INDIVIDUAL DIFFERENCES IN STABLE MOTIVATIONAL QUALITIES AND SKILL ACQUISITION: DISPOSITIONAL GOAL ORIENTATION AND SELF-EFFICACY

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INDIVIDUAL DIFFERENCES IN STABLE MOTIVATIONAL QUALITIES AND SKILL ACQUISITION: DISPOSITIONAL GOAL ORIENTATION AND SELF-EFFICACY

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THESIS ABSTRACT

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The current study extends previous research on skill acquisition to develop a more complete picture of the motivational variables that influence task performance. Participants completed measures of cognitive ability, global self-efficacy, dispositional and state-dependent goal orientation, and experience. Participants then completed Sudoku grids as measure of performance, as well as measures of subjective task complexity and task specific self-efficacy across three trials. Experience, cognitive ability, and subjective task complexity were stable predictors of performance across the skill acquisition trials.

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INTRODUCTION

In the current rapidly changing work environment, companies expect employees to be adaptable, to learn new skills, and to perform well on a wide variety of tasks. Organizations operating in a dynamic environment require, and benefit from training procedures tailored to the specific needs of employees. The potential exists to utilize the strengths and weaknesses of individual employees, to enhance the speed and quality of training, and ultimately job performance. A large proportion of the variability in task performance is accounted for by individual differences in cognitive ability and motivation.

Intelligence and motivation are fundamental elements in the processes of skill acquisition. Historically, approaches have proposed either motivation or intelligence as the most important factor in skill acquisition.

In society, the commonly held belief exists that motivation and hard work compensate for lower ability. However, Gottfredson's (1997) meta-analysis argued that (a) general intelligence is the most powerful predictor of overall job performance, (b) the validity of intelligence measures applies to most occupations, and (c) the importance of general intelligence increases with job complexity. Schmidt and Hunter (1998) examined the predictive validity of many selection methods including general mental ability (GMA) tests, work samples, interviews, assessment centers, job knowledge, and job experience. GMA tests have validity coefficients of .51 with job performance and .56

with job training. Research supports the strong relationship between intelligence and performance.

Motivation has a weaker predictive relationship with performance than intelligence. Gagne and St. Pere (2001) found that students' self-judgments of motivation did not significantly affect performance after controlling for intelligence. However, Schmidt and Hunter found a correlation of .31 between conscientiousness and performance and a correlation of .10 between vocational interests and performance. These findings demonstrate the weaker relationship between motivation and performance.

The relationship between motivation and performance is often explored through goal setting applications. For example, Kanfer and Ackerman (1989) incorporated individual differences in cognitive ability, and the application of goals, to explain performance throughout the phases of skill acquisition. The portrayal of motivation as goal setting depicts goals as a solely external manipulation. This approach implies that goal application is similar for anyone acquiring a skill. Explaining motivation according to these types of external influences does not account for differences in motivational qualities that are intrinsic to each individual.

The acquisition of skills and job knowledge during training is highly correlated with job performance for many different jobs (Schmidt and Hunter, 1992). The acquisition of skills through the involvement of cognitive ability and motivation is an essential component of performance in the workplace. Goal orientations have inherently self-motivating properties; thus, individual differences in motivational resources, including goal orientation, are important to consider when explaining differences in performance. Goal orientation is a construct may be defined in terms of the individuals' dispositional goal orientation or as the situational manipulation of the goal applied during training (Button, Mathieu, & Zajac, 1996). A better explanation of differences in skill acquisition may result from considering individual differences in stable motivational qualities, while also accounting for situational goal manipulations. This study extends previous research by exploring the ability of individual differences in cognitive ability, experience, and motivational resources to predict skill acquisition. The motivational variables of interest in this study are subjective task complexity, global self-efficacy, task specific self-efficacy, dispositional goal orientation, and state-dependent goal orientation

Skill Acquisition

Skill acquisition is a process of progressive phases that underlie human cognition (Anderson, 1983; 1993). Anderson proposed a model that described this complex process of human cognition. His model, originally called Adaptive Character of Thought (ACT), proposed that cognition arises from the interaction of declarative and procedural knowledge structures. Declarative knowledge results from a direct encoding of the environment into chunks that the mind may recall and use by following procedural knowledge rules. These chunks represent the information a person knows. Procedural rules apply transformations to declarative knowledge and act on the newly formed information. Anderson proposed that the foundation of human cognition lies in the amount of declarative knowledge individuals possess and their minds' ability to transform the information. The explanation of human learning or problem solving as a process of encoding and transforming information provides the basis for exploring the skill acquisition process. Researchers have identified variables that are integral to this skill acquisition process as these variables influence the declarative formation of knowledge and the use of procedural rules of transformation.

The use of declarative and procedural knowledge, the underlying components of the ACT model, is integral throughout the skill acquisition process (Anderson, 1983; 1993). The relative importance of declarative and procedural knowledge varies throughout skill acquisition. Fitts (1964; Fitts & Posner, 1967) described three stages of skill acquisition. In the first, the cognitive phase, an individual learns the task requirements through memory and reasoning, this process results in high cognitive load. During the second, the associative phase, sequences of cognitive and motor processes are compiled thereby decreasing cognitive load. In the final, autonomous phase, the skill becomes automatic and rapid. Kanfer and Ackerman (1989) described a coherent framework explaining how individuals differ in skill acquisition and performance by integrating cognitive ability resources, motivation, and information processing demands. Kanfer and Ackerman stated that the differential use of declarative and procedural knowledge throughout skill acquisition is influenced by task complexity and the type of knowledge used has numerous implications for the use of cognitive resources and application of motivational resources throughout skill acquisition.

The Integrative Resource Model (IRM), proposed by Kanfer and Ackerman (1989), diverges from a model that strictly fixates on intelligence or motivation and promotes an interactionist perspective. This model, which is depicted in Figure 1 (see Appendix A), uses a contingency-based approach to explain how the individual's motivation and intelligence interact with task demands. The demands of the task change throughout the phases of skill acquisition in a predictable manner, based on the type of knowledge used: declarative or procedural. The IRM includes the following variables when accounting for differences in skill acquisition: task difficulty, cognitive ability, self-regulation, and motivation (defined as external goal setting).

The relationship among theses variables and skill acquisition depends, in part, on the difficulty level of the task. The IRM acknowledges that task characteristics (e.g. difficulty) may moderate skill acquisition and directly affect the variance in performance across individuals. Terborg (1977) first proposed the moderating effects of task difficulty, and suggested the use of an information-processing language to develop an integrative model of intelligence, motivation, and task characteristics. When using an information-processing approach to determine performance, it is critical to assess the characteristics of the task and the interaction of these characteristics with cognitive ability and motivation. A model such as the IRM provides practitioners with the necessary resources to enhance skill acquisition in an applied setting by combining the necessary constructs and their interactions using a coherent language.

Performance

Performance during skill acquisition is determined by how quickly and competently an individual masters the components of the task. Constraints placed on an individual during skill acquisition determine performance. These constraints are a function of both the person and the task. Resource limitations are based on individual differences in the availability of cognitive resources. Data limitations are due to the nature and difficulty of the task. Task performance during skill acquisition depends on resource limitation and data limitation. These constraints decrease performance, but for different reasons (i.e. the person or the task; Kanfer and Ackerman, 1989). Resource-insensitive tasks are not affected by the amount of attentional resources allocated towards a task. When changes in performance correspond to changes in the amount of attention directed towards the task, the task is resource-dependent. Performance improves as a task moves from resource-dependent to resource-insensitive. Changing task difficulty is one way to affect resource dependence. A difficult task places cognitive load on memory and results in greater resource dependence. Simplifying the task makes it more resource-insensitive. Furthermore, practice also affects the resource dependency of a task; an initially resource-dependent task will become more resource-insensitive with practice because it becomes automatic.

Practice

Practice is an essential component of skill-acquisition as it leads to familiarity with the task. Practice also causes greater retention of material (Baldwin & Ford, 1988), including the procedures and the rules associated with the task. As previously mentioned, practice influences the resource dependency of the task. Since practice influences the resource-dependency of the task, it also influences the affect of cognitive ability and motivational qualities on task performance. Research has shown that there are portions of any task that differ in resource dependency and only during times of high resource dependency will increased availability of cognitive resources and increased effort result in better performance (e.g. Kanfer & Ackerman, 1989; Yeo & Neal, 2004).

Cognitive Ability and Resource Dependency

General cognitive ability tends to be the most important during the early stages of skill acquisition, while performance at later stages is contingent on specific abilities (Ackerman, 1988). The phases of skill acquisition vary in the requirement of cognitive resources. Kanfer and Ackerman (1989) explain that the phases of skill use declarative and proceduralized knowledge as expected by Anderson (1983; 1993; Fitts, 1964; Fitts & Posner, 1967). For example, the first phase of skill acquisition requires the establishment of declarative knowledge. This process increases cognitive load making the task substantially resource-dependent. Since a resource-dependent task requires cognitive resources, those high in cognitive ability perform better at this stage, but with practice, the performance difference decreases between high and low ability participants. Practice leads to the compilation of knowledge during the second or associative phase of skill acquisition. Practice decreases differences in performance between individuals high and low in cognitive ability, self-efficacy, and task familiarity. As a skill is learned through practice, the skill requires more proceduralized knowledge and less declarative knowledge, thus, less cognitive resources are necessary, so the difference in performance between high and low ability participants is smaller.

During the second phase, cognitive load decreases because the decrease in the use of declarative knowledge and the increase in the use of procedural knowledge. Performance during phase two rests on an individual's perceptual speed, which is used during coding, comparison, and integration of information; individuals with quick perceptual speed tend to perform during this phase. In the third or autonomous phase, the knowledge necessary to perform the task is procedural; therefore, little attention is necessary to perform the task. Performance is contingent on the individual's psychomotor speed and accuracy. In this final stage, additional practice and effort result in diminishing returns, as the task is now resource-insensitive. Furthermore, once a task has become automatic, cognitive ability is unlikely to continue to affect performance; however, retention and transfer of the skill may still relate to cognitive ability.

Motivation

Motivation is the mechanism though which participants choose to direct their attention and thereby their cognitive resources towards a task. The utility of this effort depends on the stage of skill acquisition and on individual difference variables. As previously mentioned, performance generally increases with practice, however at a diminishing rate (Yeo & Neal, 2004). Effort exercised through practice increases performance during the early phases of skill acquisition for novel tasks, as the effort results in the individuals learning how to perform the task. Early theorists predicted that both cognitive ability and motivation would affect performance and that performance may depend on the relationship between cognitive ability and motivation (e.g., Vroom, 1964).

The IRM follows the work of Vroom (1964), which found that when motivation is low, both high and low ability individuals show similar levels of performance. However, when motivation is high there is more variability in performance, thus the higher ability individuals' superior performance becomes evident. These findings imply an interaction between ability and motivation. If individuals are unmotivated, they are unlikely to apply effort and devote cognitive resources towards performance resulting in similar performance, despite ability. Therefore, enhancing task motivation should benefit performance among individuals both high and low in ability. Training motivation is the direction, intensity, and persistence of behavior focused on learning in training contexts (Colquitt, LePine, & Noe, 2000).

Individual Differences in Dispositional Motivational Qualities

The IRM (Kanfer & Ackerman, 1989) sets the framework for skill acquisition. It accounts for major variables in the process, including cognitive ability, the differential requirements of resources throughout skill acquisition, and external motivational influences. Identifying individual difference variables is important during the person-analysis phase of training (Colquitt et al., 2000). The importance of individual differences supports the inclusion of not only cognitive ability, but also individual motivational qualities when attempting to predict performance during skill acquisition. A clearer picture is established after accounting for individual differences in subjective task complexity, self-efficacy, and goal orientations. The addition of these components will extend and clarify the importance of individual differences in skill acquisition.

Subjective task complexity. Steele-Johnson et al. (2000) define task complexity as the declarative knowledge that must be learned, and the number of production rules that must be formed to perform a task. The complexity of a task increases if task demands are inconsistent because the task is more difficult to proceduralize. Braarud (2001) distinguished between the actual complexity of a task (objective task complexity) and participant's perception of task complexity (subjective task complexity). Individuals experience and perceive identical tasks in different ways, thus influencing subjective task complexity (STC; Schroeder, Driver, & Streufert, 1967). STC includes an assessment of the task participant’s cognitive ability, and prior experience with task characteristics (Quiñones, Ford, & Teachout, 1995). Baron and Kenny (1986) explored the relationship between objective task complexity, cognitive ability, subjective task complexity, and performance. Objective task complexity moderated the relationships between task performance and individual difference variables, including STC by determining the strength of the relationship between the variables. Maynard and Hakel (1997) also explored this relationship. Cognitive ability and objective task complexity to predicted performance as a hierarchical regression analysis showed significant main effects for both cognitive ability and objective task complexity. Maynard and Hakel found that cognitive ability and objective task complexity placed limits on an individual's performance. However, subjective task complexity also partially mediated the relationship between both constructs and performance. This research demonstrates that perceptions of task complexity (i.e. subjective task complexity) and objective task complexity are different concepts that uniquely predict performance.

