EXAMINING CHANGE IN SELF-ASSESSMENTS OF DECISION MAKING UNDER STRESS IN A FLIGHT OPERATIONS CENTER SIMULATOR

by

Jessi Pope

A Thesis Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Arts in Psychology

Middle Tennessee State University
August 2018

Thesis Committee:

Dr. Michael Hein, Ph.D., Chair

Dr. Glenn Littlepage, Ph.D., Committee Member

ACKNOWLEDGEMENTS

I would like to thank those who were instrumental in the completion of my thesis. I would like to thank my parents for graciously allowing me the opportunity to pursue a graduate degree. Their support through these two years has been second to none, and I will be forever grateful for their love and wisdom. I would like to thank my committee chair, Dr. Hein. Thank you for your guidance and insight throughout this process. It’s been an absolute pleasure working with you. I would like to thank Dr. Glenn Littlepage, who served as my committee member. Your critical eye and encouraging spirit were so appreciated. I’d like to thank my peers who have walked through these past two years with me. I will cherish the time I’ve spent with you all; each of you holds a special place with me and I cannot wait for our first reunion. Finally, I thank my Lord and Savior, Jesus Christ, for answering my prayer and growing my faith in Him during graduate school more than ever before. These past two years with You have changed my life.

ABSTRACT

This study investigated the prediction of change in perceptions of decision making under stress (DMUS) using measures of personal fear of invalidity, stress, an initial assessment of decision making under stress, and a performance feedback metric. Subjects in this study were participants in a flight operations center simulator, where a team of individuals works together to operate a virtual airline while handling various routine and non-routine issues. An assessment of change in DMUS indicated participants in the simulator training reported increased perceptions of their ability to make decisions under stress after experiencing three flight operations simulations. A test of the model predicting DMUS indicated the only significant predictor of this variable was the initial (pre) assessment of DMUS. Future research should explore other performance-related and individual difference variables that may predict decision making under stress, a skill that is critically important to high-stress and high-pressure work environments.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION & LITERATURE REVIEW

When describing decision making in naturalistic work environments, Orasanu and Connolly note that ill-defined problems, ambiguous environmental circumstances, time pressure, high-risk situations, and obscure or conflicting goals are some defining characteristics (as cited in Cannon-Bowers & Salas, 1998). A closer look enables a connection between these characteristics and flight operations centers, also known as command and control centers, or operational control centers. These work settings bring together professionals specialized in various aviation disciplines to collectively manage safe and productive airline operations. With the ultimate goal of ensuring patrons arrive at their final destination safely, airlines must balance this goal with competing goals of productivity and efficiency (Ball et al., 2010). Managing this balance often involves pressure: pressure to release flights on time, pressure to ensure flights operate in accordance with federal aviation regulations, pressure to solve unexpected problems in a timely manner, and pressure to make the most efficient yet safe decisions. Given that error in this industry can have harmful and even fatal results (Cannon-Bowers, Salas, & Converse, 1993), being able to make decisions under stress is a relevant and warranted ability for individuals in this environment.

The goal of the current study is to examine potential factors that influence individuals' perceptions of their ability to make decisions under stress. Students in a high-fidelity flight operations center simulator made judgements of their ability to make decisions under stress both prior to and after experiencing three simulations. They received feedback on their teams' performance after each simulation. Self-reported levels of stress, personal fear of invalidity, and performance feedback were analyzed for their ability to predict change in perceptions of decision making under stress across the semester. The results of this study can provide insight into what factors can either promote or obstruct the development of efficacy in a skill thought to be critical for positions in the aviation industry. Furthermore, this study has implications for how simulation training impacts individuals' perceived levels of efficacy in terms of their ability to make effective decisions in stressful work environments.

To follow is a discussion of research and theory related to the variables of interest for this study, which provides the necessary background information to support the proposed hypotheses. Then, the flight operations center simulator is described, along with the method and analyses used to test the hypotheses and research questions. Finally, the results of the analyses are reported, followed by a discussion of the findings, limitations of the study, and areas for future research.

Stress and Decision Making

Rational-actor decision making models describe the decision-maker as a rational, intelligent being that will weigh the value of each available alternative to arrive at a decision that maximizes the probability of success. This approach to decision making is often noted as ill-suited for natural settings where the ability to systematically evaluate possible alternatives is not possible, and where high cognitive loads, limited cognitive capacities, and pressing environmental circumstances prevent the use of normative techniques (Cannon-Bowers, Salas, & Pruitt, 1996; Janis, 1989; Klein, 2008; March, 1988). Indeed, research has suggested that traditional decision-making strategies become less adaptive under high stress (Payne, Bettman, & Johnson, 1986), which has direct implications for high-stress work environments. For example, in a naval command and control task, participants using a typically maladaptive approach to decision making (i.e., according to normative decision strategies) made less misidentifications of naval ships than those using an adaptive approach (Johnston, Driskell, & Salas, 1997). Contrary to expectations of normative models, nonsystematic scanning, narrow attentional breadths, and a faster, overly-simplistic approach improved performance in a familiar task that included high stress, ambiguity, and high cost of failure. However, most research has demonstrated negative effects of stress on decision making; for example, one study that analyzed the complexity of conversations between foreign policy leaders while making decisions in wartime found that one Navy Chief-of-Staff displayed significant simplification in terms of the number of characteristics and dimensions considered when making decisions compared to two other foreign policy leaders (Levi & Tetlock, 1980). If a decision requires consideration of multiple pieces of information, failing to acknowledge all relevant parts could be detrimental to the outcome (Keinan, 1987).

While stress has been shown to impact decision processes, it may not function the same across individuals. Edwards, Franco-Watkins, Cullen, Howell, and Acuff (2014) discovered that only after implementing a strong stress manipulation did individual differences in reactions to stress become less impactful. In this scenario, individual differences in response to stress were less able to impact performance due to the strength of the stressor. This implies that under low to medium stress levels, individuals vary in their response to stress. This idea is supported by research studies that have examined the relationship between individual differences and stress (e.g., Brace & Hein, 2011; Byrne, Silasi-Mansat, & Worthy, 2015; Phillips, Fletcher, Marks, & Hine, 2015; Svensson, Lindoff, & Sutton, 2008). Therefore, in order to understand decision making in stressful environments, acknowledging individuals' differential capacities to handle stress will be important.

Self-Efficacy and Performance

According to Albert Bandura, "an efficacy expectation is the conviction that one can successfully execute the behaviors required to produce the outcome" (1997). Self-efficacy applied in this context may be described as the internal belief that one can make effective decisions under stress. This internal belief is thought to influence both cognitive appraisals of the self and external behaviors in terms of performance and effort when faced with stress (Bandura, 1977). In his theory of behavioral change, Bandura explains four sources of information that influence efficacy expectations: performance accomplishments, vicarious experience, verbal persuasion, and physiological state (1977). Evaluated in the context of a flight operations center simulator, three of these sources are thought to provide insight into the prediction of individuals' perceptions of their ability to make decisions under stress: performance accomplishments, vicarious experience, and physiological state.

