ADAPTABILITY TO CHANGING TASK CONTEXTS: EFFECTS OF GENERAL COGNITIVE ABILITY, CONSCIENTIOUSNESS, AND OPENNESS TO EXPERIENCE

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We examined the extent to which cognitive ability, Conscientiousness, and Openness to Experience predict decision-making performance prior to and after unforeseen changes in the task context. Seventy-three undergraduates made decisions on a series of 75 problems during a 3-hour computerized simulation. Unbeknownst to participants, the rules used in determining correct decisions changed after problems 25 and 50. Effects of the individual differences on decision-making performance became significantly stronger after the changes. Only cognitive ability explained variance in prechange performance. Individuals with higher cognitive ability made better decisions. After the change, the cognitive ability effect increased and the effects of Conscientiousness and Openness became statistically significant. As expected, those with high Openness made better decisions. Unexpectedly, those with low Conscientiousness made better decisions. Subsequent analyses revealed that the surprising effect for Conscientiousness was due to the traits reflecting dependability (i.e., order, dutifulness, deliberation) rather than volition (i.e., competence, achievement striving, self-discipline).

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We have all heard about the rapid pace of change in the competitive landscape and what this means to organizations and those who work in them (Bridges, 1994; Edwards & Morrison, 1994; Howard, 1995; Offermann & Gowing, 1990). Advances in information processing have increased the pace at which new products and services are developed and brought to market. Product lifecycles are becoming shorter due to rapid transfer of innovation in a global marketplace. As a result of these trends, organizations must often change what they do and how they do it to remain competitive.

An important consequence of this new environment is that employees' knowledge, skills, and abilities (KSAs) are subject to continual obsolescence and displacement (Howard, 1995). Practitioners must choose from several strategies for dealing with this obsolescence. One option is to discharge those who do not possess newly required KSAs and hire others who do. Indeed, organizations have used this approach to some extent as evidenced by the rise in the number of temporary workers and the disappearance of lifetime careers with a single employer. However, because this approach requires constant turnover, it may not be useful if organizations wish to maintain and build stores of intellectual capital (never mind employee commitment and loyalty).

A second option for managing human resources in a dynamic environment is to emphasize training or formal programs intended to impart newly required KSAs to employees. A potential shortcoming with this approach, however, is that the amount of training necessary to keep pace with change may be overwhelming. In addition, change often takes place rapidly and without warning. By the time a training need is identified and a training program is developed and validated, the need may have changed into something completely different. Alternatively, organizations could develop training interventions designed to make individuals more adaptable to change (e.g., Smith, Ford, & Kozlowski, 1997). Although this approach has great potential, research in this area is fairly new and there are many issues that need to be resolved before it can be used effectively in applied settings. We do not know, for example, whether the skills needed for adaptability are generalizable across contexts, or how best to measure the learning outcomes associated with adaptability training, such as knowledge structures and meta-cognitive skills (e.g., Goldsmith & Kraiger, 1997; Kraiger, Ford, & Salas, 1993; Smith et al., 1997).

A third approach to managing human resources in a dynamic environment is to hire individuals who are capable and willing to work in a changing environment. That is, rely on the organization's selection and staffing systems to provide the organization with people who are
more adaptable. The emphasis of this paper is on this approach. Specifically, we sought to explore whether the types of predictors currently used in many organizations' selection batteries—general cognitive ability and the Big Five personality variables—are as capable of predicting adaptability as they are of predicting more general job performance.

It seems clear that the stability of the task context influences which characteristics individuals need to be effective (e.g., Cohen & Bacdayan, 1996; Keisler & Sproull, 1982; Weiss & Ilgen, 1985). Unfortunately, there has been surprisingly little attention devoted to discovering which characteristics matter most in dynamic contexts. We do not know if those characteristics that have been found to predict performance across most task contexts (i.e., cognitive ability and Conscientiousness) also predict performance in changing contexts. We also do not know whether characteristics generally thought to be poor predictors of performance across most task contexts (e.g., Openness to Experience) predict performance better in changing contexts.

Thus, although the importance of individual adaptability to organizational success has been noted before (e.g., Hedge & Borman, 1995; Howard, 1995), the accumulation of knowledge is inadequate in terms of being able to advise the practitioners who must select employees in today's organizations. The purpose of this paper is to make some initial progress in this area. We examine the relationships between three well-known individual differences (general cognitive ability, Conscientiousness, and Openness to Experience) and decision-making performance both before and after an unforeseen change in the task context. Decision-making performance before change is indicative of performance in stable task contexts. Decision-making performance after change is indicative of the type of adaptability required in contemporary organizations.

Using Individual Differences to Predict Adaptability

Performance is behavior that can be evaluated in terms of the extent to which it contributes to organizational effectiveness (Motowidlo, Borman, & Schmit, 1997). Just as there are differences between individuals in their performance in stable task contexts, so too are there differences between individuals in their performance in changing task contexts. Those who perform well in a changing task context are said to have high adaptability, and those who do not perform well in a changing task context are said to have low adaptability.

Scholars have suggested that relatively stable characteristics influence individuals' adaptability (e.g., Morrison, 1977; Mumford, Baughman, Threlfall, Uhlman, & Costanza, 1993; Murphy, 1989; Sternberg,
However, there is ambiguity as to which individual characteristics really matter. Most of this ambiguity can be attributed to the fact that there have been only a few empirical studies specifically aimed at predicting adaptability. Existing research from an individual differences perspective has focused on the use and development of measures of adaptability based on single types of individual differences such as cognitive ability, personality, or biodata (e.g., Gough, 1987; Jackson, 1967). We suggest that an exclusive focus on single measures of adaptability oversimplifies a phenomenon that would seem to be influenced by several independent processes (e.g., ability, motivation, and creativity).

Some of the ambiguity in research findings on adaptability is because the adaptability criterion has been conceptualized and operationalized haphazardly. Scholars focus on one type of adaptability without acknowledging that there are others types, perhaps with different sets of behavioral requirements. Adaptability has been operationalized most often in terms of learning or performance in a task that is either complex, novel, or just ill-defined (e.g., Mumford et al., 1993). Although learning and performance in such contexts is important, the focus of this study is on learning and performance when there is a change in the task context that results in novelty and complexity. This focus is distinct from the simple learning of a new or complex task because it requires “unlearning” how to do the task and then “relearning” how to do it in light of the change (Chan, 1996; Lewin, 1951; Starbuck & Hedburg, 1977).