Self-efficacy. Bandura (1986; 1989) stated that self-efficacy is an individual's perception of how well he or she can perform a specific task. High self-efficacy leads to increased effort, persistence, and the setting of difficult and challenging goals during skill acquisition. Self-efficacy is conceptualized as a reflection of the individual's capacity to perform a particular task well (Mitchell, Hopper, Daniels, George-Falvy, & James, 1994) and an individual's belief in his or her capacity (Eyring, et al., 1993). Eyring et al. concluded that the confidence described by each of these definitions is the development of self-efficacy through successful performance, observation of others, encouragement, and minimal psychological arousal during task performance.

Kanfer and Ackerman (1989) proposed that a person changes the amount of cognitive resources they devote and their allocation strategy throughout the phases of skill acquisition; these changes influence the person's expectations of success (self-efficacy), and influence which predictors are the best indicators of performance. Self-efficacy is a complex judgment process (Gist & Mitchell, 1992). Initially, many cues are used to determine self-efficacy, including task attributes, the context, and the individual's knowledge, skills, abilities, personality, goals, and priorities. In the later phases of skill acquisition, fewer cues are used to determine self-efficacy. Self-efficacy determination follows a pattern similar to skill acquisition; the processes become less effortful with time (Mitchell et al., 1994). Self-efficacy is related to the assessment of prior task performance and ability, however, it is different because it measure perceptions of future capability and will be more influential during complex tasks (Kozlowski et al., 2001). Self-efficacy correlates .34 with personal goals (Locke & Latham, 1990), however, it represents a distinct construct. Locke and Latham explain that self-efficacy is an individual's judgment of capability in achieving a desired level of performance, while goals are the actual level of performance desired.

Goal orientation. Goal orientation refers to the type of super ordinate goals held during skill acquisition, not a specific target used in goal setting. The two goal orientations primarily discussed are learning and performance (Nicholls, 1984). Research suggests that learning and performance goals are not two ends of the same continuum, but represent "neither mutually exclusive, nor contradictory orientations" (Button et al., 1996, p. 28). However, debate continues on the subject.

Each goal orientation focuses the individual's resources on a different outcome. A learning goal orientation (LGO) cues an individual to assess their competence based on experience, and to persist during difficult tasks (Dweck, 1986; Harackiewicz & Elliot, 1993; Nicholls, 1984). A performance goal orientation (PGO) cues an individual to believe that their competence is not likely to change, to compare their performance to others, and to choose tasks in which they can either prove their competence or avoid failure. Based on the last distinction, Eliot and Harackiewicz (1996) separated performance goal orientation into two dimensions: performance-prove (approach) and performance-avoid. While both performance orientations are based on meeting normative standards, they do so by either seeking favorable judgment or avoiding unfavorable judgment, respectively (Zweig & Webster, 2004). Since learning, performance-prove, and performance-avoid goal orientations are neither mutually exclusive, nor contradictory it is sensible that an individual may hold multiple goal orientations simultaneously. Furthermore, individuals may hold goal orientations separately that are inline with their disposition and with the situation.

Personality conceptualized as individual differences variables has been a source of considerable debate, especially as to whether personality should be conceptualized as basic processes operating within situational constraints or as stable traits holding across situations (e.g. Mischel & Shoda, 1998). Traditionally the "situation" has been eliminated from personality and individual difference research creating an artificial representation of the individual difference constructs. To capture individual personality differences accurately and develop a more coherent understanding of the individual, Mischel and Shoda propose using an if…then approach. This approach considers the situation when explaining individual personality differences. The consideration of state-dependent personality characteristics, including state goal orientation, more accurately reflects the nature of individual differences, which are linked to the situation in which they are manifested.

State goal orientation. As previously mentioned, debate surrounds the operationalization of goal orientations as a dispositional characteristic or as a state-dependent quality. Research supports the conceptualization of goal orientation as an individual characteristic that is somewhat stable, but susceptible to manipulation by situational properties (Button et al., 1996; Dweck, 1989; Farr et al., 1993). In the presence of few orientation clues, the learner will adopt his or her individual style (Button et al., 1996). Orientating cues include the performance reward structure, organizational climate, social comparison information, task instructions, feedback type, and perceptions of task complexity (Dweck, 1989; Farr et al., 1993). The presence of strong orientating cues induces the individual to hold a particular state-dependent orientation. The relationship between dispositional and situational goal orientation and its resulting affect on performance, self-efficacy, and subjective task complexity requires future research.

Breland and Donovan (2005) explored the relationship between dispositional goal orientation and state goal orientation. Their study measured participants' dispositional goal orientation and their state goal orientation with regard to a set of in class exams. They found that distal personality traits (i.e. dispositional goal orientation) are mediated by manifestations of the personality trait (i.e. state goal orientation) that are proximal to the motivational or behavioral outcome of interest. Previous research has generally considered dispositional goal orientation and found it to be a surprisingly small predictor of specific motivational and behavioral outcomes, which suggests the presence of mediators such as state goal orientation. By allowing participants to form naturally their state goal orientation, Breland and Donovan confirmed what was expected by theoretical research (e.g. Button et al., 1996). Dispositional learning goal orientation (DLGO) correlates highly with state-dependent learning goal orientation (SLGO) in the absence of strong orientating cues, as does dispositional performance goal orientation (DPGO) and state-dependent performance goal orientation (SPGO). Furthermore, their findings support the proposition that dispositional goal orientation provides a default orientation that is held across situations, but may be influenced by state characteristics. Breland and Donovan concluded that state goal orientation does mediate the relationship between dispositional goal orientation and performance and self-efficacy.

Relationship among the examined variables. The current study explores the relationships between cognitive ability, experience, subjective task complexity, self-efficacy, goal orientation (dispositional and situational), and performance during skill acquisition. The relationships among these variables are discussed and the specific hypotheses of this study are proposed in the following paragraphs.

The nature of goal orientation is debated: whether it is a stable trait or a transient, situation-induced characteristic (e.g. Button et al., 1996; Breland & Donovan, 2005). As proposed by previous research, this study will continue to explore the conceptualization of goal orientation as a somewhat stable individual difference variable that may be influenced by situational characteristics. This study will induce state-dependent goal orientation by manipulating task instructions. Dispositional and state-dependent goal orientations appear to be independent (Nicholls, Cheung, Lauer, & Patashnick, 1989; Nicholls, Patashnick, & Nolen, 1985; Thorkildsen, 1988). It is possible for a participant to have a predisposition toward one goal orientation, however, the characteristics of a situation will either promote or inhibit the participant's natural orientation. In the presence of few orientation clues (Dweck, 1989; Farr et al., 1993), the learner will adopt his or her individual style (Button et al., 1996). The presence of strong orientating cues induces the individual to hold a particular state-dependent orientation. A person's ability to adapt their learning orientation supports the malleability of goal orientation.

> *Hypothesis 1*: Regardless of their dispositional orientation, participants will adapt their goal orientation based on the instructions of the task.

As mentioned previously, Breland and Donovan (2005) stated that state goal orientation does mediate the relationship between dispositional goal orientation and performance and self-efficacy. The extent to which dispositional and situational goal orientation congruence affects performance, self-efficacy, and subjective task complexity requires future research. The manipulation of task instructions pairs participants with either a dispositional learning or performance orientation with a congruent or an incongruent state-induced orientation. State-dependent goal orientation mediates dispositional orientation and likely affects subjective task complexity, self-efficacy, and performance differently based on the congruence or incongruence of the goal orientations. Furthermore, research has shown that the specific dimensions or types of goal orientation (learning, performance-prove, and performance-avoid) differential affect the outcomes of interest, including self-efficacy, subjective task complexity, and performance.

Historically goal orientation has been conceptualized either as a single continuum with learning orientation on one end and performance orientation on the other end, or as two dimensions with learning and performance orientations representing different continuums. However, previous research on the dimensionality of goal orientation has yielded mixed results. Nicholls et al. (1995) found a positive correlation between learning and performance goal orientations, while Nicholls, Cobb, Wood, Yackel, and Patashnick (1990) found a negative correlation (for a more complete discussion of these findings, see Button et al., 1996). Although mixed findings exist, research tends to support the notion that goal orientations represent separate dimensions and that their relationship is influenced by the nature and difficulty of the task. Button et al. (1996) concluded that goal orientation is better represented as two unrelated dimensions, rather than one; as learning and performance goal orientations appear to be neither mutually exclusive, nor contradictory. Button et al. propose that it is possible for an individual to strive to simultaneously improve one's skills and perform well relative to others. Since it is possible to hold multiple goal orientations (i.e. learning, performance-prove, performance avoid), it is also possible to hold matching or not matching dispositional and state-dependent goal orientations.

Mangos and Steele-Johnson (2001) studied the relationship between goal orientation and performance on a simple task and found that goal orientation is mediated by subjective task complexity, which is further mediated by self-efficacy. This relationship is depicted in Figure 2 (see Appendix A). They found that subjective task complexity positively relates to the motivational component of self-efficacy, however, they did not find a relationship between subjective task complexity and cognitive ability. These findings are somewhat counterintuitive, as one would expect participant's perceptions of subjective task complexity to depend on the intelligence of each participant. The reason for these findings may lie in the simplistic nature of the task. The influence of cognitive ability is more prominent during complex tasks, furthermore, the motivating nature of the task did not appear to reach a ceiling effect as it would with a very complex task; the task would become frustrating and de-motivating.

This study extends the research of Mangos and Steele-Johnson (2001) as well as Breland and Donovan (2005) in several ways. First, it uses a different task than Mangos and Steele-Johnson. The task used in the present study is Sudoku, the logical reasoning task. A simple version of the task was used so that participants would reach proceduralization. Secondly, it looks at the task over a longer acquisition period thereby increasing the likelihood that participants will reach the procedural phase of skill acquisition. Finally, it considers dispositional goal orientation and state-dependent goal orientation when predicting behavioral and motivational outcomes. This study also builds on the work of Breland and Donovan by attempting to explore the affects of congruent and incongruent pairing of dispositional and state goal orientations to establish the predictive ability of each construct. It also addresses the ability of dispositional and state goal orientations, cognitive ability, global self-efficacy, and task familiarity to explain differences in skill-acquisition (performance on the Sudoku task), task specific (Sudoku) self-efficacy, and subjective task complexity. The following hypotheses are outlined in terms of the dependent variables of interest: subjective task complexity, Sudoku self-efficacy, and performance.

Subjective task complexity reflects an individual's assessment of the cognitive load associated with a task. This perception is influenced by goal orientation, global and specific self-efficacy, cognitive ability, and task familiarity. Previous research has found that goal orientation will predict subjective task complexity (e.g. Mangos and Steele-Johnson, 2001). Individuals who hold a learning goal orientation likely have increased perceptions of task complexity (Campbell, 1988). Since a learning goal orientation promotes mastery, it may also alter the participants' perception of the task. Participants with a learning goal orientation assess their competence based on experience and tend to persist during difficult tasks (Dweck, 1986; Harackiewicz & Elliot, 1993; Nicholls, 1984). Participants with a learning goal orientation will perceive the task as more difficult as they are constantly striving for mastery, even when they achieve an adequate performance level.

Global self-efficacy may also affect subjective task complexity, as participants who believe in their capability will perceive the task to be less difficult. Participants who have a performance goal orientation and high self-efficacy perform similarly to participants who have a learning goal orientation (e.g. Dweck, 1986). Believing in one's ability to perform the task has a preventative affect, as high self-efficacy reduces self-regulation and the cognitive demands associated with the reflection process. High self-efficacy leads to increased effort and persistence during skill acquisition, which will lead to better performance, especially when initially acquiring a skill.

It seems reasonable to expect that a participant's perceptions of STC would depend on their intelligence. However, Mangos and Steele-Johnson (2001) found that cognitive ability did not affect task complexity. As previously mentioned, these findings are somewhat counterintuitive, it appears that intelligence will predict subjective task complexity when the task is difficult enough for cognitive ability to become a determining factor in participants' perceptions of success. The reason for the findings of Mangos and Steele-Johnson may lie in the simplistic nature of the task, as the influence of cognitive ability is more prominent during complex tasks.

Participants with a greater amount of experience will perceive the task as being less complex than participants with little task experience as the person has gained familiarity with the task's components. Thus, experience will affect participants' perceptions of subjective task complexity.

> *Hypothesis 2a*: Experience will account for a significant proportion of the variance in subjective task complexity.

