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A Continuation of Research: Student Decision Making Under Stress in a Flight Control Center Simulation

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A CONTINUATION OF RESEARCH: STUDENT DECISION MAKING UNDER STRESS IN A FLIGHT CONTROL CENTER SIMULATION

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Students enrolled in a capstone aerospace class participated in this study. The class involves the completion of simulations in a high-fidelity replication of an airline flight operations center called the FOCUS ((Flight Operations Center-Unified Simulation) lab. This lab also functions as a research center exploring individual and team-related attitudes, activities, and experiences. The current study builds upon previous research that suggested participation in the simulation lab resulted in improved self-efficacy towards making decisions under stress (DMUS). Additionally, data suggests that before the simulations, students' perceived fear of making the wrong decision (PFI) correlated with their perceived ability to make decisions under stress (Pope, 2018). Results of the current study showed that after completion of a full simulation in the lab, students reported a non-significant decrease in their personal fear of invalidity and a significant increase in their perceived ability to make decisions under stress.

Safety is an ever-present concern within the aviation industry. As some safety factors stem from the decision-making abilities of airline employees, this study seeks to further understand how stress can impact decision-making. The current study builds upon previous research that suggests students experienced increased confidence in their decision-making ability under stress as a result of participating in a high-fidelity simulation of a flight operations center (Pope, 2018). The relationships between the ability to make decisions under stress, perceived fear of invalidity, and stress are further investigated.

Stress has been defined in many differing ways: a stimulus, a reaction, or a hypothetical state (Sarason, 1984). However, researchers do agree on the effects of stress on an individual's cognitive states – leading to anxiety, poor decision-making strategies, cognitive interference, and decreased performance (Sarason, 1984; Johnston, Driskell, & Salas, 1997). Antecedents of stress include operating under time constraints, ambiguity (of problems encountered, environment, & goals), and high-risk situations (Cannon-Bowers & Salas, 1998**).** Within the context of this study, the primary stressors for participants include the pressure to dispatch flights on time, adhere to FAA regulations, balance productivity and efficiency, and solve unexpected problems in a safe and efficient manner.

Stress has been shown to influence an individual's ability to make decisions (Payne, Bettman & Johnson, 1988). Johnston & colleagues (1997) suggested that stress can increase the likelihood of maladaptive solutions in decision-making, such as employing the use of potentially inaccurate heuristics. Research suggests that people are sensitive to environmental changes (Payne, et al., 1988). This means that when a factor – such a stress – changes, an individual's adaptive strategies likewise change (Payne, et al., 1988). For example, if an individual's time constraints decrease or constraints increase, they may process information beginning with the most pertinent details and weigh this information more heavily to decrease decision time. These

stressful situations can tempt the decision maker to oversimplify the situation they're assessing and they may fail to fully consider all contributing factors (Levi & Tetlock, 1980). Both maladaptive decision-making strategies and oversimplification can be detrimental to the outcome of the decision (Keinan, 1987). The present study builds on the work of Pope (2018), who found no relationship between stress and perceived ability to make decisions under stress. It is thought, however, that these results were due to research design constraints.

Personal fear of invalidity may be understood as a heightened "concern for making a mistake in the face of making a decision" (Pope, 2018; Thompson, Naccarato, Parker, & Moskowitz, 2001). Individuals high in personal fear of invalidity may take more time to ruminate before making a decision, which may be detrimental to performance related to tasks that require quick decision-making (Thompson, et al., 2001). Previous research suggests that after simulation-based training during which students solve real-life operations center problems fosters perceptions of an increased ability to make decisions that are high-risk and high-quality under stress (Pope, 2018). The same study also found support for a negative relationship between personal fear of invalidity and perceptions of decision-making ability under stress.

Methods

Participants

The participants of this study are 83 undergraduate senior aerospace students enrolled in a capstone aerospace class. This class involves completion of simulations within a high-fidelity simulation of a flight operations center and receive experience working together to run a simulated airline. Students are placed into one of nine different positions within the lab. The lab serves a secondary function as a research center exploring individual and team-related attitudes, activities, and experiences. After each simulation, the students attend an After-Action Review (AAR) where a facilitator and scribe discuss the student team's performance data with the students and facilitate discussion centered around behaviors to improve performance in the next simulation. Levels of participation fluctuated throughout the semester due to the attendance of students and general participation attrition. Previously collected data from 39 students who completed the lab in Fall 2018 was also used within the study.

Measures and Data Collection Sequence

Data was obtained with student consent through self-report surveys conducted confidentially online via *Qualtrics*. Personal fear of invalidity was measured using the 14-item Personal Fear of Invalidity Scale (PFI) by Thompson and colleagues (2001). Decision-making under stress was measured by 14 selected items from the Leadership Behavior Description Questionnaire (LBDQ; Stogdill, 1963; Brace, 2011). Stress was measured using a four-item scale developed by researchers in the capstone lab designed specifically to capture perceived stress (Pope, 2018).

DMUS, PFI, and stress measures were collected during the first half of the Spring 2019 semester. Archival stress data from Fall 2018 was also used in data analyses. These archival measures were collected after the team's AAR a week after the completion of their simulation. DMUS was measured three times over the semester: (1) after students were trained in their individual positions within the lab and participated in a mock simulation (training day); (2) after

their first AAR (scheduled a week after the first simulation); (3) after they had completed the lab portion of their capstone course. PFI was collected on training day and after students completed the lab portion of their capstone course. Stress measures were distributed immediately after the completion of both simulations during Spring of 2019.