First, personal success or failure is thought to have a direct influence on the development of self-efficacy. Successful performance is likely to increase mastery expectations, while failures are likely to decrease them. The timing and collective pattern of successes and failures, however, will determine the final impact of performance on efficacy beliefs. Intermittent failure is not expected to overthrow efficacy beliefs if the general pattern of behavior experienced is success, though failure in the beginning of the development of efficacy may be particularly harmful. The relationship between self-efficacy and performance is well established (e.g., Stajkovic & Luthans, 1998), and research has shown that performance feedback (Daniels & Larson, 2001) and training (Davis, Fedor, Parsons, & Herold, 2000; Earley, 1994) can have a direct effect on efficacy beliefs.

A second influence on efficacy beliefs, though thought to be less powerful than personal experience, is the effect of others' experiences. While this source of information is primarily relevant in a clinical context where modeling of another person's behavior can help one overcome a fear, this acknowledges the role of social influences on individuals' efficacy beliefs. Indeed, researchers have found that team-level constructs can influence individual level outcomes (e.g., Han & Williams, 2008), and particularly relevant here is a study that measured efficacy beliefs at both the individual and team level (Chen, Thomas, & Wallace, 2005). The researchers found that efficacy beliefs for performing a simulated flight task were similar across individuals and teams. These findings are highly relevant for work teams that must collaborate to achieve goals.

Finally, the third source of information thought to offer insight for the development of efficacy beliefs is emotional arousal (i.e., physiological state). As mentioned previously, high-stress situations may elicit high levels of emotional arousal that can be detrimental to performance. Bandura notes, "individuals are more likely to expect success when they are not beset by aversive arousal than if they are tense and viscerally agitated" (1977, p. 198). In high-stress work environments, this could elicit different efficacy beliefs for individuals uniquely susceptible to this kind of arousal compared to those who experience less emotional stimulation.

Efficacy-Performance Spirals

Evaluation of change implies the assumption that over time, something might happen to inflict such change. When considering change in efficacy beliefs across time, it will be important to recognize those factors that may impart change. Lindsley, Brass, and Thomas (1995) recognize various factors that can contribute to the complex pattern of relationships between efficacy and performance in their discussion of efficacy-performance spirals. These authors propose that deviation in one variable, such as self-efficacy, can result in a similar deviation in another variable, such as performance. When this cycle continues, it is known as a deviation-amplifying loop (Masuch, 1985). Downward or upward efficacy-performance spirals then, are a result of similar patterns in these variables that amplify over time. Alternatively, a self-correcting cycle refers to a pattern whereby deviation in one variable does not match the other, or "when a decrease in performance and self-efficacy is followed by an increase in performance or self-efficacy (or vice versa)" (Lindsley et al., 2005, p. 650).

While Lindsley and colleagues observe that this relationship has been studied primarily at the individual level, they believe it can also function at group and organization levels. They define collective efficacy as "the group's (or organization's) collective belief that it can successfully perform a specific task," which may increase or decrease depending on various factors, including task performance (1995, p. 648). The authors note that cognitive appraisal of positive or negative outcomes can confirm behavioral expectations, and affect future performance. This relationship is especially relevant for the study of group behavior in the context of task simulations, where performance during one simulation may affect the group's belief that they can successfully perform during the next simulation (i.e., collective efficacy), affecting future performance.

Lindsley et al. are careful to recognize the complexity of these cycles as they discuss multiple influences on the course and pattern of efficacy-performance spirals. When evaluated in tandem with Bandura's behavior change theory, these two theories offer valuable insight for the formulation of hypotheses for predicting decision making efficacy beliefs over time.

Link Between Behavior Change Theory and Efficacy-Performance Spirals

Just as Bandura (1997) noted that task experience, vicarious experience, and emotional arousal can influence efficacy expectations, Lindsley et al. (1995) describe how these factors affect efficacy-performance spirals. They suggested that after performing the task, the reception of detailed feedback on performance will determine the direction and/or occurrence of subsequent performance spirals. Feedback then, serves to determine efficacy-performance spirals similar to the way success or failure can determine efficacy expectations. Both feedback and task performance have been demonstrated to be related to self-efficacy beliefs (Davis et al., 2000; Early, 1994; Shea & Howell, 2000).

Another link involves emotional arousal. Based on Bandura's theory, Lindsley and colleagues suggest that spirals will be more likely to occur when arousal exceeds typical levels. They propose decreased sensitivity to feedback, failure to process complex information, and failure to adapt strategies for performance as a result of emotional arousal will induce downward efficacy-performance spirals. Underlying stress or worry are self-preoccupying thoughts which remove an individual's focus on the task at hand and onto task-irrelevant items such as self-doubt, fear of failure, and concern for peer judgment. Such thoughts serve to interfere with the mental processes and behaviors required to successfully perform a task (Sarason, 1982; Sarason, Sarason, Keefe, Hayes, & Shearin, 1986). Based on these theories and past research on the effects of stress, we prose the following hypothesis:

Hypothesis 1: Higher reported levels of stress during the simulations will predict lower self-perceptions of the ability to make decisions under stress.

Finally, Lindsley and colleagues make a connection between Bandura's notion of vicarious experience and efficacy-performance spirals by acknowledging that collective efficacy is developed from group-level evaluation. The behavior of the group is observed, and subsequently influences efficacy beliefs. It may be thought that individual efficacy beliefs are likely to be influenced by the group's overall efficacy expectations. This idea has implications for how team-level constructs can manipulate individual level constructs. Chen et al. found evidence for the relationship between team- and individual-level processes when they found individual and team empowerment were positively related (2007). Further, individual empowerment served to increase individual performance, subsequently enhancing team performance. Evidence of the cross-fertilization of influences among individuals and teams is relevant for this study since we evaluate perceptions of individuals that are nested within teams. More specifically, team performance feedback may be expected to influence individual level constructs; therefore, a multilevel modeling approach is explored to handle the nested data.

Distal Hypothesis and Research Question

A construct that may be thought to contrast the belief that one can make effective decisions under stress is personal fear of invalidity (PFI). PFI is the concern for making a mistake in the face of a decision (Thompson, Naccarato, Parker, & Moskowitz, 2001). Thompson et al. comment that individuals high in PFI may ruminate on which course of action to take and be less inclined to quickly arrive at a solution (2001). In this case, their decision performance on naturalistic tasks that require quick responses under ambiguous circumstances may suffer. In line with this, Brace discovered that individuals who rated themselves as high in PFI also reported less effective decision-making behaviors (2011). A potentially harmful consequence of this characteristic is the attitude of ambivalence (i.e., indecision when faced with competing options; Thompson & Zanna, 1995). Thus, individuals with a greater concern for committing an error may not be equipped to handle decision situations with intense time pressure, dynamic environments, and ill-defined problems.

Hypothesis 2: Individuals high in personal fear of invalidity will predict lower self-perceptions of the ability to make decisions under stress.