> *Hypothesis 2b*: Dispositional characteristics including cognitive ability, dispositional goal-orientations, and global self-efficacy will account for an incremental portion of the variance in subjective task complexity beyond experience.

> *Hypothesis 2c*: Situation-induced goal orientations will account for a significant proportion of the variance in subjective task complexity beyond experience and dispositional characteristics.

The assessment of self-efficacy requires an understanding of the task requirements and an assessment of the individual's capability to complete the task. The variables that influence self-efficacy will change over the course of skill acquisition. These variables include global self-efficacy, goal-orientation, cognitive ability, experience, and subjective task complexity.

Global self-efficacy will affect participants' belief in their capability to perform the specific Sudoku task set before them, as it represents a general measure of the participants' self-efficacy across situations. Sudoku specific self-efficacy will also be affected by the goal orientation held by the participant. A learning goal orientation generally increases self-efficacy (e.g., Phillips & Gully, 1997), while a performance goal orientation generally decreases self-efficacy (Dweck & Leggett, 1988; Phillips & Gully, 1997).

A learning goal orientation generally results in effects that coincide with the inherent motivating properties of the task (Button et al., 1996; Farr, Hofmann, Ringenbach, 1993). A learning goal orientation facilitates the transfer of information to an automatic nature and does not disrupt the task under high cognitive load. This is especially important during the initial stages of skill acquisition, as performance standards and social comparison used in a performance goal orientation during the early stages are de-habilitating. As expected, Bell and Kozlowski (2002) found that participants with a learning goal orientation reported higher levels of intrinsic motivation and self-efficacy on a complex task with inconsistent demands. They found that a learning orientation positively relates to self-efficacy, knowledge obtainment, and performance, especially for high ability individuals. However, a performance orientation relates negatively to performance.

The relationship between cognitive ability and motivational constructs, including self-efficacy has been somewhat mixed. Mangos and Steele-Johnson (2001) found that subjective task complexity was related to self-efficacy regardless of cognitive ability, while Bell and Kozlowski (2002) found that the relationship between self-efficacy and cognitive ability was more profound for high ability individuals. The differences in these findings are likely due to the objective difficulty of the task, but never-the-less demonstrate the importance of cognitive ability, subjective task complexity, and the objective task difficulty when predicting self-efficacy. Initially, many factors affect self-efficacy, however, over time fewer cues are used to determine self-efficacy. Experience and the associated previous success or failure will influence Sudoku specific self-efficacy throughout the skill acquisition process.

Hypothesis 3a: Experience will account for a significant proportion of the variance in Sudoku self-efficacy.

Hypothesis 3b: Dispositional characteristics including cognitive ability, dispositional goal-orientations, and global self-efficacy will account for an incremental portion of the variance in Sudoku self-efficacy beyond experience.

Hypothesis 3c: Subjective task complexity will account for an incremental portion of the variance in Sudoku self-efficacy beyond experience and dispositional characteristics.

Hypothesis 3d: Situation-induced goal orientations will account for an incremental portion of the variance in Sudoku self-efficacy beyond experience, dispositional characteristics, and subjective task complexity.

Performance during skill acquisition is explained by goal orientation, global and task-specific self-efficacy, cognitive ability, experience, and subjective task complexity. The relationship among these variables is complex and changes throughout skill acquisition. For example, the type of goal orientation held has a differential affect on performance depending on the phase of skill acquisition and the available cognitive resources. The application of Kanfer and Ackerman's (1989) IRM explains the interaction between skill acquisition phase and goal orientation.

Generally, it is believed that a learning orientation is beneficial during the early phases, while a performance orientation is beneficial in the later phases or during a simple task. A learning goal orientation generally coincides with the inherently motivating properties of the task (Button et al., 1996; Farr, Hofmann, Ringenbach, 1993) and facilitates skill acquisition. This is especially true during the early stages of skill acquisition. Participants with a learning orientation have an outlook and perform the task in a manner that facilitates learning under the high cognitive demand conditions that exist during the declarative phase of skill acquisition. Learning goal orientation enhances performance on complex tasks (e.g., Ford, Smith, Weissbein, Gully, & Salas, 1998). A participant using a learning goal orientation seeks higher levels of challenge and persists under complex or difficult task conditions (Dweck, 1986; Dweck & Leggett, 1988; Elliot & Dweck, 1988). When the task is complex, and individuals do not have the abilities to perform the task effectively, a learning approach is most beneficial. Task interest and a learning or mastery approach are congruent because both orientations direct people towards personal improvement. A learning goal orientation does not necessarily improve the relationship between interest and actual performance, but incongruent performance goal orientation shifts attention away from the intrinsically interesting aspects of the task and result in decreased performance (Van Yperen, 2003). Incongruent performance goals appear to change the motivating nature of the task. Training and goal application should attempt to capitalize on the intrinsically motivating properties of the task by fostering its development and remaining vigilant of the actions that undermine it.

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Yperen, 2003). Incongruent performance goals appear to change the motivating nature of the task. Training and goal application should attempt to capitalize on the intrinsically motivating properties of the task by fostering its development and remaining vigilant of actions that undermine it.

Performance goal orientation is likely to focus the participants' attention externally on meeting a certain standard, thus limiting the participants' perceptions of the complexity of the task. A performance goal orientation cues an individual to believe that competence is not likely to change and to choose tasks in which they can prove their competence and avoid failure. Thus, a performance-avoid or a performance-prove orientation may lead to similar outcomes depending on the difficulty of the task. Performance orientated participants will perceive the task as easy as long as achieving an adequate performance level reinforces them. A performance orientation generally decreases self-efficacy (Dweck & Leggett, 1988; Phillips & Gully, 1997). This is especially evident during the initial stages of skill acquisition, as performance standards and social comparison during the early stages are de-habilitating.

A performance orientation is a maladaptive learning strategy especially at higher task complexity. Furthermore, low performance orientated individual's performance improved more quickly than high performance orientated individuals (Yeo & Neal, 2004). High performance oriented individuals are more likely to direct their attention to off-task activities like self-regulation and ego management. However, Yeo and Neal found that the benefits of a low performance orientation occurred only when individuals also had a high learning orientation. However, during the early phases of skill acquisition individuals with a performance goal orientation out-performed those with a learning goal orientation on simple tasks (Steele-Johnson, Beauregar, Hoover, & Schmidt, 2000). Performance goal orientation led to better performance on a consistent task, but worse performance on an inconsistent task (Bell & Kozlowski, 2002). Steele-Johnson et al. (2000) observed no goal orientation effects during the initial stages of a difficult task condition. While these findings appear to contradict the benefits of a learning orientation, but the difficulty of the task may account for the results. An individual's performance under a "do their best" approach will not necessarily be lower than performance under an explicit goal approach (Van Yperen, 2003). Performance goal orientation may lead to better performance on a consistent task. Van Yperen proposed that participants become more interested in a task when they discover that they perform well on the task, and this implies the adoption of a performance goal approach, which emphasizes comparative evaluation, may actually be a result and not a cause of better performance. Furthermore, Van Yperen found that once people have become proficient at a task at an automatic level performance goals redirect superfluous cognitive resources back to on-task activities. Further research is necessary to determine if, and at what level of task difficulty, a learning goal orientation becomes beneficial. Previous research has explored the relationships among these variables.

Maynard and Hakel (1997) found that perceptions of task complexity increased motivation as moderated by cognitive ability. Complex tasks were motivational only to the point that they were not discouraging, due to their difficulty. Furthermore, Maynard and Hakel found that increases in effort generally lead to increases in performance, especially on simple tasks; however, the relationship between effort and performance on complex tasks was weaker and more complex. Less interesting tasks are inherently less motivating and effort inducing; however, perceiving a task to be extremely complex also decreases motivation, effort, and expectations of eventual success (Gardner, 1990; Scott, Fahr, & Podsakoff, 1988). These findings explain why a performance goal-setting orientation may lead to better skill acquisition for immediate and simple tasks, rather than complex tasks (e.g., Earley, 1985; Wood, Mento, & Locke, 1987). Furthermore, goals do not need to be introduced if the task is inherently motivating (Kernan, Bruning, & Miller-Guhde, 1994). A final implication is that a coherent, effortful strategy increases performance for complex tasks, but not for simple ones (Earley, 1985; Campbell, 1991).

Differences in performance that are related to differences in self-efficacy will be especially evident on difficult tasks and during the early phases of skill acquisition. Self-efficacy is a better predictor of performance in the early phases of skill acquisition (Kanfer & Ackerman, 1989, Mitchell et al., 1994), while goal-setting is a better predictor of later performance (Mitchell, et al.), thus, supporting the benefit of a performance goal orientation late in skill acquisition. Dweck (1986) found that the previously mentioned negative affect of performance goal orientation on performance in early skill acquisition does not occur when the individual has high self-efficacy. In this study, participants with performance goal orientations and high self-efficacy performed similarly to participants with high learning goal orientation. It appears that the preventative affect of self-efficacy may reduce the use of self-regulation associated with performance goal orientation and decreased cognitive demands.

Self-efficacy promotes better performance because participants with high self-efficacy believe in their ability to accomplish the task. Self-efficacy is closely related to intrinsic motivation (Callahan, Brownlee, Brtek, & Tosi, 2003). However, goals and intrinsic motivation both act through self-efficacy, which influences self-regulatory processes and ultimately performance. Furthermore, previous research found that the affect of performance goal orientation on performance is mediated by subjective task complexity, which is further mediated by self-efficacy when predicting performance (Mangos & Steele-Johnson, 2001). The relationship between subjective task complexity, self-efficacy, and performance is complicated as each of the constructs may influence the development of the other. Task specific self-efficacy would be expected to influence performance. It is a proximal predictor of task performance, as is subjective task complexity. Self-efficacy may not predict performance when it is too closely related to another construct (e.g. intrinsic motivation; Callahan et al., 2003 or learning goal orientation). Intrinsic motivation directs attention to the task and increases persistence and effort, thus, it has a similar affect to self-efficacy and learning goal-orientation. Self-efficacy's close relationship with goal setting has been established by Locke and Latham (1990). Furthermore, self-efficacy did not uniquely explain variance in final training performance after considering previous performance (Ackerman, Kanfer, & Goff, 1995; Mitchell et al., 1994; Gist & Mitchell, 1992); however, self-efficacy did explain the ability to generalize (Gist & Mitchell, 1992).

The affect of individual differences in cognitive ability on performance changes with the stages of skill acquisition and the difficulty of the task (Kanfer and Ackerman, 1989). Cognitive ability is critical when learning a difficult task, however, its importance declines throughout the phases of skill acquisition. The importance of cognitive ability in skill acquisition has been widely established (Gottfredson, 1997; Schmidt & Hunter, 1998). Those high in cognitive ability will perform better, especially in the early stages of skill acquisition. During the early stages of skill acquisition, the demands of the task draw on a limited amount of cognitive resources. Those higher in cognitive ability have a larger pool of cognitive resources, which facilitate learning under the demand of high cognitive conditions (e.g. the declarative phase of a task). This study will replicate the large stream of previous research establishing the importance of cognitive ability in skill acquisition (e.g. Kanfer & Ackerman, 1989).

Experience through practice decreases differences in performance between individuals high and low in cognitive ability and self-efficacy (e.g. Kanfer & Ackerman, 1989; Kozlowski et al., 200). Performance differences between high and low ability participants will decrease throughout skill acquisition, with practice, and is attributable to a decreased reliance on cognitive ability and increased task proceduralization. Experience influences the relationship between self-efficacy and performance similarly. Thus, experience of the participants is an important predictor of performance.

> *Hypothesis 4a*: Experience will account for a significant proportion of the variance in Sudoku self-efficacy.

> *Hypothesis 4b*: Dispositional characteristics including cognitive ability, dispositional goal-orientations, and global self-efficacy will account for an incremental portion of the variance beyond experience.

> *Hypothesis 4c*: Sudoku self-efficacy will account for an incremental portion of the variance beyond experience and dispositional characteristics.

> *Hypothesis 4d*: Subjective task complexity will account for an incremental portion of the variance beyond experience, dispositional characteristics, and Sudoku self-efficacy.

> *Hypothesis 4e*: Situation-induced goal orientations will account for an incremental portion of the variance beyond experience, dispositional characteristics, Sudoku self-efficacy, and subjective task complexity.