A third possible reason for the ambiguity of research findings of adaptability is that the behavioral requirements underlying performance in changing contexts have not been adequately specified. We suggest that rather than developing theories of adaptability where the focus is on “performance” per se, it may be beneficial to focus on specific unidimensional components of performance (Campbell, 1990; Motowidlo & Van Scotter, 1994). Although managers may demand answers in terms of broad concepts such as job performance, applied science may cumulate more quickly by focusing on more narrow and homogeneous dependent variables (Nunnally & Bernstein, 1994). Once an understanding of these narrow performance constructs is developed, theories can then be integrated to address the more general issues of interest to practitioners.

Although performance can be thought of as behavior that contributes to the organization’s social or psychological context (i.e., contextual performance), we chose to focus on behaviors that contribute directly to the organization through the transformation of inputs into outputs (i.e., task performance). We chose this focus to be consistent with past research on adaptability. However, our focus is even a bit narrower in that we consider a specific type of task performance: decision-making performance (i.e., accuracy). We chose this criterion because technological advances
have increased the role of cognitive factors at work, relative to physical strength and endurance (Howard, 1995; Ilgen & Pulakos, 1999), and the need to make accurate judgments and decisions is important in many different types of jobs. In fact, all major job analytic schemes consider this component of work when characterizing a job (e.g., McCormick, Jeanneret, & Mecham, 1972; Primoff, 1975). Thus, the performance criterion in this study was decision-making performance, as opposed to global performance in a broader sense.

Finally, although the distinctions between performance prior to any change in the task context and adaptability may seem well accepted and straightforward, research relating individual differences to adaptability should explicitly consider comparisons with prechange performance as well. Contrasting the two types of performance in terms of their relationships to individual differences will provide a better understanding of the broader nomological network in which both types of performance are embedded. Moreover, such research will allow us to assess the extent to which adaptability is empirically distinct from performance prior to change in the task context. If the relationships between individual differences and adaptability and prechange performance are the same, then it may not be meaningful to view the constructs differently. If this were true, practitioners would not have to worry about predicting adaptability—they could simply rely on selection systems designed to predict performance in general.

In the subsequent section we explore the relationships between general cognitive ability, Conscientiousness, and Openness to Experience and decision-making performance prior to an unforeseen change in the task context (i.e., prechange decision making performance), and after an unforeseen change in the task context (i.e., adaptability). These three individual differences were chosen because they capture three distinct and seemingly necessary preconditions for adaptability: ability, motivation, and creativity.

Adaptability and General Cognitive Ability

General cognitive ability or g refers to individual differences in information processing capacity or the ability to learn (Hunter, 1986; Kanfer & Ackerman, 1989; Ree & Earles, 1991). Those with higher levels of g are able to represent more information in the cognitive space where the data that guide behavior are processed (i.e., working memory). As a result, those with higher levels of g are able to learn more quickly from their experiences and are able to develop larger and more efficiently organized stores of job knowledge and skills (Schmidt, Hunter, & Outerbridge, 1986). Overall, there is a consensus that g relates positively
to job performance across a wide variety of contexts (Hunter & Hunter, 1984; Ree, Earles, & Teachout, 1994). With this in mind, and because decision making is a cognitive task that requires mental representation and manipulation of information obtained from long-term memory and environmental stimuli, g should relate positively to decision-making performance. Taylor and Dunnette (1974) confirmed such a relationship, finding that high levels of g improved individuals’ abilities to judge which pieces of information were predictive of correct decisions.

However, it is quite clear that g relates more strongly to performance in tasks that are complex and novel than in tasks that are simple and routine (Hartigan & Wigdor, 1989; Hunter & Hunter, 1984). This relationship is consistent with the notion that learning and performance in novel or complex situations requires more information to be cognitively represented and processed within a given period. We suggest that when there is an unexpected change in the task environment, there are additional information processing demands placed on individuals. Specifically, when adaptability is required as a result of a contextual change, individuals must: (a) relearn how to do the task in light of the new situation; and (b) learn not to reactivate the old learning, scripts, and schemes that guided past behavior. These additional demands in the face of unforeseen changes make individual differences in g even more critical determinants of decision-making performance in conditions where adaptability is required. We therefore expect that:

**Hypothesis 1:** The relationship between g and decision-making performance will be moderated by the task context, such that the high g will be more beneficial after the unforeseen change in context, when adaptability is required, than before.

*Adaptability and Conscientiousness*

Conscientiousness is one of the Big Five personality dimensions (Barrick & Mount, 1991; Costa & McCrae, 1992; Costa, McCrae, & Dye, 1991). Conscientiousness includes a volitional component that is related to one’s will to achieve, self-motivation, and efficaciousness. Conscientiousness also includes a dependability component that is related to orderliness, reliability, and cautiousness. Given this description, it should not be surprising that Conscientiousness has been found to relate positively to job performance across a wide variety of contexts (Barrick & Mount, 1991). Conscientiousness is thought to influence job performance through several mechanisms. For example, highly conscientious individuals tend to be more perseverant and are more committed to the difficult goals they set for themselves than individuals who are
less conscientious (Barrick, Mount, & Strauss, 1993; Hollenbeck, Klein, O'Leary, & Wright, 1989; Hollenbeck & Williams, 1987).

As in most performance tasks, variability in decision-making effectiveness should depend on the extent to which individuals exert effort toward the task. Perseverance is important in decision-making tasks to the extent that individuals must often search for important information and use trial and error in learning how to appropriately weigh information. Decision-making performance is also likely to be higher for individuals who tend to be orderly and deliberate. This is because decision making often demands consideration of a disorganized pool of informational cues. Individuals who consider informational cues haphazardly, or who spontaneously make "seat of the pants" decisions, should be less effective than individuals who carefully consider the ecological value of available cues. Given this line of reasoning, and consistent with the relationship with job performance, it seems likely that those who score high on Conscientiousness will make decisions that are more accurate than those who score low on Conscientiousness.