Our research question involves the influence of the variables in the developed model. The current study utilized self-perception ratings and performance feedback ratings gathered across a three-month period. The individuals within the flight dispatch teams worked together in three flight operations center simulations. In the context of this study, it is likely that team performance fluctuated from one simulation to another. Similarly, individuals may feel their stress levels are elevated during the first simulation compared to the second or third simulations. However, since the number and difficulty of problems that the students in the simulations must solve increase from the first simulation to the third, stress levels may increase in a sequential fashion. Considering the potential fluctuations in these variables across the semester, the influence of stress, performance feedback, and personal fear of invalidity on change in decision making perceptions across the semester cannot be foreseen. See Figure 1 below for a model predicting change in decision making under stress. A pre-test assessment of decision making under stress is included as a predictor to account for change in this construct.

Research Question 1: How will various levels of each predictor influence change in self-perceptions of the ability to make decisions under stress?

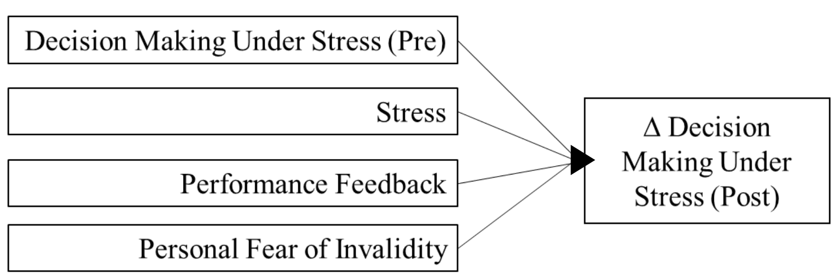

Figure 1. Research Question 1. Hypothesized model for predicting change in decision making under stress.

CHAPTER II

METHOD

Participants

The participants of this study consisted of individuals participating in an aerospace capstone lab course. Undergraduate seniors enrolled in this course participate in three flight operations center simulations across the semester, where they work together in teams to operate a virtual airline. The lab has developed an ongoing research project intended to explore various individual and team-related attitudes, actions, and experiences that result from participation in the simulations. At the start of each semester, students are provided with an online informed consent document that details the purpose of the research and asks for their participation in multiple data collection sessions. It is during the post-training and post-simulation questionnaires that the measures detailed below are administered to students. The following analyses used data collected from a total of 117 students that participated in the capstone lab during the Spring and Fall of 2017. These students comprised 12 teams; there were nine teams with 10 individuals and three teams with nine individuals.

Experimental Setting

Aerospace Capstone Lab. Participants in the capstone lab are senior undergraduate aerospace students. At the beginning of the semester, all students complete onboarding and are introduced to “Universal E-lines” at the same time. Universal E-lines is the mock-employer for these students for the entire semester, designed by lab administrators to increase the fidelity of the airline simulation. After onboarding, the students are separated into teams consisting of approximately 10 students each. Team assignment is guided by students' aviation concentration in order for each unit to have a diverse and balanced skill-set. The concentrations include: aviation management, dispatch, maintenance management, professional pilot, technology, and unmanned aircraft operations.

Students within each team are designated to one of ten positions and are tasked with specific responsibilities and duties linked to the collective operation of the airline. Team size, however, can vary depending on the number of students enrolled in the capstone lab. The ten positions include: flight operations coordinator, weather specialist, flight operations data 1 (i.e., scheduling), flight operations data 2 (i.e., weight and balance), crew scheduling specialist, hub coordinator, maintenance specialist, ramp tower, and CRJ pilot 1 and 2 (See Figures 2 and 3). Position assignment remains stable across simulations, with the exception of pilots operating the CRJ-200 flight simulator. For some teams, each pilot acts as the Hub Coordinator for their team during one simulation.

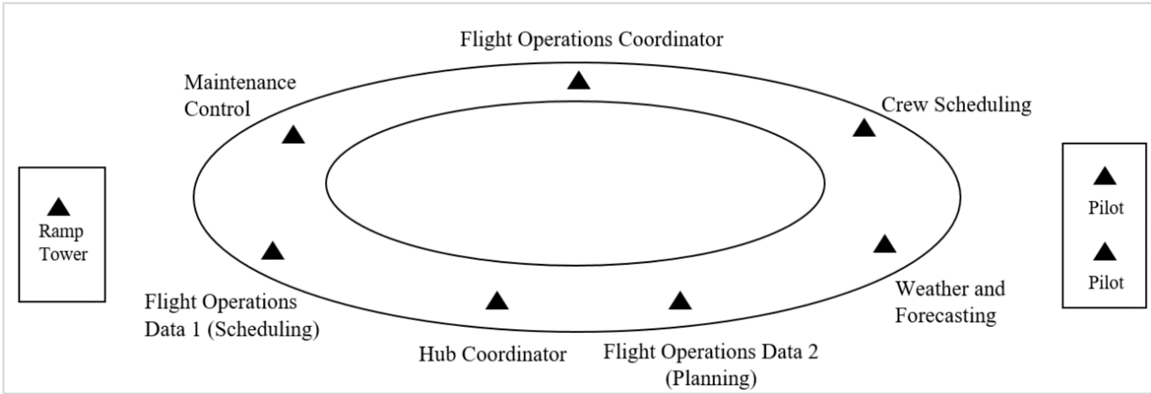

Figure 2. Simulation Lab Layout. Graphic of the capstone lab layout including the location of the ten positions. The positions in boxes work in separate locations for fidelity purposes.