Since goal orientation is generally considered to be a three-dimensional construct (Elliot & Harackiewicz, 1996; VandeWalle, 1997; Zweig & Webster, 2004; Attenweiler & Moore, 2006) and the dimensions of learning, performance-prove, and performance avoid orientations are independent and not mutually exclusive (Button et al., 1996) it is possible for an individual to rate highly on more than one dimension. A person's dispositional goal orientation may be better described as a profile of their scores on each of the three dimensions. When a profile approach is used and the participants' scores along each dimension are classified by a high/low dichotomy, eight possible dispositional goal orientation groups emerge. When each goal orientation profile is combined with a state goal orientation, 16 different conditions are formed. Predicting the outcomes for these goal orientation pairings is complicated as the dominance of the situational versus dispositional goal orientation has yet to be established. This study attempted to explore the possible dispositional goal orientation and state goal orientation pairings (i.e. congruent, mixed, or incongruent). Participants with a dispositional goal orientation of learning or performance and matching a state goal orientation represent a congruent pairing, while participants without matching state and dispositional goal orientations represent an incongruent pairing. Table 1 depicts the congruent, mixed, and incongruent pairings (see Appendix B).

Congruent, incongruent, and mixed goal orientations will affect subjective task complexity Sudoku specific self-efficacy, and performance. However, the relationship between dispositional and state-dependent goal orientation congruence has not been widely explored. Donovan and Breland (2005) found that in the absence of orientating cues of the situation, participants would adapt a state orientation similar to their learning orientation. This congruence is similar to the agreement between a dispositional and state-induced goal orientation of this study. Thus, participants who have a congruent orientation will show similar subjective task complexity, Sudoku specific self-efficacy, and performance as would be expected when only considering their dispositional learning orientation.

The relationship that exists among incongruent and mixed goal pairings will be more complicated. Since learning and performance goal orientations are held to be separate dimensions, a participant may exhibit traits that are consistent with both orientations. During their use of structural equation modeling (SEM), Breland and Donovan (2005) found an unexpected moderate correlation between learning and performance goal orientations, which supports further the conceptualization of LGO and PGO as distinct constructs that are not mutually exclusive. This suggests an interaction between the two orientations will predict performance. Participants who are high on both orientations will likely show concern for high performance and a desire to improve, while participants who are low on either dispositional orientation will show general apathy, and be susceptible to situational demands; thus, the manipulated goal orientation will guide behavior. The results of a mixed or incongruent orientation will be explored as more is learned about the dominance of dispositional and situation specific goal orientation when predicting performance, greater Sudoku self-efficacy, and increased ratings of subjective task complexity. Therefore, no specific hypotheses regarding mixed and incongruent dispositional and state goal orientation pairings will be made.

> *Hypothesis 5a*: A congruent dispositional learning orientation and state-dependent learning orientation will lead to increased performance, greater Sudoku specific self-efficacy, and increased ratings of subjective task complexity.

Hypothesis 5b: A congruent dispositional performance orientation and state-dependent performance orientation will lead to decreased performance, lower Sudoku specific self-efficacy, and decreased ratings of subjective task complexity.

METHODS

Participants

During this study, 450 participants completed the task (*n* = 141 males; 31.3% and n = 309 females, 68.7%). The participants were undergraduate psychology students at a large southeastern university in the United States. The sample was fairly homogenous in terms of race (83.9% Caucasian, 12.4% African American, .9% Hispanic American, 2.4% Asian/Pacific Islander, .2% American Indian, and .4% did not indicate their ethnicity) and age (*M* = 19.7 years, *SD* = 2.3 years). Extra course credit was awarded in exchange for participation in this study. The anonymity of the participants was protected throughout the course of the study. Only those participants that indicated that they played Sudoku occasionally, rarely, or never were included in the analysis. This limitation was placed in order to assess skill acquisition in inexperienced participant. The sample size for the analysis is 391 (*n* = 130 males; 33.2% and n = 261 females, 66.8%). The sample remained homogenous in terms of ethnicity (82.9% Caucasian, 12.5% African American, 1% Hispanic American, 2.8% Asian/Pacific Islander, .3% American Indian, and .5% did not indicate their ethnicity) and age (*M* = 19.7 years, *SD* = 2.5 years).

Task

Participants played a popular logical-reasoning game called "Sudoku." The game, which originated in Japan where it is called "Number Place," is now found in daily newspapers across the globe, books specific to the game, and is widely accessible on the

Internet. Sudoku is a logical reasoning puzzle consisting of squares that form a grid. Most Sudoku puzzles consist of a 9x9 grid. The puzzles used in the present study are 4x4 grids. The grid is divided into sub grids, columns, and rows. Each Sudoku grid has some of the squares of the grid already completed with numbers. Players must fill in the missing squares of the grid to obtain the unique solution to the puzzle. The rules for this study are very simple; every row, column, and sub grid of the larger grid must contain the numbers 1, 2, 3, and 4 used in the puzzle without duplication (Delahaye, 2006). The difficulty of the Sudoku game changes depending on the size of the grid and numbers that are provided initially. However, the difficulty level of the grids remained consistent during this study.

Reasoning games have been previously used in research including crosswords (Underwood, Deihim, & Batt, 1994), chess, puzzles (Dollinger & Reader, 1983), bridge (Engle & Bukstel, 1978; Charness, 1983; 1987), and Latin square. Specifically in Sudoku, participants may use strategies ranging from simple logical techniques to complex pattern recognition. Sudoku puzzles are part of a class of puzzles called NP-complete, which include network routing, gene sequencing, and scheduling procedures. Sudoku puzzles correspond to the scheduling task used by Mango and Steele-Johnson (2001) to study skill-acquisition. Instead of scheduling classes into a calendar without conflicts, participants fill numbers into each row, column, and sub grid without duplication. For these reasons, Sudoku puzzles are an appropriate medium through which one may study skill-acquisition.

Procedure

Participants began the study by indicating their own sex, race, and age. Participants circled either male or female, and then filled in the blank indicating their race/ethnicity and their age. Participants who were over the age of 19 read an information sheet about the study, while participants under the age of 19 turned in a completed informed consent form indicating their willingness to participate in the study and their parent's permission (this consent procedure is in accordance with Alabama state law regarding age of consent). Participants then completed a cognitive ability measure, dispositional goal orientation measure, and a general self-efficacy scale. Next, participants listened to instructions on how to play Sudoku and perform a practice trial, which consisted of four easy Sudoku grids. The participants had the opportunity to clarify questions they had regarding the rules of the puzzle. Participants also completed a measure indicating their experience playing Sudoku, crosswords, and word search games.

Next, participants were assigned randomly to a goal orientation (learning or performance) condition. Participants read a second set of task instructions, which were manipulated to influence the goal orientation held by participants. This type of goal orientation manipulation was utilized in past research (e.g. Mangos & Steele-Johnson, 2001; Nicholls, 1984; and Elliot & Dweck, 1988). In the learning goal orientation condition, instructions implied that performance on Sudoku could be increased through effort and practice. Instructions read, "Skill in Sudoku is developed through practice. Playing the game allows people to improve their logical reasoning skill and you can track your improvement from game to game." In the performance goal orientation condition, instructions implied that skill in Sudoku is a stable, innate, underlying ability.

Instructions read, "Sudoku provides people with the opportunity to demonstrate their logical reasoning skills. Initial performance is a good indicator of later performance and the higher you perform in this game, the higher your logical reasoning skills are." After receiving the relevant goal orientation introduction, participants complete a second goal orientation measure as a check of the manipulation. This scale measured the participants' state-dependent goal orientation.

Participants then completed three performance blocks. They began by completing Sudoku specific subjective task complexity and self-efficacy scales. Then they completed as many Sudoku grids as possible within a 10-minute period. The participants completed each of three performance blocks by following this procedure. The entire protocol took approximately 90 minutes to complete.

Measures

Dispositional goal orientation. A three-factor goal orientation measure was used to assess the participant's dispositional goal orientation. Previous research has established that the three-factor model of goal orientation is the most appropriate representation of dispositional goal orientation (Elliot & Harackiewicz, 1996; VandeWalle, 1997; Zweig & Webster, 2004; Attenweiler & Moore, 2006). Furthermore, the importance of measuring a global orientation that holds across situations has been established (Zweig & Webster, 2004; Attenweiler & Moore, 2006) as the construct of interest is the person's goal orientation without regard to a specific situation. Attenweiler and Moore (2006) developed a non-domain specific scale that identifies the participant's score on the dimensions of learning orientation, performance-avoid orientation, and performance-prove orientation. The items were administered on a 7-point Likert-type scale with responses ranging from (1) "Strongly Agree" to (7) "Strongly Disagree." The 21-item scale has eight items measuring learning goal orientation (α = .86 to .91), six items measuring performance-prove goal orientation (α = .82 to .92), and seven items measuring performance-avoid goal orientation (α = .71 to .83). An individual with a learning goal orientation desires to develop competence, and acquire and master skills. An individual with a performance-prove orientation seeks the opportunity to prove their competency and obtain favorable judgments, while an individual with a performance-avoid orientation tries to avoid negative judgments regarding their capability (VandeWalle, 1997). The 19-item scale used in this study had reliabilities within the historical range, α = .86, α = .87, and α = .76, for learning, performance-prove, and performance-avoid, respectively. The items for this scale are found in Appendix C.

State-dependent goal orientation. Button et al. (1996) voiced concern over using the same measure across situations; they felt that this practice might confound dispositional and situational goal orientation. Therefore, a different measure was used to assess state-dependent goal orientation adopted by participants as after being exposed to either the learning oriented or performance oriented task instructions. Since the task instructions were proposed to induce either a learning or a performance state goal orientation a two-factor learning and performance goal orientation scale was used. The scale, which serves as a manipulation check of the task instructions, was tailored specifically to the Sudoku task to address concerns raised by VandeWalle (1997) regarding participants' holding different goal orientations across tasks. Button et al. (1996) developed an eight-item performance goal orientation scale (α = .73) and an eight-item learning goal orientation scale (α = .79). The items for this scale are found in

Appendix D. Participants answered each question on a 7-point scale ranging from (1) “Strongly Disagree to (7) “Strongly Agree.” A high score indicated that the participant held the respective orientation. Performance goal orientation (α = .90) reflects a preference for non-challenging activities, avoiding mistakes, and evaluation against norms. Learning goal orientation (α = .84) reflects a preference for challenging activities, desire to improve, and comparison against past performance.

Subjective task complexity. The participants’ perception of the difficulty of the task was assessed using a measure adapted from the Subjective Task Complexity Scale (Maynard & Hakel, 1997; α = .90; Appendix E. This 4-item measure was completed on a Likert-type scale ranging from (1) “Totally Disagree” to (7) “Totally Agree.” Responses to the four items were averaged to produce the overall subjective task complexity rating, which ranges from 1 to 7. The internal reliability of the scale for this sample was α = .91 for time 1, α = .93 for time 2, and α = .96 for time 3.

Self-efficacy. Global self-efficacy was measured using the General Self-Efficacy Scale (GSE) developed by Schwarzer and Jerusalem (1995; Appendix F). This measure was designed for the general adult population to assess the internal-stable attribute of self-efficacy, which facilitates goal setting, persistence, and effort investment. The scale consisted of 10 items that are answered using a 5-point Likert-type scale. Scores range from 10 to 50. This scale has been used internationally with reliability α ranging from .76 to .90 and α = .81 in this study. A second task-specific scale was developed to assess the participants' self-efficacy that is specifically related to Sudoku (Appendix G). The new items followed the format of “I am certain that I can do xy, even if …zz” as specified by Schwarzer and Fuchs (1996). The reliability in this study for the Sudoku

Specific Self-Efficacy Scale was $\alpha = .90$ for time 1, $\alpha = .93$ for time 2, and $\alpha = .94$ for time 3.

Cognitive Ability. The Wonderlic Personnel Test has served as a measure of intelligence in business and industry for over 60 years (Wonderlic, 2002; WPT). Participants completed the paper and pencil version of the test by answering as many of the 50 questions that they could within the 12-minute time limit. Questions were arranged in order of difficulty, which began at a moderate level and gradually increased. This short version of a general mental intelligence test correlates highly with other longer measures, including the Wechsler Adult Intelligence Scale and the cognitive or "Aptitude G" scale of the General Aptitude Test Battery, thus demonstrating construct validity. Reliability coefficient α ranges from .73 to .95 depending on the population of interest.

Experience. A measure assessing experience was developed specifically for the Sudoku task. The measure included items that assess the participant's familiarity with the components of task that possess similar declarative knowledge or procedures (see Eyring et al., 1993 for the reasoning behind the scale development). The participants answered these items after reading the task instructions and completing the practice grids. The items address familiarity with logic games including Sudoku, crosswords, Latin square ($\alpha = .63$, Appendix H). Upon further analysis it was determined that the one item experience with Sudoku measure and the two item experience with the other games measure ($\alpha = .70$) should be used separately in the regression analysis.

Performance. Performance on Sudoku is operationalized as the number of small squares correctly completed across the larger grids during a 10-minute trial. The squares of the grid contain either numbers or empty spaces. A participant earns points by filling in each empty space correctly according the rules of the game. Any incorrect or blank squares did not earn points toward the participants' final score.

