The Effects of Cultural Factors on Safety in Aviation Focusing on Asian and Western Cultures

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THE EFFECTS OF CULTURAL FACTORS ON SAFETY IN AVIATION FOCUSING ON ASIAN AND WESTERN CULTURES

by

Jiyeon Song

A Graduate Capstone Project Submitted to the College of Aviation, Department of Graduate Studies, in Partial Fulfillment of the Requirements for the Degree of Master of Science in Aeronautics

Embry-Riddle Aeronautical University
Daytona Beach, Florida
April 2018

THE EFFECTS OF CULTURAL FACTORS ON SAFETY IN AVIATION FOCUSING ON ASIAN AND WESTERN CULTURES
This Graduate Capstone Project was prepared under the direction of the candidate’s Graduate Capstone Project Chair, Dr. Steven Hampton, Professor, Daytona Beach Campus, and has been approved. It was submitted to the Department of Graduate Studies in partial fulfillment of the requirements for the degree of Master of Science in Aeronautics Graduate Capstone Project:

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Acknowledgments

First of all, I would like to thank my family for their support. Their support is what leads me to my path, and what makes me who I am today. My family has been a big motivation to me to keep pursuing my goal, and that really helped me to finish this capstone.

Next, enormous thanks goes to Andrey Babin, my boyfriend. Even though my topic might not be interesting to him, he was always happy to help me, and supported me as much as my family. He was more than a boyfriend to me, giving me a highly professional and critical viewpoint to my research, which made my writing qualified better than expected.

Also, I would like to express my gratitude to Embry-Riddle Aeronautical University staff and faculty members. They are Dr. Steven Hampton, Dr. Dahai Liu, Dr. Haydee Cuevas, Dr. Andrew Dattel, Dr. Margaret Klemm, and James Cox. I would like to thank Dr. Liu and Dr. Cuevas for welcoming me whenever I need help. Also, I could not collect any data from my participants without the help from Dr. Dattel, Dr. Klemm, and Mr. Cox from ERAU Flight Training Department. Most of all, I really appreciate the feedback and advice from Dr. Hampton during this semester.

Lastly, my capstone would not be possible without the help of my MSA friends. They willingly spent their time for my research providing me practical advice to design a flight scenario. Especially, I would like to thank Mwangi Karuri, who became a guinea pig for a perfectly designed experiment.
Abstract

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Title: The Effects of Cultural Factors on Safety in Aviation Focusing on Asian and Western Cultures
Institution: Embry-Riddle Aeronautical University
Degree: Master of Science in Aeronautics
Year: 2018

Several aviation accidents from the past, such as the Asiana Flight 214 crash at San Francisco International Airport in 2015, have highlighted possible effects of Korean hierarchy culture on the safety of flight. Previous research conducted primarily with the use of surveys revealed that Asian pilots are less likely to report an unsafe condition out of fear that it will damage their relationships with coworkers and superiors. Western pilots see reporting as dealing with the problem and not a person, thus they feel more open to it. This study looked at student pilots’ ability to recognize and deny an unsafe flight instruction from a superior based on their cultural background. Ten Western and ten Korean participants were asked to fly around a mountainous region with low-lying clouds in a flight simulator. During the flight, participants were given instructions by the researcher, who pretended to be a flight instructor. One of the instructions was made intentionally unsafe and non-compliant with the Federal Aviation Administration regulations; participant reactions to the instructions were recorded. Significantly more Korean than Western participants were able to recognize the unsafe instruction, but significantly more Western pilots denied the unsafe instruction. It is recommended for the aviation industry to recognize and consider cultural differences when developing regulations and training programs, such as Crew Resource Management, to reassured the Safety Culture in aviation. Further research is suggested to determine other cultural factors that can affect safety of flight.
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Chapter I

Introduction

Culture in Korean aviation has been the focus of attention because of numerous accidents involving Korean airlines, such as:

- Korean Air Flight 7468 that crashed on approach to Antonio B. Won Pat International Airport, United States territory of Guam (Gladwell, 2008; National Transportation Safety Board, 2000);
- Korean Air Cargo Flight 8509 that crashed after takeoff from London Stansted Airport, UK (Department of Transport, 2003).

Since the most recent of the accidents mentioned above, media sources such as CNN (USA), CNBC (USA), and CCTV (China) reported that Korean culture in the aircraft cockpit was a factor that contributed to the accident. However, YTN (Korea) did not mention Korean culture as one of the reasons for the Asiana crash (Kim, 2016).

According to Hofstede’s cultural dimensions, Korean culture is attributed to authoritarianism, avoidance of uncertainty, collectivism, and passivism, where an individual feels uncomfortable to show her or his own opinion, especially to higher social levels or to a group. An individual, however, expects others to take his or her advice for granted, or, furthermore, to obey to him or her when their hierarchy is the highest in the group. This characteristic of Korean culture is very similar to cultures of other East Asian countries under the Confucius connection (Hofstede & Bond, 1988). Several media sources reported that characteristics of Korean culture led to miscommunication between the Captain and the First
officer during the flight in the Asiana crash (Ashlers, 2013; Asiana 214 pilot realized plane too…”, 2013; Did Korean culture contribute…””, 2013; Wee, 2013).