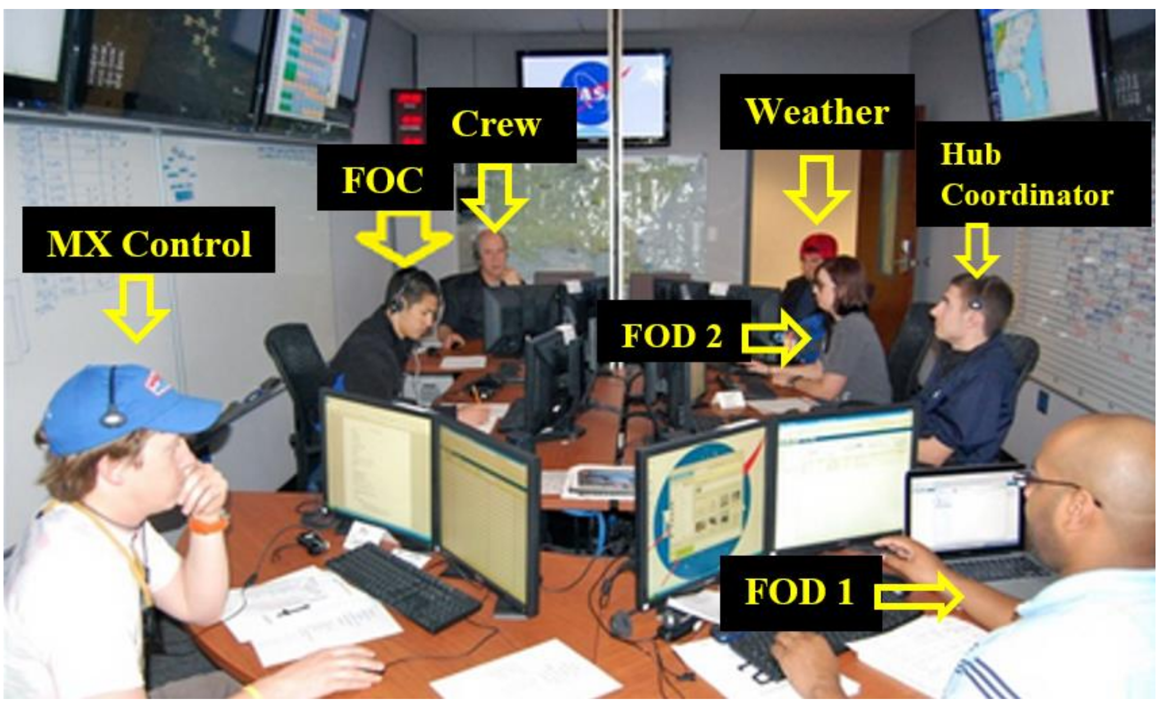

Figure 3. Capstone Lab Graphic. This figure displays seven of the positions in the capstone lab. Ramp tower and the pilots are not pictured. Ramp tower is located in a

room adjacent to the lab, while the pilots are located in a separate building at the location of the flight simulator.

Flight Operations Center Simulator. During each three-hour simulation, students in their unique positions work together to dispatch flights for the airline safely and effectively. This requires frequent communication between the positions to ensure each factor that influences a flight is accounted for and complies with Federal Aviation Administration regulations (e.g., proper fuel load, adequate weather conditions, maintenance issues fixed). Throughout this process, the students are required to make both routine and non-routine decisions that affect 1) individual performance as rated by a trained evaluator and subject matter expert and 2) team performance as rated by a group of trained evaluators and indicated through various financial performance metrics. The tasks that remain constant throughout each simulation, requiring little problem solving as a result of their familiarity, are thought of as routine decisions. In contrast, each team is also presented with “triggers”, or unexpected, non-routine situations or problems that must be handled to return to normal operations and ensure safety. Some examples of triggers include on- and off-flight emergencies such as a passenger peanut allergy reaction, plane equipment malfunctions, and airport security issues. Since new triggers are presented during each simulation, they often require creative solutions and necessitate communication, teamwork, and adaptability. While the triggers are new to the teams, they are standardized so that each team experiences the same difficulty level during each simulation.

A week after each simulation, teams participate in an after action review where they are debriefed on their performance in the previous simulation. Positive and negative outcomes of their performance are discussed, and the team identifies specific behaviors that can be attributed to the outcomes. Goals are formed through action plans that are designed to help the team improve their performance in the upcoming simulation.

The Product of Stress. Due to the gravity of the consequences if standard operating procedures are not followed, the uncertainty of tasks, time pressure, and complexity of the operations, working in airline operations proves to be a stressful work environment. Safety is the number one priority for airlines, leaving great responsibility on the individuals who can impact passengers' and crew members' safety on a daily basis. Recognizing the impact of stressors (e.g., emergency situations, heavy workload) on human performance, aviation training devotes time to education on the harmful effects of stress and provides techniques to avoid human error as a result of such stress (e.g., Crew Resource Management; Helmreich, Merritt, Wilhelm, 1999).

Since high-risk situations, intense workloads, and time pressure are a reality of this industry, the capstone lab strives to obtain a high level of fidelity each year to facilitate a real-world experience for the students. As a result, the researchers in the lab are privy to the impact of these stressors on the students. While no formal stress metric has been used in the past, it is hypothesized that the students will indicate feelings of stress during the simulation. This idea is based on personal anecdotes from students in the after-action review meetings, observations of the students' interactions with one another during the simulations, and the constant call for more training in the end-of-year lab evaluation survey. This finding will contribute to the ability to examine decision making in a natural context under stressful conditions.

Data Collection Sequence. This study will utilize archival data from three measures distributed to students in the capstone lab and one team-level metric. The Personal Fear of Invalidity scale (PFI) and the Decision Making Under Stress (DMUS) scale (selected items from the Leadership Behavior Description Questionnaire; LBDQ) are administered to students after they have completed the individual training session for their position in the capstone lab, and thus, before the first flight operations simulation. The Decision Making Under Stress scale is administered again after the completion of all three simulations. A four-item stress scale is administered to the students after they have completed the after action review in the week following each simulation; thus, it is given three separate times. All measures are administered to students via Qualtrics survey platform and are taken in a university computer lab. The final metric used in the analyses includes delay loss, which is a team-level financial performance metric that is calculated during each of the three simulations and provided to teams during their after action review following the simulation.

Measures

Personal Fear of Invalidity. Personal fear of invalidity, or the fear of making a mistake in the face of a decision, was assessed using the 14-item Personal Fear of Invalidity scale (Thompson et al., 2001). Thompson et al. found a Chronbach's alpha of .88 on the final version of the scale, with item-total correlations between .44 and .72 (2001). The authors also found the PFI scale to be correlated with distally related constructs including the personal need for structure (*r* = .24), authoritarianism (*r* = .22), depression (*r* = .47), and self-consciousness (*r* = .64; Thompson et al., 2001). The PFI scale has proven to be a reliable measure, with Cronbach's alpha reaching .75 to .84 (Blais, Thompson, & Baranski, 2005; Brace, 2011; Clarkson, Valente, Leone, & Tormala, 2013; Clow & Esses, 2005; Rietzschel, De Dreu, & Nijstad, 2007; Thompson & Zanna, 1995). Response options fell along a 6-point Likert scale (1 = *strongly disagree*, 6 = *strongly agree*). Individuals high in PFI are more ambivalent when making decisions for fear of being wrong (e.g., "I wish I did not worry so much about making errors"), while individuals low in PFI are less ambivalent in their decisions (e.g., "Decisions rarely weigh heavily on my shoulders"). This scale was administered once after students completed training for their position. See Appendix A for the scale items.

Decision Making Under Stress Scale. In a study that sought to examine leadership effectiveness and decision making, a 14-item scale was developed from the Leadership Behavior Description Questionnaire – Form XII, (LBDQ; Stogdill, 1963) to assess decision-making under stress (DMUS; Brace, 2011). The author selected items from the LBDQ that related specifically to decision making. Sample items include, "I anticipate problems and plans for them," and, "I take full charge when emergencies arise." Each item was rated on a 5-point Likert scale (1 = *never*, 5 = *always*). Higher scores correspond to more effective decision making under stress. After removing reverse-scored items, Brace found a Cronbach's alpha of .81 (2011), and item-total correlations ranging from .175 to .568. This scale was administered twice: once after students completed training for their positions (i.e., pre) and once after the completion of all three simulations (i.e., post). See Appendix B for the 14-item DMUS scale.

Measure of Stress. A four-item stress scale was developed by the researchers in the capstone lab to capture perceived stress. The items include “I feel used up at the end of the lab,” “I feel that my workload in the lab interferes with the quality of my work,” “I feel busy or rushed during the lab,” and “I feel pressured during the lab,” (See Appendix C). Participants in the lab indicated their level of agreement with the statements on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*). This scale was administered after the completion of the after-action review that took place the week following each simulation; therefore, there are three administrations of this scale. Since the proposed model intends to predict decision making under stress after the simulations have occurred, the last measurement of stress will be used in the analyses. This measurement of stress is closest in time to the second administration of DMUS.