RESULTS

All tables are contained within Appendix B. Table 2 contains the means, standard deviations, and correlations of the composite scales for the predictor variables, as well as subjective task complexity, Sudoku self-efficacy, and performance for trial 1, 2, and 3.

Hypothesis 1 proposed that regardless of their dispositional orientation, participants will adapt their goal orientation based on the instructions of the task. A one-way analysis of variance (ANOVA) was conducted to test if the task instruction manipulation used to induce a state-dependent learning or performance goal orientation was successful. The ANOVA was not significant for either learning or performance goal orientation condition, $F(1, 389) = .000$, $p = .999$ and $F(1, 389) = 2.033$, $p = .155$, respectively. Hypothesis 1 was not supported. Since the manipulation was not significant, the participants' scores on the goal orientation measure completed after the instructions will be referred to a Sudoku learning goal orientation (SLGO) and Sudoku performance goal orientation (SPGO), since the instructions asked the participants rate the items with respect to the Sudoku task.

In order to test the hypotheses 2-4, hierarchical regression analyses were performed to test if individual difference variables account for the variability in subjective task complexity, Sudoku self-efficacy, and performance over time. First, composite scores were obtained for subjective task complexity and Sudoku self-efficacy at trial 1 (STC1/SSE1), trial 2 (STC2/SSE2), and trial 3 (STC3/SSE3) by averaging the items on the respective scales. Performance, STC, and SSE are the dependent variables in the hierarchical regression models assessed in this study. Composite scores were also obtained for the facets of dispositional goal orientation, Sudoku goal orientation, and global self-efficacy, which were used as predictors in the regression models. The abbreviations DLGO (dispositional learning goal orientation), DPPGO (dispositional performance-prove goal orientation), DPAGO (dispositional performance-avoid goal orientation), SLGO (Sudoku learning goal orientation), SPGO (Sudoku performance goal orientation), STC (subjective task complexity), and SSE (Sudoku self-efficacy) will be used throughout the rest of the results section for simplicity. Experience with the Sudoku task was also used as a predictor variable; however, experience with other related tasks was not included in the regression model as it was not predictive of the dependent variables. Furthermore, when testing each of these hypotheses the interaction between state and dispositional goal-orientation was not tested for, as the manipulation was not successful.

Hierarchical Regression Models: Subjective Task Complexity

The model to predict subjective task complexity was constructed so that experience with the task was entered first into the first block of the hierarchical regression equation. Previous experience with the task influences the participants' perceptions of task complexity. There has been some research to support the relationship between stable characteristics including GSE, dispositional goal orientation, and cognitive ability; thus, these variables were entered into the second block of the regression equation to determine if they accounted for a significant incremental amount of variance in STC beyond experience. Finally, SLGO and SPGO were entered into the third block of the model to test for a significant increase in the amount of variance accounted for in STC. The hierarchical regression results for STC are presented in Table 3.

Hypothesis 2a, which proposed that experience accounted for a significant proportion of the variance in subjective task complexity, was supported. The results of the hierarchical regression analyses of STC showed that experience accounted for 7.7% of the variance in trial 1 (R^2= .077, p <.001). Hypothesis 2b, which proposed that dispositional characteristics including cognitive ability, dispositional goal orientations, and global self-efficacy accounted for incremental variance beyond experience, was also supported. Dispositional characteristics accounted for a significant increment of 3.5% of the variance in STC1 beyond experience (ΔR^2=.035, p=.010). However, Hypothesis 2c, which proposed that situation-induced goal orientations would account for a significant amount of incremental variance, was not supported. Sudoku goal orientation did not account for a significant amount of the variance in STC1 beyond experience and dispositional characteristics (ΔR^2=.001, p=.827). At the final significant step, in trial one, experience and cognitive ability significantly predicted STC, $t(384) = -5.084$, $p < .001$ and $t(384) = -2{,}490$, $p = .013$, respectively. The total amount of variance in STC explained by the regression analysis during trial one was 11.3%.

The hierarchical regression procedure was repeated with STC2 as the dependent variable. Hypothesis 2a was supported. Experience accounted for 11.8% of the variance in trial 2 (R^2= .118, p <.001). Hypothesis 2b was supported. Dispositional characteristics accounted for a significant increment of variance in STC2 beyond that explained by experience (ΔR^2=.032, *p*=.013). Hypothesis 2c was not supported. Sudoku goal orientation did not account for a significant amount of the variance in STC2 beyond experience and dispositional characteristics (ΔR^2=.023, *p*=.977). At the final significant step, in trial 2, experience and DPAGO significantly predicted subjective task complexity, $t(384) = -7.173$, $p < .001$ and $t(384) = 3.264$, $p = .001$, respectively. The total amount of variance in STC explained during trial two was 15.1%.

The hierarchical regression procedure was repeated with STC3 as the dependent variable. Hypothesis 2a was supported. The results of the hierarchical regression analyses showed that experience accounted for 16.4% of the variance in trial 3 (R^2= .164, p <.001). Hypothesis 2b was supported. Dispositional characteristics accounted for a significant increment of the variance in STC3 beyond that explained by experience (ΔR^2=.032, *p*=.010). Hypothesis 2c was not supported. Sudoku goal orientation did not account for a significant amount of the variance in STC3 beyond experience and dispositional characteristics (ΔR^2=.002, *p*=.662). At the final significant step, in trial 3, experience and DPAGO significantly predicted STC, $t(384) = -8.704$, $p < .001$ and $t(384) = -3.271$, $p = .001$, respectively. The total amount of variance in STC explained in during trial two was 19.7%.

Hierarchical Regression Models: Sudoku self-efficacy

The model to predict Sudoku self-efficacy was constructed so that experience was entered into the first block of the hierarchical regression equation predicting SSE. Experience was entered first because previous experience with the task and similar tasks will influence the participants' perceptions of their capability to complete the task. Dispositional variables, including GSE, cognitive ability, and dispositional goal orientation were entered into the model as a second block to determine if they accounted for a significant incremental amount of variance in SSE beyond experience. Global self-efficacy was entered into the first block of the regression analysis, as it is a measure of self-efficacy across situations. Subjective task complexity was entered into the model as a third block to determine if it accounted for a significant incremental amount of variance in beyond experience and dispositional variables. Finally, SLGO and SPGO were entered into the fourth block. The hierarchical regression results for SSE are presented in Table 4.

Hypothesis 3a, which proposed that experience would account for a significant proportion of variance in Sudoku self-efficacy, was supported. The results of the hierarchical regression analyses of SSE showed that experience accounted for 2.6% of the variance in trial 1 (R^2= .026, p <.001). Hypothesis 3b, which proposed that dispositional characteristics including cognitive ability, dispositional goal-orientations, and global self-efficacy would account for incremental variance, was supported. Dispositional characteristics accounted for a significant increment of 14.5% of the variance in SSE1 beyond experience (ΔR^2=.145, p <.001). Hypothesis 3c, which proposed that subjective task complexity would account for incremental variance, was not supported. Subjective task complexity did not account for a significant amount of the variance in SSE1 beyond experience and dispositional characteristics (ΔR^2=.002, p=.336). However, hypothesis 3d, which proposed that situation-induced goal orientation would account for incremental variance, was supported. Sudoku goal orientation account for a significant increment of 1.5% of the variance in SSE1 (ΔR^2=.015, p = .034). At the final significant step, in trial one, experience significantly predicted Sudoku self-efficacy, $t(381) = 2.858$, $p = .005$, GSE predicted Sudoku self-efficacy, $t(381) = 4.501$, $p < .001$, and SPGO predicted Sudoku self-efficacy, *t*(381) = 2.526, $p = .012$. The total amount of variance in SSE explained during trial one was 18.8%.

The hierarchical regression procedure was repeated with SSE2 as the dependent variable. Hypothesis 3a was supported. Experience accounted for 1.5% of the variance in trial 1 ($R^2 = .015$, $p < .001$). Hypothesis 3b was supported. Dispositional characteristics accounted for a significant increment of 1314.5% of the variance in SSE2 beyond experience ($\Delta R^2 = .130$, $p < .001$). Hypothesis 3c was supported. Subjective task complexity also accounted for a significant amount of variance in SSE2 beyond experience and dispositional characteristics ($\Delta R^2 = .011$, $p = .029$). Hypothesis 3d was not supported. Sudoku goal orientation did not account for a significant increment of the variance when added in the final block of the regression equation ($\Delta R^2 = .009$, $p = .117$). At the final significant step, in trial two, DLGO, GSE, and STC significantly predicted Sudoku self-efficacy, *t*(383) = 2.312, $p = .021$, *t*(383) = 5.025, $p < .001$, and *t*(383) = -2.191, $p = .029$, respectively. The total amount of variance in SSE explained during trial two was 16.6%.

The hierarchical regression procedure was repeated again with SSE3 as the dependent variable. Hypothesis 3a was supported. The results of the hierarchical regression analyses showed that experience accounted for 2.7% of the variance in trial 1 ($R^2 = .027$, $p < .001$). Hypothesis 3b was supported. Dispositional characteristics accounted for a significant increment of 12.9% of the variance in SSE2 beyond experience ($\Delta R^2 = .129$, $p < .001$). Hypothesis 3c was supported. Subjective task complexity accounted for a significant amount of variance in SSE2 beyond experience and dispositional characteristics ($\Delta R^2 = .010$, $p < .030$). Hypothesis 3d was not supported.

Sudoku goal orientation did not account for a significant increment of the variance when added in the final block of the regression equation (ΔR^2=.011, p = .072). At the final significant step, in trial three, cognitive ability, DLGO, GSE, and STC significantly predicted SSE, $t(383) = 2.139$, $p = .033$, $t(383) = 2.772$, $p = .006$, $t(383) = 4.162$, $p <$ .001, and $t(383) = -2.179$, $p = .030$. The total amount of variance in SSE explained during trial two was 17.8%.

Hierarchical Regression Models: Performance

The model to predict performance was constructed such that experience was entered into the first block of regression equation, dispositional variables were entered into the second block, Sudoku self-efficacy was entered into the third block, subjective task complexity was entered into the fourth block, and state-dependent goal orientation was entered into the final block. This procedure assessed if the additional variables accounted for variance in performance above the variables included in the previous block. Experience was entered first because previous experience with the task may decrease differences in performance due to individual differences in the other variables of interest. Dispositional variables including, cognitive ability was entered into the second block because of cognitive ability's strong relationship with performance. The hierarchical regression results for Sudoku self-efficacy are presented in Table 5.

The results of the hierarchical regression analyses of performance showed that experience accounted for 44.1% of the variance in trial 1 (R^2= .441, p <.001), thus, hypothesis 4a, which proposed that experience would account for a significant amount of the variance in experience, was supported. Hypothesis 4b, which proposed that dispositional characteristics would account for a significant increment of variance in performance at trial 1 beyond experience, was supported (ΔR^2=.040, p <.001). Hypothesis 4c, which proposed that Sudoku self-efficacy would accounted for a significant increment of the variance in performance, was supported (ΔR^2=.010, p =.009). Hypothesis 4d, which stated that subjective task complexity would accounted for a significant amount of the variance in performance beyond experience, dispositional characteristics, and SSE was supported (ΔR^2=.021, p <.001). Hypothesis 4e was not supported as Sudoku goal orientation did not account for a significant increment of the variance in performance when added in the final step (ΔR^2=.005, p = .163). At the final significant step, in trial one, experience, cognitive ability, SSE, and STC significantly predicted performance, t(382) = 13.721, t(382) = 4.284, p < .001, t(382) = 2.475, p = .014, and t(382) = -3.965, p < .001, respectively. The total amount of variance in performance explained during trial one was 48.3%.

The results of the hierarchical regression analyses of performance showed that experience accounted for 37.1% of the variance in trial 2 (R^2= .371, p <.001), thus, Hypothesis 4a was supported. Hypothesis 4b was also supported. Dispositional characteristics accounted for a significant increment of 5.1% of the variance in performance at trial 2 beyond experience (ΔR^2=.051, p <.001). Hypothesis 4c was supported. Sudoku self-efficacy accounted for a significant increment of .8% of the variance (ΔR^2=.008, p =.025). Hypothesis 4d was supported. Subjective task complexity accounted for a significant amount of the variance in performance beyond experience, dispositional characteristics, and SSE (ΔR^2=.022, p <.001). Hypothesis 4e was not supported. Sudoku goal orientation did not account for a significant increment of the variance when added in the final step (ΔR^2=.005, p = .199). At the final significant step, in trial two, experience, cognitive ability, DPPGO, and STC significantly predicted performance, $t(382) = 12.276$, $p < .001$, $t(382) = 4.277$, $p < .001$, $t(382) = 2.047$, $p = .041$, and $t(382) = -3.939$, $p < .001$, respectively. The total amount of variance in performance explained during trial two was 45.2%.