Contrarily to Western media sources (CNN, CNBC, and BBC), articles from Korean media, including YTN, did not mention the authority and hierarchy culture as a problem related to the accident. Instead, most media sources reported that the National Transportation Safety Board (NTSB) offended Korea by stating that Korean culture was one of the main reasons of the Asiana crash (Lee, 2013; Kim, 2013).

The researcher brought into this study a situation in which two opposite opinions existed on the same fact (Asiana crash in San Francisco), which helped the researcher determine whether cultural factors influence pilots’ decision-making and the safety of flight. To measure culture as a factor, the researcher asked student pilots from two different culture groups, Western and East Asian (Korean in this research), who agreed to participate in the study, to fly an airplane in Microsoft Flight Simulator X (MS FSX) flight simulator. The researcher took the role of the flight instructor to be of a higher level than the participants. Participants were asked to follow the researcher’s instructions. One of the instructions was made intentionally unsafe, and participant reactions were recorded.

**Significance of the Study**

Culture in an aircraft cockpit is an essential aspect of successful flight operations. It has been proven by the success of Crew Resource Management (CRM) that a correct approach with cultural background consideration can improve communication in the cockpit and thus increase the effectiveness of the flight crew (Kanki, Helmreich, & Anca, 2010).

The results of this research would reveal cultural influences on pilot decision-making if any discrepancies in participants’ reactions based on their cultural background were to be found.
Furthermore, the research could bring the awareness of the necessity to improve cockpit culture in Korea if cultural background negatively influenced the reaction of Korean participants.

**Statement of the Problem**

Malcolm Gladwell’s theory (Gladwell, 2008) implies that cultural constraints contribute to airplane accidents and incidents. However, ICAO and IATA regulate safety equally in every country leaving out cultural differences (Liao, 2015). Aviation is a high-risk industry that requires synergy and cooperation between all nations that are involved in it (Kanki et al., 2010). While research related to the cultural issues in East Asia has been performed across the world (Batteau & Jing, 2015; Friedman, Chi, & Liu, 2006; Liao, 2015; Zreet & Stark, 2015), limited research has been done in Korea that would address this cultural problem in aviation safety.

**Purpose Statement**

The purpose of this research was to observe whether the characteristics of Asian culture, especially in East Asia (Korea, China, and Japan), such as authority, passiveness, and collectivism, affect pilot’s decision-making processes. The results of this research have the potential to suggest improvements for pilot training in Korea and other Asian cultures, as well as propose additional safety regulations to ICAO and IATA.

The study looked at the relationship between safety and culture among Korean and non-Korean pilots studying at Embry-Riddle Aeronautical University, which is a flight school located in Daytona Beach, Florida. The relationship measured student pilot’s reaction to a deliberately unsafe instruction from the researcher. The researcher was taking a role of a flight instructor being higher in rank than the student pilot.

**Research Questions and Hypotheses**

The research questions for this study were:
1. Does culture identity affect a pilot’s recognition of an emergency environment (Just Culture by Cultural Background)?

2. What is the reporting culture tendency according to the relationship between the recognition of an unsafe environment and cultural backgrounds (Reporting Culture by Just Culture and Cultural Background)?

3. Is a set of expected data (retrieved through a survey) as reliable as a set of observed data (retrieved through conducting an experiment)?

The following hypotheses were stated:

1. Hypothesis 01: There is no difference between the number of Korean and Western student pilots recognizing an unsafe situation during the flight.

2. Hypothesis 02.a: There is no difference between the number of Korean and non-Korean student pilots refusing to accept an unsafe instruction.

3. Hypothesis 02.b: There is no difference in the number of student pilots refusing to accept an unsafe instruction between the two groups to which they belong: (a) high Just Culture or (b) low Just Culture.

4. Hypothesis 02.c: There is no interaction between cultural background and the degree of just culture for student pilots, which affects student pilots’ decision to refuse an unsafe instruction.

5. Hypothesis 03: There is no difference between the number of students who expected themselves to report any unsafe situation and the number of students whom the researcher and the observer observed reporting the unsafe situation.

Limitations and Delimitations

Because of the time limitation restricting the research to one semester (4 months) and geographical constraints, the researcher sampled Embry-Riddle Aeronautical University (ERAU)
flight students only (limitation and delimitation). The researcher narrowed the scope of the research down to East Asian and Western groups for comparison instead of a comparison between all culture groups, such as Latin, African, Middle Eastern, etc. (delimitation). The researcher collected data only from Korean student pilots at ERAU because there have already been several studies that discussed Chinese culture and its effect on aviation (Liao, 2015; Bedford, 2011; Tsui, Wang, & Xin, 2006). These studies proved that hierarchy affects the decision-making process and communication between coworkers (delimitation). Moreover, according to Embry-Riddle Tutor Lab student assistants, there are only three Japanese flight students at ERAU. Therefore, in this research, it would not be possible to generalize the test results to the Japanese population.