As mentioned earlier, individuals must react to a change in the task context by focusing much of their attention on developing new ways of doing their task given that their existing routines are no longer appropriate. Effectiveness in this type of context may be even more dependent on Conscientiousness than performance in a more stable context for several reasons. Individuals will usually experience decrements in decision-making performance before the change in the context is even noticed. Those who do not possess high levels of task commitment and feelings of self-competence might be tempted to abandon or lower their performance goals after a series of poor decisions that have occurred for no apparent or well-understood reason. The behavioral tendencies associated with dependability should promote high levels of postchange decision-making performance as well. This is because increased understanding of the new situation should be promoted by a methodical, careful, and deliberate consideration of decision outcomes in both the new and old contexts.

Thus, although it is reasonable to expect that Conscientiousness may be positively related to decision-making effectiveness prior to any change in the task context, we expect that the relationship will be stronger after some unexpected change. That is, Conscientiousness should be more highly related to adaptability than to prechange decision-making performance.

_Hypothesis 2:_ The relationship between Conscientiousness and decision-making performance will be moderated by the task context, such that high Conscientiousness will be more beneficial after the unforeseen change in context, when adaptability is required, than before.
Adaptability and Openness to Experience

Openness to Experience is another one of the Big Five personality characteristics. Open individuals are imaginative, curious, original, and broad-minded (Barrick & Mount, 1991). Open individuals have a strong intellectual curiosity and often seek out new and unconventional experiences and ideas. In contrast to Conscientiousness, however, there is no evidence that Openness promotes performance effectiveness at work. In one meta-analysis, for example, Barrick and Mount (1991) reported an estimated true correlation of $\rho = .04$ across performance criteria and occupations. Tett, Jackson, and Rothstein's (1991) meta-analysis found larger effect sizes for openness and performance in confirmatory studies. However, the 95% confidence interval for the sample-weighted mean $r$ ranged from $-.07$ to $.44$, so it is difficult to draw any firm conclusions about the true nature of the Openness–performance relationship. Given the behavioral requirements of decision making, there is also very little reason to expect a positive relationship between Openness and the accuracy of decisions under circumstances where the path to effectiveness is established and fairly well understood.

However, open individuals are more willing to engage in the type of self-monitoring and assessment that is necessary for learning in changing task contexts (Blickle, 1996; Busato, Prins, Elshout, & Hamaker, 1999). This is supported in that Barrick and Mount (1991) found that Openness is positively related to training proficiency ($\rho = .25$). Interestingly, in reflecting on the aforementioned training proficiency relationships, Mount and Barrick noted that "we have been somewhat surprised that this finding has not had more of an impact." (1998, p. 851). Indeed, very few studies since the 1991 meta-analysis have examined the implications of Openness, despite its intuitive appeal. Adaptability not only requires learning (actually unlearning and relearning) but also the development of different, more appropriate, and possibly counterintuitive ways of doing things. This requirement places a premium on creativity and the ability to focus attention on areas that others may not consider. Because open individuals tend to be creative, receptive to change, enjoy intellectual types of problems (e.g., brain teasers), and are more willing to try new things (Costa & McCrae, 1992; King, Walker, & Broyles, 1996; McCrae, 1987), they should be more effective in decision making after a familiar path to success has changed. That is, Openness should be more highly related to adaptability than to decision-making performance before an unexpected change in the task.
Hypothesis 3: The relationship between Openness and decision-making performance will be moderated by the task context, such that high Openness will be more beneficial after the unforeseen change in context, when adaptability is required, than before.

Summary

Given a number of the trends facing organizations today, it is important that we begin to understand how to predict who will perform effectively in a rapidly changing environment. To date, there has not been much research on this topic. However, given the demands placed on individuals in a changing environment and our current knowledge of individual differences, we predicted that adaptability would be a function of g, Conscientiousness, and Openness. Specifically, we hypothesized that the effects of these individual differences would be stronger on adaptability than on prechange decision-making performance. In the next section we describe a study used to test these hypotheses.

Method

Participants

Research participants were 73 undergraduates enrolled in an upper level management course at a large state university. Participants completed the cognitive ability test and the personality instrument when they were recruited for the study during the first week of class. Participants received course credit for participation as well as eligibility for cash prizes based on their performance. In order, the top three performers earned $20, $15, and $10.

Procedure

Research setting. We conducted our study in a laboratory setting. The use of a laboratory task to test our hypotheses was justified on several grounds. First, in field settings it is difficult to anticipate the timing of a contextual change that is likely to impact a fairly large number of individuals the same way. Therefore, it is difficult, a priori, to find a field setting where adaptability may be important and where there is an opportunity to observe a fairly large number of participants prior to and after an unforeseen change. Second, in field settings it is difficult to anticipate the nature of a contextual change. This makes it difficult, a priori, to anticipate the set of behaviors needed to effectively respond to the change.
The laboratory, on the other hand, allows researchers to control both the timing and the nature of a change in context. Controlling these aspects of the change is especially crucial when studying adaptability because experience (both in terms of breadth and depth of knowledge) likely plays an important role in strengthening the very routines that must be overcome during times of change. The laboratory setting allowed us to equalize all participants' experience. Thus the effects of experience on routine strength was controlled for by design.