The results of the hierarchical regression analyses of performance showed that experience accounted for 41.2% of the variance in trial 3 ($R^2 = .412$, $p < .001$), thus, hypothesis 4a was supported. Hypothesis 4b was also supported. Dispositional characteristics accounted for a significant increment of 5.5% of the variance in performance at trial 3 beyond experience ($\Delta R^2 = .055$, $p < .001$). Hypothesis 4c was supported. Sudoku self-efficacy accounted for a significant increment of variance in performance ($\Delta R^2 = .006$, $p = .034$). Hypothesis 4d was supported. Subjective task complexity accounted for a significant amount of the variance in performance beyond experience, dispositional characteristics, and SSE ($\Delta R^2 = .061$, $p < .001$). Hypothesis 4e was not supported. Sudoku goal orientation did not account for a significant increment of the variance in performance when added in the final step ($\Delta R^2 = .003$, $p = .303$). At the final significant step, in trial three, experience, cognitive ability, and STC significantly predicted performance, $t(382) = 11.865$, $p < .001$, $t(382) = 5.812$, $p < .001$, and $t(382) = -7.092$, $p < .001$, respectively. The total amount of variance in performance during trial three was 53.5%.

Since the task instruction manipulation did not work, it was not possible to test Hypothesis 5a and 5b. Hopefully, in future studies a stronger manipulation will allow for the assessment of the affect of congruent, incongruent, and mixed dispositional and state-dependent goal orientations on subjective task complexity, task-specific self-efficacy, and performance.

DISCUSSION

A summary and discussion of the results of the hypothesis testing is as follows. Hypothesis 1 was not supported. The manipulation did not influence participants in either of the conditions (i.e. learning or performance goal). Participants in the two conditions did not significantly differ on their responses to the state-dependent goal orientation measure, thus, the manipulation of task instructions did not induce the participants to hold a state goal orientation that matched the manipulation. Because of the ineffective manipulation, Hypotheses 5a and 5b could not be analyzed.

Dispositional and State Goal Orientation

The relationship between dispositional and situational goal orientations is complicated by the likelihood that the facets of goal orientation (i.e. learning, performance-prove, performance-avoid) are not mutually exclusive. Breland and Donavon (2005), found an unexpected correlation between learning goal orientation and performance goal orientation. This study also found a significant, but small positive correlation between dispositional learning goal orientation and dispositional performance-prove goal orientation. Furthermore, this study found that dispositional performance-prove goal orientation and performance-avoid goal orientation was moderately positively related. The relationships among the facets of goal orientation support the claim that goal orientations are neither mutually exclusive, nor contradictory

(Button et al., 1996). Furthermore, the correlated facets of goal orientation make efforts to influence goal orientation difficult.

This study was designed to assess the relationship of dispositional and state goal orientations under strong orientating cues, however, since the manipulation did not work, a situation in which there were weak orientating cues was created. Breland and Donovan (2005) allowed participants to adopt a state goal orientation under no orientating cues and found that participants adopted a state goal orientation that was consistent with their dispositional orientation. This study assesses participants' goal orientations under very weak orientating cues by reviewing the relationship between dispositional goal orientation and state-dependent goal orientation.

Under strong cues, participants should respond to the state-dependent goal orientation measure inline with the learning or performance instructions they received, thereby providing evidence for the malleability of goal orientation (Button et al., 1996). In the presence of few weak orientating cues, the participant should adopt their dispositional orientation (Button et al.) Breland and Donovan (2005) found this relationship under no orientating cues. However, this study showed that it is not necessarily the case, as the participants' goal orientations were not consistent. For example, we found a significant, but small negative relationship between dispositional learning goal orientation and Sudoku learning goal orientation, while there was a strong positive correlation between dispositional learning goal orientation and Sudoku performance goal orientation. Furthermore, there was also a moderate positive correlation between dispositional performance-prove goal orientation and Sudoku learning goal orientation and a smaller, but still significant positive relationship with Sudoku performance goal orientation. Finally, dispositional performance-avoid goal orientation had a strong positive relationship with Sudoku learning goal orientation.

These findings are inconsistent with the theory of Button et al. and the findings of Breland and Donovan, as it is expected that a participant's dispositional and state goal orientation would remain consistent under no or weak orientating cues. Although the manipulation in the current study was not successful, it is possible that other orientating cues in the experiment (e.g. the task) influenced the goal orientations held by the participants. In this study, the Sudoku task was a simple 4x4 grid. It is likely that the simplistic surface nature of the task would not induce participants to approach this task with a master or learning approach as there is not enough apparent complexity to warrant such a strategy. However, a performance orientation, which is similar to the desire to demonstrate competence, may have been invoked by the seemingly simple task. The nature of the task may explain the relationships found between dispositional goal orientation and Sudoku goal orientation in this study.

The nature of these relationships supports the notion that goal orientations are malleable and may be more appropriately defined within Mischel and Shoda's (1998) if…then conceptualization of personality or motivational constructs. These findings provide evidence that even under few orientating cues (i.e. an ineffective task manipulation or the task itself), participants may adapt a goal orientation that differs from their dispositional orientation, thus, it is important to consider the situation when assessing goal orientation. This approach does not discount the existence of trait-based personality or motivational constructs, but states that they may be better understood within situational constraints. Dispositional goal orientation may provide a default orientation that is held across situations; however, goal orientation can change with respect to the specific task the participant is completing. For example, the simplistic nature of this task likely induced participants with a strong dispositional goal orientation to hold a strong state (Sudoku) performance goal orientation. By only considering dispositional characteristics, we ignore the situation in our assessments.

The remainder of the discussion will focus on the findings from the hierarchical regression analyses used to predict subjective task complexity, Sudoku self-efficacy, and performance. These findings demonstrate that the some of the predictors of the two individual difference outcomes (i.e. subjective task complexity and Sudoku self-efficacy) and performance outcome change in the different trials. Each outcome will be discussed in terms of its significant predictors in Trial 1, 2, and 3.

Predictors of Subjective Task Complexity

The pattern of significant steps in the regression equation to predict subjective task complexity remained consistent across the three trials. Step 1, which included experience, accounted for significant variance in participants' subjective task complexity. Step 2, which included stable characteristics, accounted for additional variance beyond experience. However, Step 3, which included situational variables (i.e. state-dependent goal orientation) did not account for incremental variance in subjective task complexity. The significant predictors within this regression equation were experience, cognitive ability, and dispositional performance-avoid goal orientation.

As expected by Quiñones et al., (1995) cognitive ability as well as experience influenced the participants' perceptions of task complexity. Experience predicted participants' perceptions of subjective task complexity across all of the trials. Those participants with more experience had lower perceptions of subjective task complexity. This relationship grew stronger across the trials. Through experience, a participant gains familiarity with the components of a task, which leads to changes in their perceptions of task complexity. The more experience a participant has the less complex a task appears.

Cognitive ability was predictive in the first trial of this study; those with higher cognitive ability had lower subjective task complexity. However, this relationship did not remain significant across the second and third trials. Mangos and Steele-Johnson (2001) did not find a relationship between cognitive ability and subjective task complexity in their study, but they assessed subjective task complexity only in a later trial, thus this study is consistent with their finding. The reason that cognitive ability may be predictive of subjective task complexity only in the early trials of skill acquisition is because cognitive ability becomes a less important component in their assessment of subjective task complexity as the participant learns the task. During the first trial of this study, the participant has completed only four practice squares, thus, their exposure to the task was very limited. In such a situation, cognitive ability may be a major determinant that influences the participants' perceptions of task complexity, but as the participants complete the trials, other factors would became more predictive.

As found by previous research, goal orientation predicted subjective task complexity (Mangos & Steele-Johnson, 2001). Although previous findings regarding learning goal orientation and subjective task complexity (e.g. Campbell, 1988) were not replicated by this study, evidence was found for the relationship between performance-avoid goal orientation and subjective task complexity. In the second and third trials of this study, participants with a higher dispositional performance-avoid goal orientation had higher subjective task complexity. A performance-avoid orientation leads participants to avoid situations in which they perceive a chance for failure; this mindset is likely to increase perceptions of task complexity. A learning approach is supposed to generate high levels of subjective task complexity as the participant strives to master the task. However, the simplistic nature of this task may account for the null findings regarding learning goal orientation, as there was not a sufficient amount of objective complexity to warrant the high of assessment of subjective task complexity. However, this study shows that even with a simple task a performance-avoid orientation can lead to greater perceptions of task complexity.

Predictors of Sudoku Self-efficacy

The pattern of significant steps in the regression equation to predict Sudoku self-efficacy remained consistent across trials 2 and 3, but differed slightly in trial 1. Step 1, which included experience, accounted for significant variance in participants' Sudoku self-efficacy across all three trials. Step 2, which included stable characteristics, accounted for additional variance beyond experience across all three trials. Step 3, which included subjective task complexity, accounted for significant variance beyond experience and dispositional variables in trial 2 and 3; however, it was not significant in trial 1. Step 4, which included situational variables (i.e. Sudoku goal orientation), accounted for incremental variance in Sudoku self-efficacy in trial 1, but not in trial 2 or 3. The significant predictors within this hierarchical regression were experience, cognitive ability, dispositional learning goal orientation, global self-efficacy, subjective task complexity, and Sudoku performance goal orientation. The significance of each predictor across trials is discussed below.

The assessment of task specific self-efficacy (i.e. Sudoku specific self-efficacy) involved a self-reflective assessment of the participants' capability to complete a task. Global self-efficacy predicted Sudoku self-efficacy across the trials. Those participants with higher GSE also had higher SSE. This finding is intuitively appealing as task specific self-efficacy (Sudoku self-efficacy) is simply a more proximal (specific) predictor of a general construct.

Experience and Sudoku performance goal orientation predicted Sudoku self-efficacy in trial 1, those with more experience and a higher Sudoku performance goal orientation had higher Sudoku self-efficacy. Experience leads a participant to understand the task and believe that they can complete it, while a performance goal orientation specifically related to the Sudoku guides a person to demonstrate their competence and thus, believe they can complete the task. As mentioned previously, Sudoku performance goal orientation was positively related to dispositional learning goal orientation, which has been shown to promote self-efficacy in previous research (e.g. Bell & Kozlowski, 2002). Experience and Sudoku performance goal orientation were not predictive of Sudoku self-efficacy in trial 2 and 3. Once the participants completed the first Sudoku trial, it is likely that their initial experience no longer influenced their Sudoku self-efficacy. Furthermore, the high correlation between dispositional learning goal orientation and Sudoku performance goal orientation may explain why Sudoku performance goal orientation was replaced by dispositional learning goal orientation in the subsequent trials.

In the second and third trial dispositional learning goal orientation and subjective task complexity predicted SSE. Those with a dispositional learning goal orientation had higher Sudoku self-efficacy and those with lower subjective task complexity had higher Sudoku self-efficacy. These findings support the work of Bell and Kozlowski (2002) regarding the positive affect of a learning goal orientation on self-efficacy. Mangos and Steele-Johnson found that subjective task complexity predicted self-efficacy this research supports their findings as their study assessed Sudoku self-efficacy in later trials of skill acquisition.

Research has provided mixed findings regarding the relationship between cognitive ability and self-efficacy (e.g. Bell & Kozlowski, 2002; Mangos & Steele-Johnson, 2001). Bell and Kozlowski found that cognitive ability is a predictor of self-efficacy, while Mangos and Steele-Johnson did not find a relationship between cognitive ability and self-efficacy. The results of trial 3 support the findings of Bell and Kozlowski as cognitive ability predicted Sudoku self-efficacy. Those with higher cognitive ability had higher Sudoku self-efficacy. However, trials 1 and 2 supported the findings of Mangos and Steele-Johnson as cognitive ability was not predictive of Sudoku self-efficacy. The relationship between cognitive ability and task specific self-efficacy remains uncertain. The nature of this relationship may depend on the type of task, the difficulty of the task, or on characteristics of the participant. Further research is needed to clarify this relationship.

Predictors of Performance

The pattern of significant steps in the regression equation to predict performance remained consistent across all trials. Step 1, which included experience, accounted for significant variance in participants' Sudoku self-efficacy. Step 2, which included stable characteristics, accounted for additional variance beyond experience. Step 3, which included subjective task complexity, accounted for significant variance beyond experience and dispositional variables. Step 4, which included Sudoku self-efficacy, accounted for significant incremental variance. Step 5, which included situational variables (i.e. Sudoku goal orientation), did not account for incremental variance in performance. The significant predictors within this hierarchical regression were experience, cognitive ability, dispositional performance-prove goal orientation, Sudoku self-efficacy, and subjective task complexity. The significance of each predictor across the trials is discussed below.