Performance Feedback. During each after action review, the students received feedback on their teams’ past simulation performance. For financial performance, the team received information on how well they performed in terms of delay loss and penalties accrued. Delay loss represents the revenue loss per minute due to failure to release flights by their scheduled departure time. Penalties consist of fines associated with various airline operations. Examples include fines from the Federal Aviation Administration for releasing a flight into dangerous weather conditions, fines for leaving an airplane stranded, and airline tickets for passengers who have missed a connecting flight. For the purposes of this study, only delay loss will be used in the analysis.

In order to help the team better understand their performance, the team is made aware of the average delay loss and penalties for that particular simulation (i.e., first, second, or third) across previous semesters. With this information, the teams may receive generally positive, negative, or neutral feedback as they learn how well they performed in comparison to other teams. To avoid categorizing feedback as positive, negative, or neutral, z-scores were assigned to team delay loss for each simulation using the average and standard deviation of this metric across previous semesters. Since teams participated in three simulations, this resulted in three standard scores. Higher standard scores represent more positive feedback, while lower standard scores represent more negative feedback. These scores were entered into the regression model as variables. This method allows performance feedback to function as a continuous variable in the model proposed in the research question.

CHAPTER III

RESULTS

Descriptive statistics for stress, personal fear of invalidity, and decision making under stress at both administrations can be found in Table 1. Prior to analyzing the hypotheses and research model, reliability analyses were performed. When reverse scored items were included in the PFI measure, we obtained a Cronbach's alpha of .67. Excluding reverse scored items increased the PFI scale reliability to .80. The previous study that examined PFI and DMUS similarly removed reverse scored items on this scale to improve reliability (Brace, 2011). All subsequent analyses are performed with the PFI measure that excludes reverse scored items.

To analyze both hypotheses, intercorrelations were performed between the measures of stress, personal fear of invalidity, and decision making under stress assessed before (i.e., pre) and after (i.e., post) the simulations occurred. Cronbach's alpha for each scale and intercorrelations between scales can be found in Table 2. Hypothesis 1 was not supported. The relationship between stress and the decision making under stress scale was not significant, $r(85) = -.15$, $p = .17$ at pre ($N = 87$), $r(85) = -.11$, $p = .30$ at post ($N = 87$). Hypothesis 2 was partially supported. Personal fear of invalidity displayed a significant negative relationship with decision making under stress prior to the simulations, $r(85) = -.33$, $p = .001$ ($N = 87$), but this relationship did not hold after the simulations occurred, $r(85) = -.19$, $p = .07$ ($N = 87$). Upon analyzing the data, we created an interaction variable between PFI and stress. We expected individuals with high PFI to be more influenced by a high-stress situation, and for this product to exacerbate feelings of personal fear of invalidity and ultimately influence perceptions of the ability to make decisions under stress. Persons with a high score on this interaction experienced high stress during the last simulation and scored high in PFI. This variable was moderately negatively correlated to decision making under stress prior to the simulations, $r(85) = -.29$, $p < .0001$ ($N = 87$), but did not meet the .05 significance level when correlated with decision making under stress after the simulations, $r(85) = -.21$, $p = .052$ ($N = 87$).

Table 1

Descriptive Statistics for Stress, PFI, and DMUS

				95% Confidence Interval	
Measure	*n*	*M*	*SD*	Lower Bound	Upper Bound
Stress	97	2.92	.88	2.74	3.10
PFI	111	3.53	.74	3.45	3.71
DMUS (pre)	111	3.46	.40	3.38	3.54
DMUS (post)	104	3.58	.41	3.50	3.65

Note. PFI = Personal Fear of Invalidity; DMUS = Decision Making Under Stress.

Table 2

*Summary of Cronbach's Coefficient Alpha and Intercorrelations for Scores on Stress, PFI, DMUS, and PFI*Stress*

Measure (*n* = 87)	α	1	2	3	4	5
1. Stress	.85	-				
2. PFI	.80	.09	-			
3. DMUS (pre)	.76	-.15	-.33*	-		
4. DMUS (post)	.77	-.11	-.19	.60**	-	
5. PFI*Stress	-	.85**	.56**	-.29*	-.21	-

Note. PFI = Personal Fear of Invalidity; DMUS = Decision Making Under Stress. The product of PFI and stress scores for each individual represent PFI*Stress.
*$p < .05$. **$p < .0001$.

Before testing the model predicting change in decision making under stress, a paired samples *t*-test was conducted to examine change in scores on the decision making under stress scale prior to and after completing the flight operations simulations. The results of this analysis indicated there was a significant change in scores, $t(98) = -2.33$, $p = .02$, $d = -.23$ ($N = 99$). See Table 2 for descriptive statistics for each variable. Scores on the decision making under stress scale prior to the simulations were generally lower ($M = 3.46$, $SD = .40$) compared to scores after participating in the simulations ($M = 3.58$, $SD = .41$).

Since individuals in this study are nested in teams, the researchers evaluated the need to examine the research question using multilevel modeling techniques. To determine the level of variance in decision making under stress accounted for at the team level, we computed the intraclass correlation coefficient (ICC) through estimating an unconditional means model in SAS using PROC MIXED. This model assessed between-team variation in decision making under stress (post measure). The covariance parameter estimates for this model are shown in Table 3. The estimate for between-team variation on decision making under stress after the simulations was not significant, $\tau^2 = .009$, $z = .71$, $p = .24$ ($N = 104$). The estimate for within-team variation on decision making under stress after the simulations was significant, $\sigma^2 = .158$, $z = 6.72$, $p < .0001$ ($N = 104$). The estimates for between- and within-team variation generated an ICC of .052. Due to minimal between-team variation on the criterion variable, multilevel modeling analysis techniques were not used to test the proposed model (i.e., research question 1).

Table 3

Covariance Parameter Estimates for the Unconditional Means Model

Parameter	Subject	Estimate	SE	*Z*	Significance
UN (1,1)	Team	.009	.012	.71	.24
Residual	-	.158	.023	6.72	< .0001

Note. UN (1,1) corresponds to the estimated between variance. Residual corresponds to the estimated within variance. *N* = 104.