The task. In this study, we used a computerized multiple cue probability learning task called TIDE$^2$ (Hollenbeck et al., 1995). Although TIDE$^2$ has been used in a number studies on teams (e.g., LePine, Hollenbeck, Ilgen, & Hedlund, 1997; Hollenbeck, Colquitt, Ilgen, LePine, & Hedlund, 1998; Hollenbeck, Ilgen, LePine, Colquitt, & Hedlund, 1998), in the present study it was configured for individuals who performed the task independently. Each participant sat in front of a computer and made decisions on a series of 75 unidentified aircraft over the course of 3 hours. As aircraft entered the simulated airspace, individuals gathered information on the values of nine aircraft characteristics (e.g., altitude, speed, range, angle, corridor status) using a pull-down menu. Participants were trained how to interpret each aircraft characteristic in terms of a threat level (e.g., a low altitude value was assigned a threat value of 2, a medium altitude value was assigned a threat value of 1, and a high altitude value was assigned a threat value of 0). They were also trained to use these values to arrive at a decision regarding a course of action to take with respect to the aircraft. Ultimately, participants made decisions using a 7-point continuum of aggressiveness (1 = ignore; 2 = review; 3 = monitor; 4 = warn; 5 = ready; 6 = lock-on; 7 = defend). Immediately after making one of these seven decisions, the simulation provided participants feedback consisting of the correct decision and the absolute difference between the correct decision and their decision. Participants were also instructed that, in order to make decisions, the nine aircraft characteristics should be broken down into three rules, termed Rules Alpha, Bravo, and Charlie. Part of this instruction included information about which specific attributes needed to be combined in order to make assessments for rules (e.g., Rule Bravo required participants to consider values for altitude, heading crossing angle, and speed). Participants were told that their assessments should be made based on these rules and not based on individual characteristic values. This was because the rules were set up such that characteristic values combined multiplicatively into rule values. Thus, a nonthreatening 0 value for any one of the characteristics within Rule Bravo made the Bravo assessment nonthreatening, no matter what the other two characteristics values within the rule were (because anything multiplied by 0 equals 0).
Participants were not given formal training on what to do with the three rule assessments once they had arrived at them. That is, if Rule Alpha generated a threat value of 8 (where all three characteristics had a threat value of 2), Rule Bravo generated a threat value of 2 (where one characteristic had a threat value of 2, and the other two had values of 1), and Rule Charlie generated a threat value of 0, participants were not told how to arrive at their final decision. Rather they were told that Rules Alpha, Bravo, and Charlie were not necessarily equally important when judging aircraft threat levels. They were also told that it was up to them to figure out which rule or rules deserved the most weight when trying to arrive at the correct decision.

Prior to beginning the simulation, participants completed three training trials. During the three training trials, the aircraft information was scripted so that each rule would lead participants to the same decision (e.g., all characteristics within each rule were equally threatening). This aspect of the training insured that participants could not create an immediate perception of one rule being more important than the others. Immediately following the three training trials, participants were reminded that the rules used to make decisions would not necessarily lead them to the same answer, nor would the rules necessarily be equally predictive of the correct decision. What they were not told, however, was that for the first 25 trials during the game, Rule Charlie would receive a weight of 1 in predicting the correct decision, while Rules Alpha and Bravo would receive weights of 0. Thus, to perform well initially, participants had to learn that they should rely more heavily on Rule Charlie in making their decisions.

The change in task context occurred when, for the second 25 trials, Rule Bravo received a weight of 1 while Rules Alpha and Charlie received weights of 0. This required participants to notice that Rule Charlie no longer seemed to be driving the correct decision, and further required them to realize that Rule Bravo was now important. The change therefore required both unlearning and relearning, and it occurred completely without warning to participants. Finally, for the final 25 trials, rule Alpha received a weight of 1 and rules Bravo and Charlie received weights of 0. Although not directly related to specific hypotheses, we felt that the addition of a second change would allow us to examine the extent to which effects of individual differences generalize across subsequent change. We felt that individuals might learn how to adapt, and if so, relationships with individual differences might be similar to those found in the initial decision-making context. Alternatively, a second change might create the same kind of adaptive requirements as the initial change, and if so, relationships with individual differences
might be similar to those found for decision-making performance after the first change.

**Measures**

*Decision-making performance.* As recommended by several scholars, we operationalized decision-making performance in terms of mean squared error (MSE; Gigone & Hastie, 1997; Hollenbeck, Colquitt et al., 1998; LePine, Hollenbeck, Ilgen, Colquitt, & Ellis, 1999). For each decision, there was a decision outcome calculated as the squared difference between the individual’s decision and the correct decision. Three MSE scores were calculated for each individual by taking the average of the squared differences over the 25 decision trials in each of the three task contexts. Because the scale for decisions ranged from 1 to 7, MSE scores could range from 0 (a perfect match across trials) to 36 (the worst match across trials). Because MSE is a measure of accuracy, lower scores reflect higher decision-making performance. The odd–even trial split half reliability for the three decision contexts were .83, .84, and .77 respectively.

*General cognitive ability.* General cognitive ability was measured using the Wonderlic Personnel Test (WPT) Form 2 (Wonderlic & Associates, 1983). This 12-minute test has been used for years in a wide variety of educational, psychological, and applied business contexts. The WPT is a reliable measure of the same verbal, quantitative, and spatial abilities that indicate g. Internal consistency reliabilities across forms of the Wonderlic have been found to range from .88 to .94 (Wonderlic & Associates, 1983).

*Conscientiousness and Openness.* Conscientiousness and Openness were measured with scales from the Revised NEO Personality Inventory (NEO-PI-R, Costa & McCrae, 1992). Each scale includes 48 items capturing the subfactors thought to underlie each construct. For Conscientiousness the six subfactors include competence, order, dutifulness, achievement striving, self-discipline, and deliberation. The six subfactors that underlie Openness include fantasy, aesthetics, feelings, actions, ideas, and values. In this study, internal consistency reliabilities for the Conscientiousness and Openness scales were .86 and .89 respectively.

**Results**

**Descriptive Statistics**

Correlations and descriptive statistics for all variables in the study are shown in Table 1. Before addressing our hypotheses, it is worth
<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD</td>
<td>3.51</td>
<td>4.53</td>
<td>3.97</td>
<td>4.75</td>
<td>3.47</td>
<td>3.36</td>
</tr>
<tr>
<td>M</td>
<td>8.89</td>
<td>6.53</td>
<td>5.64</td>
<td>6.54</td>
<td>3.47</td>
<td>3.36</td>
</tr>
</tbody>
</table>

Notes: 
- *p < .05*
- Descriptive statistics are operationalized as mean squared error (a measure of accuracy), thus lower scores reflect higher decision-making performance.
- Reliabilities appear on the diagonal of the correlation matrix.

TABLE 1: Descriptive Statistics, Reliabilities, and Zero-Order Correlations
noting that the general pattern of correlations supports the notion that decision-making performance was something different across the initial and postchange contexts. Initial decision-making performance was only moderately related to decision-making performance in the periods after change \( (r = .32 \text{ and } r = .44, \text{ respectively}) \). However, the magnitude of the relationship between decision-making performance in the two periods after change was much higher \( (r = .72) \). This suggests that postchange decision-making performance captured something that initial decision-making performance did not capture.