Experience, cognitive ability, and subjective task complexity predicted performance across the trials. Those participants with higher cognitive ability and more experience performed better, while those with lower subjective task complexity performed better. These findings are in line with the logic that perceiving a task to be overly complex can lead to lower performance. This likely through decreased effort, motivation, and expectations of success (Gardner, 1990; Scot, Fahr, & Podsakoff, 1988). Furthermore, these findings reiterate the large body of research regarding the importance of cognitive ability (e.g. Gottfredson, 1997; Kanfer and Ackerman, 1989; Schmidt and Hunter, 1998) and experience (Yeo & Neal) in skill-acquisition.

The proximal assessment of self-efficacy was a significant predictor of performance, rather than global self-efficacy. This is likely due to Sudoku self-efficacy proximity to the task. However, as expected by previous research, task specific self-efficacy was a better predictor of performance in early skill-acquisition (Kanfer & Ackerman, 1989; Mitchell et al., 1994) and goal orientation was a better predictor of performance in the later trials of skill-acquisition (Mitchell et al.). In trial 1, Sudoku self-efficacy was a predictor of performance, higher Sudoku self-efficacy led to better performance. However, in trial 2, dispositional performance-prove goal orientation led to better performance. Steele-Johnson et al. (2000) found that a performance goal orientation led to better performance on a simple task, which is consistent with this study as a simple 4x4 Sudoku grid was used.

Fewer predictors were significant in trial 3 than in trial 1 or 2. It appears with time skill acquisition (performance) is determined by fewer variables, which in this study were cognitive ability, experience, and subjective task complexity. Focusing on these variable and the factors that influence these variables can enhance performance. Furthermore, focusing on the other predictors that were initially significant may enhance performance during early skill acquisition.

Limitations and Future Research

Research needs to continue to explore which variables significantly affect performance during skill-acquisition. Although this study could not formally define the phases of skill-acquisition, it did show that different predictors are significant at different points in time, even when learning a relatively simple task. However, a number of things should be considered when the evaluating the results of this study. The following paragraphs will explore these limitations as well as provide directions for future research.

The objective difficulty level of the current task is a major limitation of this study. It is likely that the 4 x 4 grid used was not difficult enough for goal orientation (both dispositional and state) to become a major predictor. The simplicity of the task also likely restricted the range of participants' subjective task complexity and Sudoku self-efficacy assessments. A more difficult task would likely lead to more discriminating individual difference predictors. However, this research reiterates that the opportunity exists to use individual differences variables including cognitive ability, goal-orientation, self-efficacy, and subjective task complexity to predict performance. Further research should continue to explore opportunities to influence these variables in an effort to enhance performance in training and on-the-job contexts. If researchers wanted to continue to use Sudoku as a task to study skill-acquisition, using a more complex task (e.g. a 6 x 6 grid) would be beneficial. By using a task that is objectively harder than the 4 x 4 grid, the task would discriminate better between individuals, while still likely allowing the participants to reach a more proceduralized state across several trials.

This study also shows that the relationship between dispositional and state goal orientation may not be as consistent as expected, even under few orientating cues. Furthermore, the actual task may serve as an orientating cue and thus, lead individuals to adopt one orientation, when they were predisposed to hold another. A further major limitation of the current study was the ineffectiveness of the task instruction manipulation (the independent variable). Since the manipulation did not work, the study became strictly correlational in nature and thus, therefore reduced the claims, which could be made from the results.

There are several possible explanations for why the instruction manipulation was not successful in inducing state goal orientation. These include, that the manipulation was not strong enough, or that the participants did not read carefully enough. Previous research (e.g. Mangos & Steele-Johnson, 2001) was successful in inducing a state-goal orientation by using this type of manipulation, however, future research should attempt to induce a stronger manipulation in order to study goal orientation under strong external cues. For example, a future study may attempt to induce many of the orientating cues proposed by Dweck (1989; Farr et al., 1993) including the task instructions, performance reward structure, and feedback type. A successful manipulation would allow researchers to explore the effect of congruent, incongruent, and mixed dispositional and state-goal orientation pairings on outcome variables of interest. This line of research may show how the situation (or orientating cues) can influence goal orientation, thereby supporting the work of Mischel and Shoda (1998). Furthermore, the manipulation of state goal orientation may prove to be an important mechanism to improve skill acquisition.

The present study is limited by the sample used. The current sample was a sample of convenience; the students who participated in this study are likely different from the workforce found in many companies. The average cognitive ability score of the student sample is higher than the general population norms provided by Wonderlic (2002). Furthermore, the students are of a different age bracket than most of the workforce and the sample is very homogenous in terms of race/ethnicity. The students completed this study for extra credit. It is likely that they were less invested in the study than employees are during a training program that directly relates to their job. For these reasons, the findings of this study may not directly generalize to the non-student population of the workplace. Despite these limitations, this study demonstrates that individual difference research in the area of skill acquisition is a possible avenue to improve performance and has direct applicability to employee training.

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Appendix A

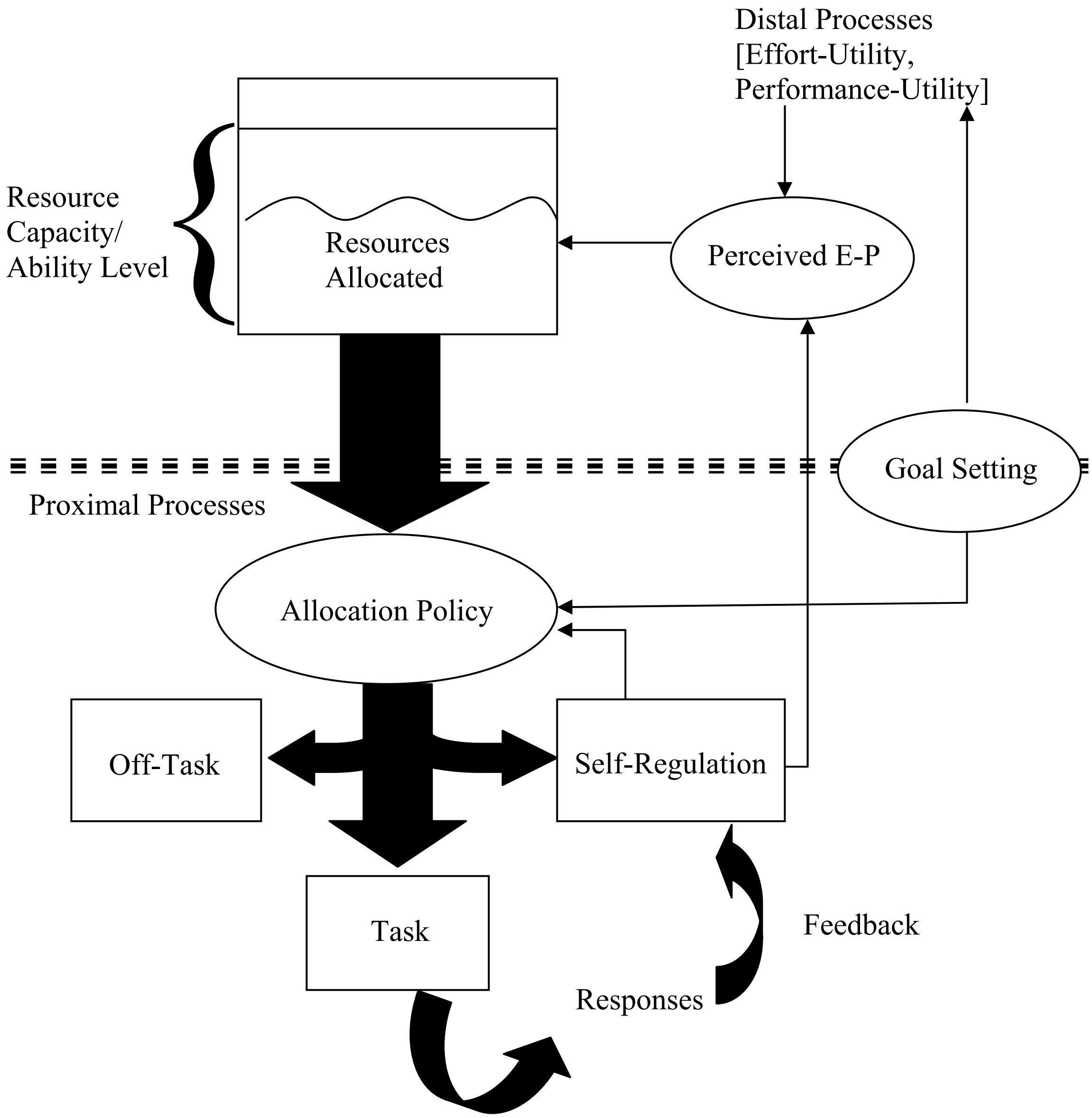

Figure 1. The Integrative Resource Model (Kanfer & Ackerman, 1989).

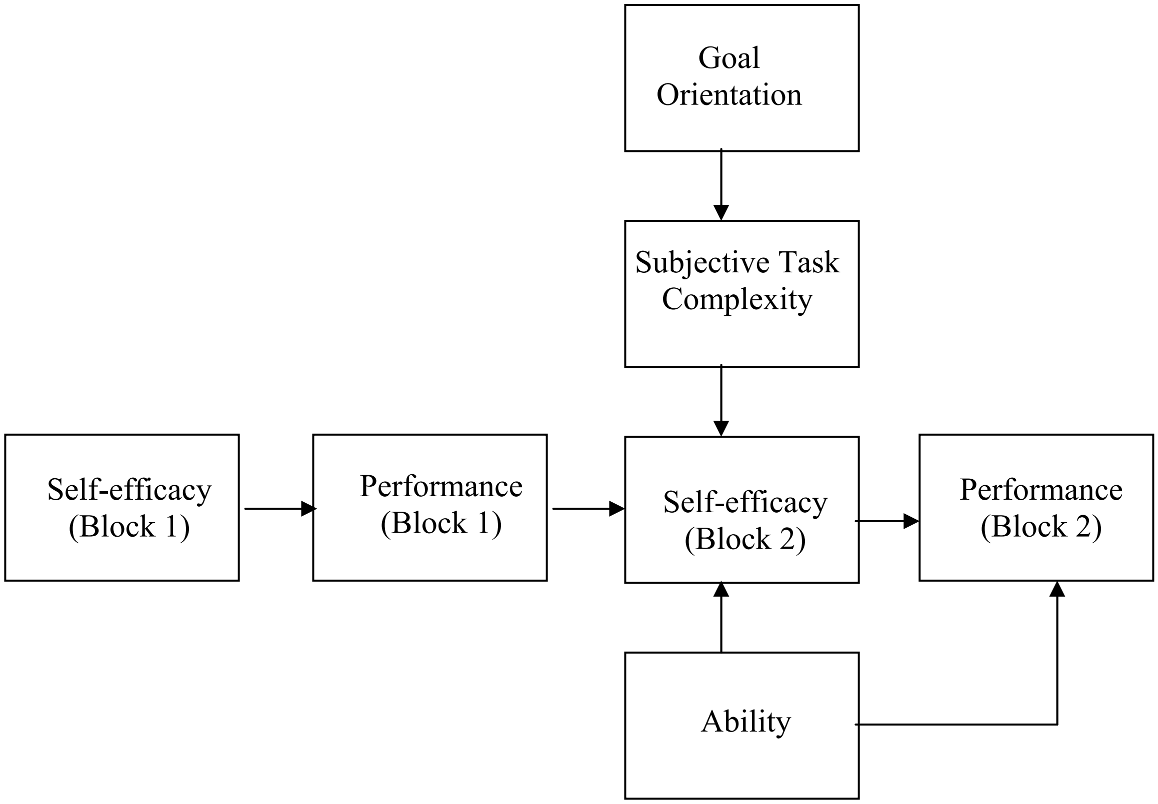

Figure 2. The relationship between goal orientation, subjective task complexity, self-efficacy, and performance (Mangos and Steele-Johnson, 2001).