Results and Discussion

A Welch independent-samples *t*-test ($\alpha = .05$) indicated the average reported stress levels did not differ between Fall 2018 during Sim 1 (M =2.64, SD =0.76, n =39) or Sim 2 (M = 3.00, SD = 0.91, n = 39) compared to Spring 2019 during Sim 1 (M = 2.62, SD = 0.96, n = 31), $t(56.2) = 1.37$, $p = .925$, $d = 0.02$ or Sim 2 (M = 2.72, SD = 0.66, n = 31), $t(67.5) = 2.27$, $p = .140$, $d = 0.35$. The test compared the stress levels of participants from Fall 2018 to stress levels of Spring 2019. The survey was administered a week after each simulation during Fall 2018, but the researchers administered the stress survey right after the end of each simulation during Spring 2019. Administration time was altered to more accurately capture real-time stress levels, as the stress reported by students a week after the simulation did not seem to reflect the level of stress students anecdotally reported experiencing during simulations. The lack of a significant difference in stress between the two conditions may be explained by the immediate relief experienced during survey administration when a stressful simulation is called to an end.

A Pearson's correlation indicated there was a significant negative association between DMUS (pre) and PFI (pre), $r(56) = -.471$, $p = <.001$. In other words, when perceived fear of invalidity increases, decision-making under stress decreases. Consistent with the literature (Pope, 2018; Brace, 2011), the students reported that when they begin the capstone course afraid of producing the wrong decisions, their perceived ability to make decisions under stress suffers. See Table 1.

Table 1.

Personal Fear of Invalidity and Decision Making Under Stress Before Simulations

		PFI (Pre-Simulation)	DMUS (Pre-Simulation)
PFI (Pre-Simulation)	Pearson Correlation	1	-.471**
	Sig. (2-tailed)		.000
	N	59	58
DMUS (Pre-Simulation)	Pearson Correlation	-.471**	1
	Sig. (2-tailed)	.000	
	N	58	58

Note. ** Correlation is significant at the 0.01 level (2-tailed).

A Pearson's correlation indicated there was a significant negative association between DMUS (post) and PFI (post), r (22) = -.547, p = .006. In other words, when perceived fear of invalidity increases, decision making under stress decreases. Researchers suspect this may be due to students' increased self-awareness of decision-making abilities after experiencing a full simulation and AAR. See Table 2.

Table 2.
Decision Making Under Stress and Personal Fear of Invalidity Post Flight Simulation

		DMUS (Post-Simulation)	PFI (Post-Simulation)
DMUS (Post-Simulation)	Pearson Correlation	1	-.547**
	Sig. (2-tailed)		0.006
	N	24	24
PFI (Post-Simulation)	Pearson Correlation	-.547**	1
	Sig. (2-tailed)	0.006	
	N	24	24

Note. ** Correlation is significant at the 0.01 level (2-tailed).

A paired samples t-test (α = .05) indicated PFI did not differ for measures taken before simulations (pre) (M =3.56, SD = .82, n =19) and measures taken after simulations (post) (M = 3.46, SD = .68, n = 19), t(18)=.780, p =.446, d = 0.13. However, the means between the pre and post conditions decreased, suggesting that as students gained experience in the simulations, they experienced less fear about potentially wrong solutions due their experiences in the lab. See Table 3.

A paired samples t-test (α = .05) indicated that DMUS scores differed for measures taken before the first simulation (M = 3.44, SD = .50, n = 19) and measures taken after the first simulation (M =3.70 , SD = .48, n = 19), t(18)= -4.54, p = <.001, d = -0.52. Additionally, the average reported DMUS after the simulations was higher than the average reported before simulations, indicating an increase in perceived decision-making ability under stress. The data shows that students feel they have learned from their experiences in the first simulation and AAR, helping them feel more confident that they can make better decisions under stress going forward. See Table 3.

Table 3.
Paired Samples Test

	M	SD	SEM	*t*	*df*	*p* (2-tailed)
Pair 1	0.1004	0.5611	0.1287	0.780	18	.446
Pair 2	-0.2545	0.2445	0.0560	-4.537	18	.000

Note. Pair 1: PFI (Pre-Simulation) - PFI (Post-Simulation)
Pair 2: DMUS (Pre-Simulation) - DMUS (Sim 1)

Conclusion

Results indicated that after experience with simulation-based training, students reported a decrease in their personal fear of invalidity and an increase in their perceived ability to make decisions under stress. Consistent with the literature, results also revealed a correlation between decision-making under stress and personal fear of invalidity – further supporting a connection between the two constructs (Pope, 2018). This suggests that individuals with a high fear of making incorrect decisions feel that they are less able to make good decisions during stressful situations. This finding is instrumental to the aviation industry as it suggests that by allowing individuals to experience job-relevant problem-solving opportunities while under stress – such as those offered by high-fidelity simulations – their decision-making self-efficacy can improve and personal fear levels can be lowered. As previous literature suggests, this may decrease rumination, maladaptive decision-making processes, and oversimplification – thus contributing to safer conditions in air flight operations (Pope, 2018; Johnston, et al., 1997; Thompson, et al., 2001).

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