Tests of Hypotheses

Hypotheses 1–3 predicted that the relationships between the individual differences and decision-making performance would be moderated by the task context, such that the relationships would be stronger after the unforeseen change in context, when adaptability is required, than before. At a zero-order level, Table 1 illustrates that only \( g \) predicted decision-making performance prior to the unforeseen changes. Openness and \( g \) were correlated with both postchange decision-making performance variables in the expected direction, providing some initial support for Hypotheses 1 and 3. However, Conscientiousness was correlated with both postchange decision-making performance variables such that highly conscientious individuals had higher error levels, contrary to our predictions.

Hypotheses 1–3 were directly tested by creating a database in which each participant had three separate decision-making performance observations, thus \( N = 219 \). We dummy coded whether each observation was for decision-making performance prior to any change, decision-making performance after the first change, or decision-making performance after the second change. We then examined Hypotheses 1–3 by testing the significance of the interactions of the individual differences and the relevant context codes (i.e., initial decision-making performance vs. decision-making performance after the first change, and initial decision-making performance vs. decision-making performance after the second change).

Because multiple observations were nested within individuals in the \( N = 219 \) data set, we needed to test Hypotheses 1–3 using a method that would acknowledge the repeated measures design, derive parameter estimates, and compute appropriate standard errors for those estimates. We chose to use the SUDAAN software because it uses an appropriate procedure for analyzing longitudinal and cluster-correlated data (Shah, Barnwell, & Bieler, 1997). SUDAAN's REGRESS procedure uses the method of Generalized Estimating Equations (Liang &
Zeger, 1986; Zeger & Liang, 1986) that accounts for the correlations of responses within time periods that tend to inflate the standard errors of regression coefficients in repeated measures data. Although parameter estimates remain unbiased and asymptotically normally distributed even when there is a lack of independence of responses, failure to account for a lack of independence in responses results in biased estimates of the variance of the estimated parameters.

Although there are a number of options to chose from in SUDAAN, we used the regression method whereby OLS parameter estimates are generated with variance correction using the "robust variance estimate" proposed by Liang & Zeger (1986). We note, however, that other regression options in SUDAAN (i.e., Exchangeable Working Conditions and Jackknife variance estimation) resulted in parameter estimates, standard errors, and p-values that were very close to those generated using the OLS estimates and robust variance estimates procedure. We entered the independent variables in steps, primarily in order to assess the extent to which the personality characteristics explained variance in adaptability over and above the variance explained by $g$. Thus, we entered the interaction terms for $g$ prior to those for Conscientiousness and Openness. We entered the Openness terms last because we wanted to assess the extent to which Openness would be predictive of adaptability over and above the effects of $g$ and Conscientiousness, the individual differences thought to be the best predictors of performance over a wide variety of situations.

The results for Hypotheses 1–3 can be found in steps 5–7 of Table 2, which test the significance of the individual differences $\times$ task context dummy code interactions. The interactions between $g$ and the two context codes were both significant, explaining an incremental 2% of the total variance in decision-making performance as a step. Moreover, the plot of these interactions was as predicted, as shown in Figure 1. The relationship between $g$ and mean squared error was more negative in the two postchange decision-making performance contexts than it was in the prechange decision-making performance context.

The interactions between conscientiousness and the two task context dummy codes were also both significant, explaining an incremental 2% of the total variance in decision-making performance as a step, over and above the effects of $g$. The plot of these interactions is shown in Figure 2, and is consistent with predictions insofar as the relationship between Conscientiousness and mean squared error is stronger in the two postchange task contexts than in the prechange task context. Note, however, that the direction of these effects was contrary to our prediction that high Conscientiousness would promote adaptability.
### TABLE 2
**Regression Results for Hypotheses 1-3**

<table>
<thead>
<tr>
<th>Decision-making performance</th>
<th>Total $R^2$</th>
<th>Regression weights</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Context code 1: Prechange vs. after first change</td>
<td>.17$^*$</td>
<td>-2.33$^*$</td>
</tr>
<tr>
<td>Context code 2: Prechange vs. after second change</td>
<td></td>
<td>-4.41$^*$</td>
</tr>
<tr>
<td>(2) General cognitive ability</td>
<td>.28$^*$</td>
<td>-1.47$^*$</td>
</tr>
<tr>
<td>(3) Conscientiousness</td>
<td>.30$^*$</td>
<td>.56$^*$</td>
</tr>
<tr>
<td>(4) Openness to Experience</td>
<td>.32$^*$</td>
<td>-.74$^*$</td>
</tr>
<tr>
<td>(5) General cognitive ability $\times$ context code 1</td>
<td>.34$^*$</td>
<td>-1.14$^*$</td>
</tr>
<tr>
<td>General cognitive ability $\times$ context code 2</td>
<td></td>
<td>-.91$^*$</td>
</tr>
<tr>
<td>(6) Conscientiousness $\times$ context code 1</td>
<td>.36$^*$</td>
<td>1.54$^*$</td>
</tr>
<tr>
<td>Conscientiousness $\times$ context code 2</td>
<td></td>
<td>1.41$^*$</td>
</tr>
<tr>
<td>(7) Openness to Experience $\times$ context code 1</td>
<td>.38$^*$</td>
<td>-1.38$^*$</td>
</tr>
<tr>
<td>Openness to Experience $\times$ context code 2</td>
<td></td>
<td>-1.18$^*$</td>
</tr>
</tbody>
</table>

**Notes:** $N = 219$. Decision-making performance is operationalized as mean squared error (a measure of accuracy), thus lower scores reflect higher decision-making performance. Repeated measures regression analysis was performed using the Generalized Estimating Equation routine in the SUDAAN program.

$^*p < .05$  $^*p < .10$

Finally, the interactions between openness and the task context dummy codes were both significant, again explaining an incremental 2% of the variance in total decision-making performance as a step, and these effects were over and above the effects of $g$ and Conscientiousness. These interactions are shown in Figure 3, and are as predicted. The relationship between Openness and mean squared error was more negative in the two postchange task contexts than in the initial prechange task context.