In lieu of multilevel modeling, regression analyses were performed to predict the proposed model (refer to Figure 1 above). Decision making under stress (post) was regressed on the pre-assessment of decision making under stress (to account for change in this construct) and each predictor to examine the impact of each independent variable. Models 1 and 2 included DMUS (pre) and stress and PFI, respectively. In each of these models, the only significant predictor was the first assessment of DMUS. See Table 4 for the regression analyses results. Model 3 included the first assessment of decision making under stress; this variable significantly predicted change in decision making under stress (post), $\beta = .59$, $t(97) = 7.16$, $p < .0001$. The first assessment of decision making under stress also accounted for a significant portion of variance in the second assessment of decision making under stress scores, $R^{2\ adj} = .34$, $F(1, 97) = 51.30$, $p < .0001$. Influence and fit diagnostics indicated that one observation had a Cook's distance value of .58 that far exceeded other observations. Cook's distance identifies influential observations in predictor variables (Cook, 1977). Closer examination revealed this observation scored high on the pre-assessment of DMUS and scored low on the post-assessment of DMUS. Since DMUS generally increased after the simulations occurred, this observation countered the trend, and thus highly influenced the fit of the regression equation. Model 4 included the first assessment of decision making under stress but this time excluded the observation with high Cook's *D*, β = .67, $t(96) = 8.53$, $p < .0001$. The adjusted R-squared value rose to .43, $F(1, 96) = 72.82$, $p < .0001$. So, while most students in the simulation lab reported improved perceptions of the ability to make decisions under stress, this was not the case for all students. This insight is fertile ground for exploring predictors of both upward and downward trends in decision making under stress after participating in high-fidelity simulation training. Model 5 tested the impact of the performance feedback metrics in the presence of the first assessment of decision making under stress. Feedback did not significantly predict change in decision making under stress (see Table 4 for the results.

Table 4
Regression Analyses Predicting Change in Decision Making Under Stress (post)

Model	Predictor	b	SE	β	*t*	$R^{2\ adj}$
Model 1[a]	Stress	-.01	.04	-.02	-.26	.34**
	DMUS (pre)**	.58	.09	.60	6.74	F = 23.57
Model 2[b]	PFI	.01	.05	.01	.13	.33**
	DMUS (pre)**	.60	.09	.59	6.77	F = 25.40
Model 3[c]	DMUS (pre)**	.59	.08	.59	7.16	.34** F = 51.30
Model 4[d]	DMUS (pre)**	.67	.08	.66	8.53	.43** F = 72.82
Model 5[e]	Performance Feedback					
	S1 Delay Loss	.06	.03	.16	1.9	
	S2 Delay Loss	-.03	.04	-.06	-.64	.35** F = 14.00
	S3 Delay Loss	-.01	.04	-.01	-.14	
	DMUS (pre)**	.60	.08	.60	7.33	

Note. PFI = Personal Fear of Invalidity; DMUS = Decision Making Under Stress; $R^{2\ adj}$ = Adjusted R-squared value; b = unstandardized regression coefficient; β = standardized regression coefficient.
[a]$n = 87$, [b]$n = 99$, [c]$n = 99$, [d]$n = 98$ (removed highly influential observation), [e]$n = 99$.
*$p < .05$. **$p < .0001$.

CHAPTER IV

DISCUSSION

Results from hypothesis 1 indicated that simulation participants' stress as reported in the last after action review did not relate to their perceptions of their ability to make decisions under stress after all simulations had occurred. We hypothesized that students with higher reported stress would indicate lower perceived ability to make decisions under stress; however, the descriptive statistics of the stress measure indicate that on average the students did not report being stressed in the simulation lab during the final assessment. Based on observation and student anecdotes, this result was unexpected. At the time of this data collection, stress was measured a week after the actual simulation occurred, which may be influencing students' perceptions of stress in the simulations.

Results from hypothesis 2 indicate that prior to partaking in flight operations center simulations, individuals high in personal fear of invalidity report lower self-perceptions of the ability to make decisions under stress. This supports past research that discovered the same relationship (Brace, 2011). This suggests that individuals who fear making mistakes in the face of a decision and ruminate on a course of action similarly feel less capable of making effective decisions under high-pressure, high-stress situations. Important to note is that this relationship disappeared after the students participated in all three flight operations simulations. Due to the increase in decision making under stress scores after the simulations, personal fear of invalidity scores no longer displayed a significant negative correlation with decision making under stress.

An encouraging result from examining change in decision making under stress in the context of flight operations center training is that student participants reported increased perceptions of the ability to make decisions under stress after experiencing all three simulations. This indicates that the simulator training resulted in greater efficacy-related beliefs in a skill that is critical to the aviation industry. It is suggested here that simulator training, which exposes students to handling real-world aviation problems, is a viable option for helping students foster greater perceptions of their ability to face these issues and make decisions in the face of high-pressure and high-risk situations, ambiguous circumstances, competing goals, and complex problems.

The results of our proposed research question in the form of a model predicting change in decision making under stress (post) using personal fear of invalidity, stress, decision making under stress (pre), and team performance feedback indicated that the only significant predictor was the first assessment of decision making under stress. Similarly, stress, personal fear of invalidity, and performance feedback failed to account for a significant portion of variance in decision making under stress (post) scores. This suggests that students' initial perceptions of their ability to make decisions under stress provides the best explanation for their perceptions of this outcome after they've experienced flight operations center training.

The use of multilevel modeling for analyzing the research question was unnecessary in this study, since there was minimal between-team variation in decision making under stress. This finding indicates that this variable may be highly individualized and therefore, less susceptible to influence by team level factors such as team performance. This idea corresponds with the finding that the team-level performance feedback variable, delay loss, failed to predict students' perceptions of their ability to make decisions under stress.

Limitations & Future Research

Sample size was a limitation for this study, since only 12 teams (made up of an average of 10 students) were available for analysis. This was a natural limitation due to the nature of the capstone course from which the research was conducted, which has a limit on student enrollment each semester. As each semester passes, sample size will increase and provide a more robust study of this topic. In addition to the initial sample size issue, since the data were collected over the sequence of a semester, attrition was also a limitation. A related limitation of this study is the inclusion of team members in the analyses that held positions which likely experienced minimal decision making under stress. These positions (i.e., pilot and ramp tower) were included to avoid decreasing the sample size. The job duties of these positions are fairly routine and do not involve a significant amount decision making in general. To capture a more robust picture of decision making under stress, future analyses should include only those positions that are subject to making decisions under high-stress, high-risk situations, and under ambiguous or complex circumstances.

Another limitation concerns the methods of data collection. First, the decision making under stress scale consists of 14 items that are adapted from the Leadership Behavior Description Questionnaire (Form XII). While these items were selected specifically because they relate to decision making, some items may not fully capture the concept of making decisions *under stress* (e.g., “I make accurate decisions”). In the future, this scale should be examined more closely in order to understand the underlying factors it is assessing. Second, students were administered the stress scale a week after the simulation had occurred, and the items do not specifically refer to the prior simulation. That is, the questions remain the same throughout the semester, and ask students to report feelings of stress in the simulation in a more general way. Further, none of the four scale items refer explicitly to “stress”, and instead use terms like “used up”, “pressured”, and “rushed”. Future studies in this type of training setting should seek to examine stress during and immediately following each simulation in order to collect a more accurate reading of students’ stress levels. In addition, utilizing an established measure of work stress for future analyses may be useful. Third, all scales used in this study were self-report Likert scales. Therefore, another avenue of exploration is to examine other methods for measuring these variables (where this is logical), such as observer-rated performance for decision making under stress. Finally, delay loss as a measure of performance feedback failed to influence the outcome variable of decision making under stress in this study. As mentioned previously, this could be because decision making under stress is a highly individualized construct that is not easily influenced by team level outcomes. This could also be due to the nature of the items on the DMUS scale since they are not written in the context of the flight operations center and do not explicitly refer to simulation performance. In the future, other performance variables beyond delay loss should be examined for their influence on decision making under stress, such as perceptions of teamwork, observer-rated teamwork, individual task performance, or other metrics of team performance.

