

Salthouse, T.A. (1985). Speed of behavior and its implications for cognition. In J.E. Birren & K.W. Schaie (Eds.), Handbook of the psychology of aging (2nd ed., pp. 400-426). New York: Van Nostrand Reinhold.

Salthouse, T.A. (1993). Attentional blocks are not responsible for age-related slowing. Journal of Gerontology: Psychological Science, 48, 263-270.

Schaie, K.W., & Willis, S.L. (1993). Age difference patterns of psychometric intelligence in adulthood: Generalizability within and across ability domains. Psychology and Aging, 8, 44-55.

Schmidt, F.L., Greenthal, A.L., Hunter, J.E., Berner, J.G., & Seaton, F.W. (1977). Job samples vs. paper-and-pencil trade and technical tests: Adverse impact and examinee attitudes. Personnel Psychology, 30, 187-197.

Schmit, M.J., & Ryan, A.M. (1992). Test-taking dispositions: A missing link? Journal of Applied Psychology, 77, 629-637.

Schmitt, N. (1977). Interrater agreement in dimensionality and combination of assessment center judgments. Journal of Applied Psychology, 62, 171-176.

Schneider, J.R. (1992). The effects of group variables on evaluations of individuals in assessment center group exercises. Unpublished doctoral dissertation. Michigan State University: East Lansing, MI.

Schneider, R.J., & Hough, L.M. (1995). Personality and industrial/organizational psychology. International Review of I/O Psychology, 10, 75-129.

Schuler, R.S., & Jackson, S.E. (1987). Linking human resource practices with competitive strategies. Academy of Management Executive, 1, 207-219.

Secretary's Commission on Achieving Necessary Skills (SCANS) (1992). Skills and Tasks for Jobs. U.S. Government Printing Office: Washington, D.C.

Smith, C.S., Reilly, C., & Midkiff, K. (1989). Evaluation of three circadian rhythm questionnaires with suggestions for an improved measure of morningness. Journal of Applied Psychology, 74, 728-738.

Smith, F.D. (1991). Work samples as measures of performance. In A.K. Wigdor and B.F. Green Jr. (Eds), Performance assessment for the workplace (pp. 27-52).

Smith, P.C., Kendall, L.M., & Hulin, C.L. (1969). The measurement of satisfaction in work and retirement: A strategy for the study of attitudes. Chicago: Rand-McNally.

Smither, J.W., Reilly, R.R., Millsap, R.E., Pearlman, K., & Stoffey, R.W. (1993). Applicant reactions to selection procedures. Personnel Psychology, 46, 49-76.

Snyder, M. (1974). The self-monitoring of expressive behavior. Journal of Personality and Social Psychology, 30, 526-537.

Snyder, M. (1979). Self-monitoring processes. In L. Berkowitz (Ed.), Advances in experimental social psychology (Vol. 12). New York: Academic Press.

Snyder, M., & Gangestad, S. (1986). On the nature of self-monitoring: Matters of assessment, matters of validity. Journal of Personality and Social Psychology, 51, 125-139.

Snyder, M., & Ickes, W. (1985). Personality and social behavior. In G. Lindzey & E. Aronson (eds.), The Handbook of Social Psychology (pp. 883-947). New York: Random House.

Snyder, M., & Kendzierski, D. (1982). Acting on one's attitudes: Procedures for linking attitude and behavior. Journal of Experimental Social Psychology, 18, 165-183.

Spearman, C. (1904). "General Intelligence," objectively determined and measured. American Journal of Psychology, 15, 201-293.

Spence, J.T., & Pred, R.S., & Helmreich, R.L. (1987). Achievement strivings, scholastic aptitude, and academic performance: A follow-up to "Impatience versus achievement strivings in the Type A pattern." Journal of Applied Psychology, 74, 176-178.

Spielberger, C.D., Jacobs, G.A., Crane, R.G., Russell, S.F., Westberry, L., Barker, L., Johnson, E.H., Knight, J., & Marks, E. (1979). Preliminary manual for the State-Trait Personality Inventory (STPI). Tampa, University of South Florida Human Resources Institute.

Steiger, J.H. (1980). Tests for comparing elements of a correlation matrix. Psychological Bulletin, 87, 245-251.

Sternberg, R.J. (1985). Implicit theories of intelligence, creativity, and wisdom. Journal of Personality and Social Psychology, 49, 607-627.

Sternberg, R.J., Conway, B.E., Ketron, J.L., & Bernstein, M. (1981). People's conceptions of intelligence. Journal of Personality and Social Psychology, 41, 37-55.

Task Force on Assessment Center Standards (1989). Guidelines and ethical considerations for assessment center operations. Public Personnel Management, 18, 457-470.

Tett, R.P., Jackson, D.N., & Rothstein, M. (1991). Personality measures as predictors of job performance: A meta-analytic review. Personnel Psychology, 44, 703-742.

Thorndike, E.L., Bregman, E.O., Cobb, M.V., Woodyard, E., & the Staff of the Division of Psychology of the Institute of Educational Research of Teachers College, Columbia University (1926). The measurement of intelligence. New York: Bureau of Publications, Teachers College, Columbia University.

Thurstone, L.L. (1937). Ability, motivation, and speed. Psychometrika, 2, 249-254.

Torsvall, L., & Akerstedt, T. (1980). A diurnal type scale. Scandinavian Journal of Work and Environmental Health, 6, 283-290.

Tuttle, D.B. (1996). Measuring individuals' temporal orientation. Paper presented at the American Psychological Association Meetings, Toronto, Ontario, Canada.

Vernon, P.A. (1987). New developments in reaction time research. In P.A. Vernon (Ed.), Speed of information processing and intelligence (pp. 1-20). Norwood, NJ: Ablex.

Vernon, P.A. (1987). Speed of information processing and intelligence. Norwood, NJ: Ablex.

Vernon, P.A. (1991). Studying intelligence the hard way. Intelligence, 15, 389-395.

Verster, J.M. (1983). The structure, organization, and correlates of cognitive speed and accuracy: A cross-cultural study using computerized tests. In S.H. Irvine & J.W. Berry (Eds.), Human assessment and cultural factors (pp. 275-292).

Warner, R. (1988). Rhythm in social interaction. In J.E. McGrath's (Ed.) The social psychology of time (pp. 63-88). Newbury Park, CA: Sage.

Weiss, H.M., & Adler, S. (1984). Personality and organizational behavior. In B.M. Staw & L.L. Cummings (eds.), Research in Organizational Behavior (Vol. 6, pp. 1-50). Greenwich, CT: JAI Press.

Wesman, A.G. (1960). Some effects of speed in test use. Educational and Psychological Measurement, 20, 267-274.

Wickelgren, W.A. (1977). Speed-accuracy tradeoff and information processing dynamics. Acta Psychologica, 41, 67-85.

Wonderlic personnel test & scholastic level exam (1992). Libertyville, IL: Wonderlic Personnel Test, Inc.

Work experience and interest inventory. Detroit, MI: Aon Consulting.

Zinbarg, R., & Revelle, W. (1989). Personality and conditioning: A test of four models. Journal of Personality and Social Psychology, 57, 301-314.