In summary, it appears that $g$, Conscientiousness, and Openness are all better predictors of decision-making performance when adaptability is required than decision-making performance prior to unforeseen change. We note here that differences in the reliabilities of the measures do not provide an alternative explanation for our results because the reliabilities of the three performance variables were similar in magnitude. Surprisingly, however, the effects for Conscientiousness were exactly the opposite of what we had expected. Whereas high $g$ and Openness appeared to promote decision-making performance following unforeseen change, high Conscientiousness appeared to detract from decision-making performance following unforeseen change. In the following section we present a set of supplementary set of analyses to try to uncover the reasons behind the results for Conscientiousness.
Figure 1: Effects of General Cognitive Ability on Decision-Making Performance Across Task Contexts.
Figure 2: Effects of Conscientiousness on Decision-Making Performance Across Task Contexts.
Figure 3: Effects of Openness to Experience on Decision-Making Performance Across Task Contexts.
Supplementary Analyses of Personality Facets

Some have suggested that it may be possible to gain insight into the mechanisms through which personality relates to performance by considering facets of personality that are more narrow and unidimensional (e.g., Ashton, 1998; Hough, 1992; Paunonen, Rothstein, & Jackson, 1999; Schneider, Hough, & Dunnette, 1996). The narrower facets are more behaviorally specific than the Big Five composites and this makes it easier to see exactly which behavioral tendencies map onto the criterion under consideration. Given that we are interested in a fairly specific performance criterion in this study (decision-making performance in stable and changing task contexts), it should be informative to also examine predictors that are fairly specific.

Hough (1992) argued that conscientiousness should be decomposed into achievement and dependability in order to predict important job-relevant criteria. Achievement relates to characteristic levels of volition and the extent to which individuals are persistent and committed to their goals. Dependability relates to whether people tend to seek order and structure in their lives and whether they are dependable and think before they act. In her meta-analysis, Hough (1992) found support for differential effects of achievement and dependability. Achievement was clearly a better predictor of overall performance ($r = .19$) and sales effectiveness ($r = .27$) than dependability ($r = .07$ and $r = .06$, respectively). For the criterion of creativity, there was a positive relationship with the achievement facet ($r = .14$) and a negative relationship with the dependability facet ($r = -.07$).

In another meta-analysis, Mount and Barrick (1995) considered relationships among Conscientiousness, achievement, dependability, and a number of criterion types including overall job proficiency, training proficiency, reliability, effort, and creativity. The results of this analysis indicated that achievement and dependability tended to predict criteria better than overall Conscientiousness only when the criteria were close conceptual matches with the facet. For example, dependability predicted reliability ($\rho = .47$) and quality ($\rho = .48$) better than overall Conscientiousness ($\rho s = .41$ and .44, respectively). In contrast, Conscientiousness was just as good a predictor as dependability or achievement for criteria that were more broad (e.g., overall job proficiency, technical proficiency) or less conceptually related to the narrower facets.

In hindsight, by considering narrower facets of Conscientiousness, it is possible to assess several potential reasons for the negative relationship with decision-making performance when adaptability is required. For example, we reasoned that high levels of motivation, commitment
to goals, and perseverance would be particularly important in changing contexts because of the need for individuals to continuously allocate cognitive resources toward the task in the face of negative feedback and frustration. However, it might be that those who were highly achievement-oriented were fixated on performing well, and thus, did not allocate the cognitive resources that were necessary to relearn how to do the task in the new situation. Likewise, those scoring high on competence may have unwittingly deceived themselves into thinking they were doing better than they actually were after change, consistent with past research linking Conscientiousness and self-deception (e.g., Martocchio & Judge, 1997). Finally, high self-discipline may have made individuals persevere too long in a course of action that was once fairly successful. Alternatively, there are reasons why the facets associated with dependability might be negatively associated with adaptability. We originally thought that being orderly, careful, and methodical would help individuals organize information so that they could make thoughtful and rational choices. However, we did not consider the possibility that, in times of change, individuals scoring high on the dependability facets might focus their attention on maintaining order (or even imposing order prematurely in the face of change) before the new situation was completely understood.

Thus, with these possibilities in mind, it seems possible that the negative relationship for Conscientiousness might be driven by the facets of the NEO PI-R that correspond to either dependability (i.e., order, dutifulness, and deliberation) or achievement (i.e., achievement striving, competence, and self-discipline). To explore these possibilities, we formed variables for the facets of Conscientiousness and computed correlations with the decision-making criteria.

For completeness, we also formed variables for the facets of Openness to Experience (i.e., fantasy, aesthetics, feelings, actions, ideas, and values) and computed the relevant correlations. However, relative to Conscientiousness, there has been much less research on the facets of Openness in terms of their nomological networks. Accordingly, it is a bit more difficult to offer detailed predictions as to which facets are likely to be most important in driving the Openness results observed in our data. However, the ideas (enjoys playing with theories, abstract ideas, puzzles) and actions facets (trying different things, learning how to do different things) seem more consistent with the behavioral requirements of adaptability than do the fantasy (daydreaming and having an active imagination), feelings (having strong emotions and noticing moods), values (tolerant of other people’s lifestyles and controversial perspectives), and aesthetics (being concerned with aesthetics, art, and music) facets.
<table>
<thead>
<tr>
<th>Big Five facet</th>
<th>Decision-making performance</th>
<th>Decision-making performance</th>
<th>Decision-making performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \alpha ) (prechange)</td>
<td>(after first change)</td>
<td>(after second change)</td>
</tr>
<tr>
<td>Conscientiousness facets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) Competence</td>
<td>.72</td>
<td>.01</td>
<td>.01</td>
</tr>
<tr>
<td>(2) Order</td>
<td>.82</td>
<td>.00</td>
<td>.25*</td>
</tr>
<tr>
<td>(3) Dutifulness</td>
<td>.82</td>
<td>-.04</td>
<td>.26*</td>
</tr>
<tr>
<td>(4) Achievement</td>
<td>.77</td>
<td>-.27*</td>
<td>.14</td>
</tr>
<tr>
<td>(5) Self-discipline</td>
<td>.77</td>
<td>.09</td>
<td>-.03</td>
</tr>
<tr>
<td>(6) Deliberation</td>
<td>.78</td>
<td>-.12</td>
<td>.30*</td>
</tr>
<tr>
<td>Openness to Experience facets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(1) Fantasy</td>
<td>.72</td>
<td>.15</td>
<td>-.20</td>
</tr>
<tr>
<td>(2) Aesthetics</td>
<td>.67</td>
<td>.01</td>
<td>-.27*</td>
</tr>
<tr>
<td>(3) Feelings</td>
<td>.71</td>
<td>-.08</td>
<td>-.28*</td>
</tr>
<tr>
<td>(4) Actions</td>
<td>.70</td>
<td>.05</td>
<td>-.31*</td>
</tr>
<tr>
<td>(5) Ideas</td>
<td>.71</td>
<td>.02</td>
<td>-.33*</td>
</tr>
<tr>
<td>(6) Values</td>
<td>.67</td>
<td>-.12</td>
<td>-.18</td>
</tr>
</tbody>
</table>

*Notes: \( N = 73 \). Performance is operationalized as mean squared error (a measure of accuracy), thus lower scores reflect higher decision-making performance. \( *p < .05 \).