Conclusion

In conclusion, this study explored predictors of change in perceptions of decision making under stress in the context of a flight operations center simulator. While personal fear of invalidity was initially negatively related to decision making under stress, the first assessment of decision making under stress was the only variable that predicted the post-assessment measure of decision making under stress. An encouraging finding of this study is that simulation-based training that presents students with scenarios they are likely to encounter in the work setting can increase students' efficacy-related beliefs pertaining to their ability to make decisions under stress, which is a vital skill in the aviation industry. Future studies should examine other possible predictors of decision making under stress, such as various performance-related metrics and other individual differences.

REFERENCES

Ball, M., Barnhart, C., Dresner, M., Hansen, M., Neels, K., Odoni, A., Peterson, E., Sherry, L., Trani, A., & Britto, R. (2010). Total delay impact study. In NEXTOR Research Symposium, Washington DC. Retrieved October 1, 2017 from http://ai2s2pdfs.s3.amazonaws.com/1408/2dee64f3c94a34ea4fdbe63ae7d13893e4d7.pdf.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215.

Blais, A. R., Thompson, M. M., & Baranski, J. V. (2005). Individual differences in decision processing and confidence judgments in comparative judgment tasks: The role of cognitive styles. *Personality and Individual Differences, 38*(7), 1701-1713.

Brace, B. R. (2011). Fear of failure and the effective leader. (Unpublished master's thesis). Middle Tennessee State University, Murfreesboro, TN.

Byrne, K. A., Silasi-Mansat, C. D., & Worthy, D. A. (2015). Who chokes under pressure? The Big Five personality traits and decision-making under pressure. *Personality and Individual Differences, 74*, 22-28.

Cannon-Bowers, J. A., & Salas, E. E. (1998). *Making decisions under stress: Implications for individual and team training*. Washington, DC: American Psychological Association.

Cannon-Bowers, J. A., Salas, E., & Converse, S. (1993). Shared mental models in expert team decision making. In N. J. Castellan, Jr. (Ed.), *Individual and group decision making: Current issues* (pp. 221-246). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cannon-Bowers, J. A., Salas, E., & Pruitt, J. S. (1996). Establishing the boundaries of a paradigm for decision-making research. *Human Factors, 38*(2), 193-205.

Clarkson, J. J., Valente, M. J., Leone, C., & Tormala, Z. L. (2013). Motivated reflection on attitude-inconsistent information: An exploration of the role of fear of invalidity in self-persuasion. *Personality and Social Psychology Bulletin*, *39*(12), 1559-1570.

Clow, K. A., & Esses, V. M. (2005). The development of group stereotypes from descriptions of group members: An individual difference approach. *Group Processes & Intergroup Relations, 8*(4), 429-445.

Chen, G., Kirkman, B. L., Kanfer, R., Allen, D., & Rosen, B. (2007). A multilevel study of leadership, empowerment, and performance in teams. *Journal of Applied Psychology*, *92*(2), 331-346.

Chen, G., Thomas, B., & Wallace, J. C. (2005). A multilevel examination of the relationships among training outcomes, mediating regulatory processes, and adaptive performance. *Journal of Applied Psychology*, *90*(5), 827-841.

Cook, R. D. (1977). Detection of influential observation in linear regression. *Technometrics, 19*(1), 15-18.

Daniels, J. A., & Larson, L. M. (2001). The impact of performance feedback on counseling self-efficacy and counselor anxiety. *Counselor Education and Supervision, 41*(2), 120-130.

Davis, W. D., Fedor, D. B., Parsons, C. K., & Herold, D. M. (2000). The development of self-efficacy during aviation training. *Journal of Organizational Behavior, 21*, 857-871.

Earley, P. C. (1994). Self or group? Cultural effects of training on self-efficacy and performance. *Administrative Science Quarterly, 39*, 89-117.

Edwards, B. D., Franco-Watkins, A. M., Cullen, K. L., Howell, J. W., & Acuff Jr, R. E. (2014). Unifying the challenge-hindrance and sociocognitive models of stress. *International Journal of Stress Management, 21*(2), 162-185.

Han, T. Y., & Williams, K. J. (2008). Multilevel investigation of adaptive performance: Individual- and team-level relationships. *Group & Organization Management, 33*(6), 657-684.

Helmreich, R. L., Merritt, A. C., & Wilhelm, J. A. (1999). The evolution of crew resource management training in commercial aviation. *The International Journal of Aviation Psychology, 9*(1), 19-32.

Janis, I. L. (1989). *Crucial decisions: Leadership in policymaking and crisis management.* New York, NY: The Free Press.

Johnston, J. H., Driskell, J. E., & Salas, E. (1997). Vigilant and hypervigilant decision making. *Journal of Applied Psychology*, *82*(4), 614-622.

Keinan, G. (1987). Decision making under stress: Scanning of alternatives under controllable and uncontrollable threats. *Journal of Personality and Social Psychology*, *52*(3), 639-644.

Klein, G. (2008). Naturalistic decision making. *Human factors, 50*(3), 456-460.

Levi, A., & Tetlock, P. E. (1980). A cognitive analysis of Japan's 1941 decision for war. *Journal of Conflict Resolution, 24*(2), 195-211.

Lindsley, D. H., Brass, D. J., & Thomas, J. B. (1995). Efficacy-performance spirals: A multilevel perspective. *Academy of Management Review*, *20*(3), 645-678.

March, J. G. (1988). Bounded rationality, ambiguity, and the engineering of choice. In D. Bell, H. Raiffa, & A. Tversky (Eds.), Descriptive, normative, and prescriptive interactions in decision making (pp.33-57). Cambridge, Great Britain: Cambridge University Press.

Masuch, M. (1985). Vicious circles in organizations. *Administrative Science Quarterly*, *30*, 14-33.

Payne, J. W., Bettman, J. R., & Johnson, E. J. (1988). Adaptive strategy selection in decision making. Duke University, Durham, NC. Office of Naval Research – Technical Report.

Phillips, W. J., Fletcher, J. M., Marks, A. D., & Hine, D. W. (2016). Thinking styles and decision making: A meta-analysis. *Psychological Bulletin, 142*(3), 260-290.

Rietzschel, E. F., De Dreu, C. K., & Nijstad, B. A. (2007). Personal need for structure and creative performance: The moderating influence of fear of invalidity. *Personality and Social Psychology Bulletin, 33*(6), 855-866.

Sarason, I. G. (1984). Stress, anxiety, and cognitive interference: Reactions to tests. *Journal of personality and social psychology, 46*(4), 929.

Sarason, I. G., Sarason, B. R., Keefe, D. E., Hayes, B. E., & Shearin, E. N. (1986). Cognitive interference: Situational determinants and trait like characteristics. *Journal of Personality and Social Psychology, 51*(1), 215-226.