Appendix B

Table 1

Groups Formed from a Profile Goal Orientation Approach

Dispositional learning	Dispositional performance-prove	Dispositional performance-avoid	State goal orientation	Match of orientations
High	High	High	Learning Performance	Mixed Mixed
High	High	Low	Learning Performance	Mixed Mixed
Low	High	High	Learning Performance	Incongruent Congruent
High	Low	High	Learning Performance	Mixed Mixed
High	Low	Low	Learning Performance	Congruent Incongruent
Low	High	Low	Learning Performance	Incongruent Congruent
Low	Low	High	Learning Performance	Incongruent Congruent
Low	Low	Low	Learning Performance	Incongruent Incongruent

Table 2

Means, Standard Deviations, and Intercorrelations of Predictor and Outcome Variables

	Variable	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	DLGO	5.95	.71	1																
2	DPPGO	5.72	1.05	.16**	1															
3	DPAGO	5.48	.93	-.09	.41**	1														
4	SLGO	5.65	.86	-.11**	.43**	.58**	1													
5	SPGO	5.60	.83	.63**	.21**	.01	.05	1												
6	WPT	24.20	4.87	.00	.05	-.09	-.08	.06	1											
7	EXP	2.01	.72	-.02	-.04	.05	-.01	.07	.16**	1										
8	GSE	40.22	5.28	.43**	.11*	-.13**	.04	.44**	.02	-.01	1									
9	STC1	3.03	1.56	-.05	.01	.08	.03	-.10	-.20**	-.24**	-.12*	1								
10	STC2	3.92	1.61	.06	.00	.11*	.07	-.01	-.14**	-.30**	-.02	.68**	1							
11	STC3	4.18	1.73	.03	-.02	.10*	.05	-.06	-.15**	-.32**	-.06	.60**	.87**	1						
12	SSE1	5.67	.98	.23**	.13**	-.04	.05	.33**	.09	.21**	.33**	-.19**	-.18**	-.22**	1					
13	SSE2	6.08	.94	.22**	.13**	-.02	.08	.29**	.14**	.14**	.30**	-.25**	-.18**	-.19**	.73**	1				
14	SSE3	6.12	.98	.23**	.12**	-.04	.04	.31**	.17**	.19**	.28**	-.24**	-.18**	-.23**	.63**	.85**	1			
15	SP1	172.41	68.65	-.03	-.00	-.04	-.02	.10*	.30**	.54**	.02	-.40**	-.51**	-.55**	.28**	.23**	.23**	1		
16	SP2	175.13	83.63	-.04	.06	-.02	.02	.11*	.30**	.52**	.03	-.34**	-.46**	-.57**	.31**	.25**	.29**	.90**	1	
17	SP3	193.04	85.68	-.04	.02	-.01	.01	.10*	.35**	.52**	.01	-.35**	-.46**	-.55**	.29**	.23**	.26**	.89**	.92**	1

Note. Abbreviations used in this table are as follows: dispositional learning goal orientation (DLGO), dispositional performance-prove goal orientation (DPPGO), dispositional performance-avoid goal orientation (DPAGO), Sudoku learning goal orientation (SLGO), Sudoku performance goal orientation (SPGO), cognitive ability as measured by the Wonderlic Personnel Test (WPT), experience (EXP), global self-efficacy (GSE), subjective task complexity in each trial (STC1, STC2, STC3), Sudoku self-efficacy in each trial (SSE1, SSE2, SSE3), and performance in each trial (SP1, SP2, SP3).

** $p < .01$, * $p < .05$

Table 3

Summary of Hierarchical Regression Results Using Experience, Dispositional Characteristics, and State-dependent Goal Orientation to Predict Subjective Task Complexity for all Three Trials

	β				
Variable	Step 1	Step 2	Step 3	R^2	ΔR^2
Trial 1					
1. Experience	-.28**	-.25**	-.26**	.08**	
2. Cognitive Ability		-.13*	-.13*		
Dispositional LGO		-.01	-.01		
Dispositional PPGO		-.01	.00		
Dispositional PAGO		.08	.10		
Global Self-Efficacy		-.09	-.09	.11**	.04*
3. Sudoku LGO			-.04		
Sudoku PGO			-.01	.11**	.00

	β				
Variable	Step 1	Step 2	Step 3	R^2	ΔR^2
Trial 2					
1. Experience	-.34**	-.35**	-.35*	.12**	
2. Cognitive Ability		-.04	-.04		
Dispositional LGO		.09	.10		
Dispositional PPGO		-.08	-.08		
Dispositional PAGO		.18**	.18**		
Global Self-Efficacy		-.03	-.02	.15**	.032*
3. Sudoku LGO			.00		
Sudoku PGO			-.01	.15**	.000

Table 3 Continued

Variable	β Step 1	Step 2	Step 3	R^2	ΔR^2
Trial 3					
1. Experience	-.41**	-.41**	-.41**	.16**	
2. Cognitive Ability		-.03	-.03		
Dispositional LGO		.07	.08		
Dispositional PPGO		-.10	-.09		
Dispositional PAGO		.17**	.19**		
Global Self-Efficacy		-.06	-.05	.20**	.03*
3. Sudoku LGO			-.04		
Sudoku PGO			-.04	.20**	.00

*p < .05, **p < .01.

Table 4

Summary of Hierarchical Regression Results Using Experience, Dispositional Characteristics, Subjective Task Complexity, and State-dependent Goal Orientation to Predict Sudoku Self-Efficacy for all Three Trials

	β					
Variable	Step 1	Step 2	Step 3	Step 4	R^2	ΔR^2
Trial 1						
1. Experience	.16**	.17**	.16**	.14**	.03**	
2. Cognitive Ability		.02	.02	.01		
Dispositional LGO		.12*	.12	.04		
Dispositional PPGO		.09	.09	.07		
Dispositional PAGO		-.04	-.03	-.06		
Global Self-Efficacy		.29**	.28**	.24**	.17**	.15*
3. STC			-.05	-.05	.17**	.00
4. Sudoku LGO				.03		
Sudoku PGO				.16*	.19**	.02*

	β					
Variable	Step 1	Step 2	Step 3	Step 4	R^2	ΔR^2
Trial 2						
1. Experience	.12*	.11*	.07	.07	.02**	
2. Cognitive Ability		.09	.09	.09		
Dispositional LGO		.11*	.12*	.08		
Dispositional PPGO		.08	.07	.04		
Dispositional PAGO		.00	.02	-.02		
Global Self-Efficacy		.27**	.26**	.23**	.15**	.13***
3. STC			-.11*	-.11*	.16**	.01*
4. Sudoku LGO				.08		
Sudoku PGO				.10	.17**	.01

Table 4 Continued

Variable	β				R^2	ΔR^2
	Step 1	Step 2	Step 3	Step 4		
Trial 3						
1. Experience	.16**	.15**	.10	.09	.03**	
2. Cognitive Ability		.11*	.10*	.10*		
Dispositional LGO		.14**	.15**	.08		
Dispositional PPGO		.10	.09	.07		
Dispositional PAGO		-.04	-.02	-.05		
Global Self-Efficacy		.22**	.22**	.18**	.16**	.13**
3. STC			-.11*	-.11*	.17**	.01*
4. Sudoku LGO				.04		
Sudoku PGO				.14*	.18**	.01

*$p < .05$, **$p < .01$.

Table 5

Summary of Hierarchical Regression Results Using Experience, Dispositional Characteristics, Subjective Task Complexity, Sudoku Self-Efficacy, and State-dependent Goal Orientation to Predict Performance for all Three Trials

	β						
Variable	Step 1	Step 2	Step 3	Step 4	Step 5	R^2	ΔR^2
Trial 1							
1. Experience	.64**	.61**	.59**	.55**	.54**	.44**	
2. Cognitive Ability		.19**	.19**	.17**	.16**		
Dispositional LGO		-.05	-.07	-.07	-.11*		
Dispositional PPGO		.04	.06	.03	.01		
Dispositional PAGO		-.05	-.04	-.03	-.04		
Global Self-Efficacy		.04	.01	.00	-.02	.45**	.04**
3. STC			.11**	.10*	.09*	.46**	.01**
4. SSE				-.16**	-.15**	.48**	.02**
5. Sudoku LGO					.02		
Sudoku PGO					.09	.49**	.01

	β						
Variable	Step 1	Step 2	Step 3	Step 4	Step 5	R^2	ΔR^2
Trial 2							
1. Experience	.61**	.58**	.57**	.52**	.51**	.37**	
2. Cognitive Ability		.18**	.17**	.17**	.17**		
Dispositional LGO		-.09	-.10*	-.08	-.12		
Dispositional PPGO		.11*	.10*	.09*	.08		
Dispositional PAGO		-.03	-.03	-.01	-.02		
Global Self-Efficacy		.08	.05	.05	.03	.42**	.05**
3. STC			.09*	.08	.07	.43**	.01*
4. SSE				-.16**	-.16**	.45**	.02**
5. Sudoku LGO					.02		
Sudoku PGO					.09	.46**	.01

Table 5 Continued

Variable	β Step 1	Step 2	Step 3	Step 4	Step 5	R^2	ΔR^2
Trial 3							
1. Experience	.64**	.60**	.58**	.47**	.47**	.41**	
2. Cognitive Ability		.23**	.22**	.21**	.21**		
Dispositional LGO		-.06	-.07	-.05	-.08		
Dispositional PPGO		.05	.04	.01	.00		
Dispositional PAGO		-.01	.00	.04	.02		
Global Self-Efficacy		.04	.02	.01	-.01	.47*	.06**
3. STC			.09	.06	.05	.47	.01*
4. SSE				-.28	-.28**	.54**	.06**
5. Sudoku LGO					.03		
Sudoku PGO					.07	.54**	.00

$*p < .05$, $**p < .01$.

Appendix C

Dispositional Goal Orientation Measure (from Attenweiler & Moore, 2006)

Learning Goal Orientation

1. I enjoy challenging and difficult task where I learn new skills.
2. I want to learn as much as possible.
3. The opportunity to learn new skills and knowledge is important to me.
4. I prefer to work on tasks that force me to learn new things.
5. The opportunity to extend the range of my abilities is important to me.
6. When I fail to complete a difficult task, I plan to try harder the next time I work on it.
7. I like best when something I learn makes me want to find out more.
8. The opportunity to learn new things is important to me.

Performance-prove Goal Orientation

1. I prefer to work on projects in which I can prove my ability to others.
2. I want others to think I am smart.
3. I enjoy proving my ability to others.
4. The opinions of others about how well I do certain things are important to me.
5. I strive to demonstrate my ability relative to others.
6. The things that I enjoy most are the things that I do best.

Performance-avoid Goal Orientation

1. I prefer to do things that I can do well rather than things I do poorly.
2. I like to do work on tasks that I have done well in the past.
3. Because I know my work will be compared to others, I get nervous.
4. I prefer to avoid situations in which I might perform poorly.
5. I like to be fairly confident that I can successfully perform a task before I attempt it.

Appendix D

State-Dependent Goal Orientation Items (adapted from a measure used by Button et al., 1996)

Performance Goal Orientation
1. I prefer to do things that I can do well rather than things I do poorly.
2. I'm happiest at work when I perform task on which I know that I won't make any errors.
3. The things I enjoy the most are the things I do the best.
4. The opinions others have about how well I can do certain things are important to me.
5. I feel smart when I do something without making any mistakes.
6. I like to be fairly confident that I can successfully perform a task before I attempt it.
7. I like to work on tasks that I have done well on in the past.
8. I feel smart when I can do something better than most other people.

Learning Goal Orientation
1. The opportunity to do challenging work is important to me.
2. When I fail to complete a difficult task, I plan to try harder the next time I work on it.
3. I prefer to work on tasks that force me to learn new things.
4. The opportunity to learn new things is important to me.
5. I do my best when I'm working on fairly difficult task.
6. I try hard to improve on my past performance.
7. The opportunity to extend the range of my abilities is important to me.
8. When I have difficulty solving a problem, I enjoy trying different approaches to see which one will work.

Appendix E

Subjective Task Complexity scale (adapted from a measure used by Maynard and Hakel, 1997).

1. I found this to be a complex task
2. This task was mentally demanding
3. This task required a lot of thought and problem-solving
4. I found this to be a challenging task

Appendix F

Generalized Self-efficacy Scale (adapted from a measure developed by Schwarzer & Jerusalem, 1995)

1. I can always manage to solve difficult problems if I try hard enough.
2. If someone opposes me, I can find the means and ways to get what I want.
3. It is easy for me to stick to my aims and accomplish my goals.
4. I am confident that I could deal efficiently with unexpected events.
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.
6. I can solve most problems if I invest the necessary effort.
7. I can remain calm when facing difficulties because I can rely on my coping abilities.
8. When I am confronted with a problem, I can usually find several solutions.
9. If I am in trouble, I can usually think of a solution.
10. I can usually handle whatever comes my way.

Appendix G

Sudoku specific Self-efficacy Scale (created based on the instructions of Schwarzer and Fuchs (1996)).

1. I am certain that I can solve these puzzles even if there are very difficult.
2. I am certain that I can solve these puzzles even if I fail at first.
3. I am certain that I can solve these puzzles even it takes me a long time.
4. I am certain that I can become quicker in solving these puzzles.
5. I am certain that I can solve the puzzles even if they are somewhat difficult.

Appendix H

Sudoku Task Familiarity (Experience) Scale

1. How often do you play Sudoku?
2. How often do you do crosswords?
3. How often do you do Latin squares?