The results of these supplementary analyses are presented in Table 3. The internal consistency reliabilities of the facet scales compared well with those reported by Costa and McRae (1992) in the NEO PI-R manual and ranged from .67 to .82. As reflected in the two far left columns of Table 3, decision-making performance after both task context changes tended to be worse for those scoring higher in order \( r = .25, .35 \), dutifulness \( r = .26, .28 \), and deliberation \( r = .30, .24 \). Note again that performance is operationalized as mean squared error, thus positive relationships reflect higher error levels. The table also shows that there were no significant correlations between any of the achievement facets and the two postchange criteria. Thus, it appears that the unexpected relationship between Conscientiousness and decision-making performance when adaptability is required can be attributed to the dependability facets, but not the achievement facets. We should also note that, in the prechange decision-making context, those scoring higher on the achievement striving facet of Conscientiousness made decisions that were more accurate \( r = -.27 \). This relationship is more consistent with meta-analytic findings (Barrick & Mount, 1991).

Table 3 also shows the pattern of correlations among Openness facets and decision-making performance. None of the Openness facets correlated significantly with prechange decision-making performance. As
expected, however, after both changes those scoring higher on the actions (r = -.31, -.30) and ideas (r = -.33, -.33) facets made decisions that were more accurate. Somewhat unexpectedly, individuals scoring higher on the other Openness facets also tended to make decisions that were more accurate after the changes. The correlations for the feelings facet were significant and about the same magnitude as the actions and ideas results (r = -.28, -.30). Correlations for the remaining facets of Openness (i.e., aesthetics, fantasy, values) were a bit lower (rs ranging from -.18 to -.27) and were either statistically significant or approaching significance.

Discussion

As noted at the outset, an increased understanding of adaptability is important to practitioners responsible for staffing organizations in increasingly dynamic contexts. Although the importance of adaptability to organizations has been noted before, there is a dearth of empirical research aimed at developing a better understanding of adaptability. Among the most important concerns is how the requirements of individuals for effective performance vary across task contexts that differ in terms of change. In this study, we examined how a set of individual differences predicted decision-making performance in both stable and changing task contexts.

Summary of Results

Overall, the results of our study support the idea that it is meaningful to talk about adaptability as something distinct from prechange performance. Although decision-making performance prior to any change was positively related to decision-making performance after change, the magnitude of the relationship was only moderate. In addition, the magnitude of the relationship between decision-making performance after the two changes was higher than that between prechange decision-making performance and decision-making performance after either of the changes. More importantly, the set of individual differences that predicted decision-making performance prior to change was different than the set of individual differences that predicted decision-making performance after changes. Thus, it seems that the set (and/or weights) of individual differences that predict decision-making performance in stable contexts may not be the same set that predicts adaptability.

Our results support the notion that adaptability may be a function of g, Conscientiousness, and Openness. We found that although g predicted prechange decision-making performance, the strength of this re-
relationship increased significantly after the first and second changes. In addition, although the personality factors did not predict prechange decision-making performance, they became as important as $g$ in predicting decision-making performance after the changes. Although some have discussed the ways in which validity coefficients for individual differences change over time (e.g., Ackerman, 1987; Henry & Hulin, 1987; Murphy, 1989), our results suggest a distinct pattern when there is a sudden, unforeseen change in the task context. Specifically, we found increases in the validity of both $g$ and the personality characteristics. These results support our assertion that change places demands on people that are quite distinct from demands existing during initial task activity where a more automatic mode of information processing is used and where information concerning appropriate behavior is less ambiguous.

It is also critical to point out that, when it came to predicting adaptability with individual differences, there was "much more than $g." Both Conscientiousness and Openness were important predictors of decision-making performance after the change in context even after the effects of $g$ were taken into account (albeit, the effect for Conscientiousness was opposite to expectations).

**Differential Effects for Facets of Conscientiousness**

Conscientiousness is generally believed to be the second best individual difference predictor of performance (after $g$), and the direction of this relationship is such that higher levels of Conscientiousness generally promote higher levels of performance (Barrick & Mount, 1991). In our study, however, Conscientiousness appeared to detract from decision-making performance after changes in the task context. Although surprising to us, this finding is consistent with the growing concern that, despite the meta-analytic results (i.e., Barrick & Mount, 1991), Conscientiousness might not always be a good thing (Brinkmeyer & McDaniel, 1998; Feist, 1998; Martocchio & Judge, 1997; Tett, 1998; Tett, Jackson, Rothstein, & Reddon, 1999).

Our supplementary analyses shed some light on the mechanism behind the relationship between Conscientiousness and adaptability. We found that the dependability facets of Conscientiousness, and not those related to volition, were responsible for the negative relationship with adaptability. Although there were no differences in decision-making performance prior to the changes in the task context, those who tended to be deliberate, orderly, and self-disciplined had trouble making accurate decisions after the changes. Through this analysis, we also found that those scoring higher on a volitional facet of Conscientiousness
(achievement-striving) made more accurate decisions prior to change but not after change.

Overall, our research emphasizes the need to include certain carefully chosen personality characteristics in selection batteries where performance requires adaptability. Our findings suggest that when predicting fairly specific criteria (decision-making performance in different contexts), it may be useful to consider personality predictors that are fairly specific (narrower than the Big Five dimensions). Although the differential relationships found in our study need to be replicated in different settings with different performance criteria, they do highlight the need for researchers to closely examine the congruence between predictor and criterion constructs in terms of their breadth (Hogan & Roberts, 1996).