Shea, C. M., & Howell, J. M. (2000). Efficacy-performance spirals: An empirical test. *Journal of Management, 26*(4), 791-812.

Stajkovic, A. D., & Luthans, F. (1998). Self-efficacy and work-related performance: A meta-analysis. *Psychological Bulletin, 124*(2), 240-261.

Stogdill, R. M. (1963). *Manual for the Leader Behavior Description Questionnaire-Form XII.* Columbus, Ohio: Ohio State University.

Svensson, E., Lindoff, J., & Sutton, J. (2008). Predictive modeling of personality traits – Implications for selection of operational personnel. *NATO HFM Symposium on Adaptability in Team Coalitions, Copenhagen, Denmark.* Retrieved from http://www.dtic.mil/get-tr-doc/pdf?AD=ADA577606#page=139

Thompson, M. M., Naccarato, M. E., Parker, K. C. H., & Moskowitz, G. B. (2001). The personal need for structure and personal fear of invalidity measures: Historical perspectives, current applications, and future directions. In G. B. Moskowitz (Ed.), *Cognitive social psychology: The Princeton Symposium on the Legacy and Future of Social Cognition* (pp. 19-39). Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Thompson, M. M., & Zanna, M. P. (1995). The Conflicted Individual: Personality-based and domain specific antecedents of ambivalent social attitudes. *Journal of Personality, 63*(2), 259-288.

APPENDICES

Appendix A

Personal Fear of Invalidity Scale (PFI)

1. *I may struggle with a few decisions but not very often.
2. *I never put off making decisions.
3. Sometimes I become impatient over my indecisiveness.
4. Sometimes I see so many options to a situation that it is really confusing.
5. I can be reluctant to commit myself to something because of the possibility that I might be wrong.
6. I tend to struggle with most decisions.
7. Even after making an important decision I continue to think about the pros and cons to make sure that I am not wrong.
8. *Regardless of whether others see an event as positive or negative I don't mind committing myself to it.
9. I prefer situations where I do not have to decide immediately.
10. *I rarely doubt that the course of action I have selected will be correct.
11. I tend to continue to evaluate recently made decisions.
12. I wish I did not worry so much about making errors.
13. *Decisions rarely weigh heavily on my shoulders.
14. I find myself reluctant to commit to new ideas but find little comfort in remaining with the tried and true.

Note. * = reverse scored.

Response options:
1 = Strongly disagree
2 = Disagree
3 = Somewhat disagree
4 = Somewhat agree
5 = Agree
6 = Strongly agree

Appendix B

Decision-Making Under Stress Scale

Selected items from LBDQ** Form XII

---

1. *6) I am hesitant about taking initiative in the group
2. 9) I make accurate decisions
3. 12) I become anxious when I cannot find out what is coming next
4. 29) I am able to predict what is coming next
5. 44) I decide what shall be done and how it shall be done
6. 59) I am accurate in predicting the trend of events
7. *61) I get swamped by details
8. 72) I remain calm when uncertain about coming events
9. 76) I take full charge when emergencies arise
10. 78) I drive hard when there is a job to be done
11. 81) I can reduce a madhouse to system and order
12. 89) I anticipate problems and plans for them
13. *91) I get confused when too many demands are made of me
14. *92) I worry about the outcome of any new procedure

Note. * = reverse scored; ** = Leadership Behavior Description Questionnaire. The first number corresponds to the order the item appears in the measure. The second number corresponds to the original item number in the LBDQ-XII.

Response options:
1 = Never
2 = Seldom
3 = Occasionally
4 = Often
5 = Always

Appendix C

Stress Scale

1. I feel used up at the end of the focus lab.
2. I feel that my workload in the lab interferes with the quality of my work.
3. I feel busy or rushed during the lab.
4. I feel pressured during the lab.

Response options:
1 = Strongly disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree

Appendix D

IRB Approval Letter

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129

MIDDLE TENNESSEE STATE UNIVERSITY

IRBN007 – EXEMPTION DETERMINATION NOTICE

Monday, February 05, 2018

Investigator(s): Jessi Pope; Michael Hein
Investigator(s') Email(s): jlp2ba@mtmail.mtsu.edu; michael.hein@mtsu.edu
Department: Psychology

Study Title: Examining Change in Self-Assessments of Decision Making Under Stress in a Flight Operations Center Simulation
Protocol ID: 18-1161

Dear Investigator(s),

The above identified research proposal has been reviewed by the MTSU Institutional Review Board (IRB) through the **EXEMPT** review mechanism under 45 CFR 46.101(b)(2) within the research category *(4) Study involving existing data* A summary of the IRB action and other particulars in regard to this protocol application is tabulated as shown below:

IRB Action	EXEMPT from furhter IRB review***	
Date of expiration	NOT APPLICABLE	
Participant Size	Existing Data	
Participant Pool	**De-identified exisiting data from ID# 17-2008**	
Mandatory Restrictions	Only de-identified data from approved protocol 17-2008 my be accessed/analyzed	
Additional Restrictions	None at this time	
Comments	None at this time	
Amendments	**Date**	**Post-Approval Amendments**
		None at this time

***This exemption determination only allows above defined protocol from further IRB review such as continuing review. However, the following post-approval requirements still apply:

- Addition/removal of subject population should not be implemented without IRB approval
- Change in investigators must be notified and approved
- Modifications to procedures must be clearly articulated in an addendum request and the proposed changes must not be incorporated without an approval
- Be advised that the proposed change must comply within the requirements for exemption
- Changes to the research location must be approved – appropriate permission letter(s) from external institutions must accompany the addendum request form
- Changes to funding source must be notified via email (irb_submissions@mtsu.edu)
- The exemption does not expire as long as the protocol is in good standing

IRBN007 Version 1.2 Revision Date 03.08.2016

- Project completion must be reported via email (irb_submissions@mtsu.edu)
- Research-related injuries to the participants and other events must be reported within 48 hours of such events to compliance@mtsu.edu

The current MTSU IRB policies allow the investigators to make the following types of changes to this protocol without the need to report to the Office of Compliance, as long as the proposed changes do not result in the cancellation of the protocols eligibility for exemption:

- Editorial and minor administrative revisions to the consent form or other study documents
- Increasing/decreasing the participant size

The investigator(s) indicated in this notification should read and abide by all applicable post-approval conditions imposed with this approval. Refer to the post-approval guidelines posted in the MTSU IRB's website. Any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918 within 48 hours of the incident.

All of the research-related records, which include signed consent forms, current & past investigator information, training certificates, survey instruments and other documents related to the study, must be retained by the PI or the faculty advisor (if the PI is a student) at the sacure location mentioned in the protocol application. The data storage must be maintained for at least three (3) years after study completion. Subsequently, the researcher may destroy the data in a manner that maintains confidentiality and anonymity. IRB reserves the right to modify, change or cancel the terms of this letter without prior notice. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

Quick Links:
Click here for a detailed list of the post-approval responsibilities.
More information on exmpt procedures can be found here.