Examining effects within task contexts. We designed our study to assess predictor-criterion relationships across different task contexts with the assumption that the prechange and postchange contexts would place different demands on the participants. However, given the design of our study, it is possible that the actions needed to achieve effectiveness changed over the course of time within each task context. Perhaps the manipulation was such that the early trials within each phase reflected “novelty” and the latter trials reflected “routine.” Early trials during each phase required participants to learn, or unlearn and relearn how to do the task in order to make effective decisions. Later trials during each phase required individuals to make decisions using the routine they had learned earlier in the phase. Stated somewhat differently, it is possible that, within each of the three phases, there might be two types of performance: adaptive (early trials) and routine (later trials). If this were true, the pattern of correlations with g, Conscientiousness, and Openness would reflect these differences across early and late trials within each of the phases. Consistent with the logic outlined earlier in this paper, within each of the three phases we would expect stronger relationships for the early trials and weaker relationships for the later trials.

To assess this possibility, we calculated MSE scores using the first 12 and the last 13 trials of each of the three phases. We then examined correlations between these six MSE scores and the individual differences. The results of this analysis showed no within phase differences across early and late trials. Not only were the magnitudes of the correlations within each phase similar to one another, but the magnitude and direction of the effects were nearly identical to that presented in the analysis reported in Table 2. We repeated this analysis using almost every conceivable breakdown of the trials within each phase to calculate early and late MSE scores. The overall pattern of the correlations remained consistent regardless of the way the trials were split. Overall, our results
suggest that the demands within each context over time were similar, at least in terms of the individual differences we considered. When considered together with the results reported in Table 2, the results of this analysis support our contention that the demands in the first decision context (where learning was important) were fundamentally different than the demands after change occurred (where unlearning and relearning were important).

Limitations

Obviously, the task, setting, sample, and narrow definition of performance (i.e., decision-making accuracy) limit the generalizability of our results to other contexts. We fully agree that future research needs to examine the extent to which our findings generalize to real world work settings where performance is defined more broadly before recommendations to practitioners can be made. However, the intent of our study was to address critical theoretical questions that have not yet received research attention. To that end, the laboratory provided an appropriate venue for several reasons. First, as noted in the Method section, it is difficult to find real world settings where a researcher can control changes in the work context (or even have a prior knowledge of changes) that are completely unexpected by the employees. Second, it is difficult to find real world settings where a researcher could obtain a fairly large number of repeated performance measures on the same task, in three different contexts, from a large number of employees. Third, although our task performance measure was fairly narrow relative to global measures used by supervisors, it was objective with a known true score and therefore was likely to be more reliable. Finally, Anderson, Lindsay, and Bushman (1999) reported very comparable meta-analytic effect sizes for laboratory and field based research designs across a broad range of psychological domains (e.g., aggression, helping, leadership style, social loafing, self-efficacy, depression). Thus, laboratory findings may be more generalizable than previously thought. Nevertheless, we do recommend that research take place in more naturalistic settings where performance cycles are less compressed and where performance itself is defined more broadly.

A second limitation is that we focus on a relatively narrow type of adaptability and this also has implication for the generalizability of our findings. First, we focus on adaptability in response to a discreet, unforeseen change in the task environment. There are many situations where change occurs more gradually. In these cases, it is likely that individuals may have time to stop what they are doing or set aside some time specifically to develop a plan to cope with the change. The extent to which $g$,
Conscientiousness, and Openness predict this type of adaptability is unknown, and it may be that the relationships with predictors change in a nontrivial manner. Accordingly, future research needs to explicitly consider different types of adaptability in predictive models before anything can be said about the phenomenon in general.

Second, in this study we focus on adaptability in the behaviors that contribute directly to the accomplishment of the task (i.e., gathering information, considering its importance, and making decisions). However, in real world contexts, it is possible that adaptability may be required in the behaviors that contribute to the organization’s social or psychological context (i.e., contextual performance). For example, if an organization shifts from individualized work to team-based work, helping and cooperation (interpersonal facilitation) are likely to become important relative to behaviors that emphasize individual task accomplishment. This distinction among behavioral forms of adaptability is consistent with Motowidlo et al.'s (1997) theory of individual differences in task and contextual performance. According to this theory, individual differences in personality should become more important relative to individual differences in cognitive ability when the focus is on predicting contextual behaviors (e.g., helping) relative to task focused behavior (making a decision). Accordingly, if there is some change that makes cooperation important (or any other promotive affiliative behavior), then perhaps other personality traits like Agreeableness and Extraversion (or relevant facets thereof) should be considered in predictive models. We raise this issue because past research on adaptability has focused on task behavior, but future research may find that adaptability in contextual behavior is predicted by a different set of variables altogether. If true, then it is important to keep the concepts separate in future theoretical and empirical research.

Finally, despite immediate postchange performance decrements, overall decision-making performance continued to improve throughout the study. Accordingly, the results of our study might not generalize to situations where prechange performance is truly “routine.” The results of our study might be less applicable in situations where individuals are highly experienced with the task or where the task is relatively simple. Alternatively, our results might be most applicable in situations where individuals lack task experience (a training context) or where the task is relatively complex. One way to examine this issue would be to conduct a study where participants make enough decisions within each phase to reach asymptotic levels of performance. Such a study might also provide a better assessment of the possibility that there are within phase differences in the demands placed on individuals, such as those discussed earlier.
Conclusion

This study attempted to provide some insight into adaptability. In particular, we explored whether adaptability in decision-making performance could be predicted using the kinds of individual differences typically used by practitioners in selection batteries. We found that g, Openness, and Conscientiousness could indeed be used to predict adaptability. In fact, they were more powerful predictors of adaptability than they were of decision-making performance prior to an unforeseen change. Unexpectedly, we found a negative relationship between Conscientiousness and adaptability. However, by decomposing the broad trait of Conscientiousness into narrower facets, it became apparent that adaptability was hindered by the tendency to be orderly, methodological, and deliberate. Although our results need to be examined in real world settings before concrete recommendations can be made to practitioners, it is hoped that this study will spur increased research interest on how to manage human resources in today’s dynamic environment.

REFERENCES