**Definitions of Terms**

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<tr>
<td>Chosun dynasty</td>
<td>A Korean dynastic kingdom that existed from 1392 to 1987</td>
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<td>Collectivism</td>
<td>A practice in which a group is put first over each individuality</td>
</tr>
<tr>
<td>Confucianism</td>
<td>A system of philosophical and ethical education created by Confucius</td>
</tr>
<tr>
<td>Guanxi</td>
<td>The system of social networks where business relationships and personal relationships coexist</td>
</tr>
<tr>
<td>High-power distance</td>
<td>Unequal power distribution between the lower and higher rank individuals; Higher rank has more power</td>
</tr>
<tr>
<td>Hofstede’s cultural dimension</td>
<td>Reporting culture</td>
</tr>
<tr>
<td>A framework which describes cultural values and their effects on behavior developed by Geert Hofstede</td>
<td>A factor of Safety culture in aviation which describes the degree of pilot’s ability to recognize an unacceptable situation during the flight.</td>
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A factor of Safety culture in aviation which describes the degree of pilot’s willingness to report an unacceptable situation.

A set of believes, attitudes, and values shared among the employees of an organization with the goal of maintaining a safe environment.

List of Acronyms

<table>
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<th>Description</th>
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</tr>
<tr>
<td>CERTS</td>
<td>Department of Transport</td>
</tr>
<tr>
<td>DOT</td>
<td>Embry-Riddle Aeronautical University</td>
</tr>
<tr>
<td>ERAU</td>
<td>Federal Aviation Administration</td>
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<tr>
<td>FAA</td>
<td>International Air Transport Association</td>
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<tr>
<td>IATA</td>
<td>International Civil Aviation Organization</td>
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<td>ICAO</td>
<td>Institutional Review Board</td>
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<tr>
<td>IRB</td>
<td>Meteorological Terminal Aviation Routine Weather Report</td>
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<td>METAR</td>
<td>Microsoft Flight Simulator X</td>
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<td>MS FSX</td>
<td>National Transportation Safety Board</td>
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Chapter II

Literature review

Culture issues have led to several aviation accidents in the past, such as Asiana Flight 214 (Ohleiser, 2013), Korean Air Flight 801 (Halperin, 2013), and Avianca Flight 52 (Harris & Li, 2008). These accidents may have been avoided if crew members focused more on procedures than personal relations and their backgrounds. Their backgrounds were related to such factors as collectivism and high-power distance (Zreet & Stark, 2015). Collectivism is related to prioritization of society’s needs over individual’s own needs (Liao, 2015) and high-power distance implies an unequal distribution of power between people of higher and lower ranks (Hofstede & Bond, 1988). In the Asiana accident, the First Officer did not mention the loss of speed at a critical stage of flight out of respect to the older captain (Ohleiser, 2013). In the Korean Air accident, poor communication between the flight crew members as well as pilot fatigue were the main reasons for the crash (Halperin, 2013). Lastly, the Avianca 52 accident occurred because of language and cultural barriers - the captain was a US national, and the other two flight crew members were Japanese (NTSB, 1991).

Crew Resource Management

Crew Resource Management (CRM) has become a synonym of cooperation and teamwork in aviation. CRM was developed in the 1980s partially as a response to the authoritarian attitudes of pilots at various american airlines. Crews frequently lacked proper communication skills between each other and were not always in clear understanding of what was happening in the cockpit. CRM went through five generations that involved multiple changes and improvements. Nowadays, CRM is not considered a program; instead, it has evolved into part of mainstream training (Kanki et al., 2010).
It is essential to understand that CRM was introduced and developed in the USA by people from the Western culture, and therefore it is tailored to the Western mentality. An abundance of research on psychology and human factors from various American publications helped the creators to identify and focus on aspects that required their attention. Any further development of the program was focused on American pilots as well. As a result of the approach taken to develop CRM, the first application of CRM outside of the United States was not as effective as expected (Kanki et al., 2010).

**Safety Culture in Aviation**

Safety is a necessity in aviation (Pidgeon, 1998). Safety culture signifies the criteria, values, and practices shared by groups in regard to risk and safety (Noort, Reader, Shorrock, & Kirwan, 2016). According to Liao (2015), Just Culture and Reporting Culture are two factors that are necessary to establish great safety culture in aviation. This is because pilots need to timely detect unsafe conditions to maintain the safety of flight. Also, when pilots recognize an unsafe condition or situation during a flight, they must report the situation to handle it (Liao, 2015). Cockpit has high Just Culture only when pilots have the ability to recognize any irregular, illegal, or improper situations which are potentially dangerous and might lead to unsafe conditions. Also, when pilots speak up their own opinion or report situations that can result in an incident or an accident, the company or the cockpit is considered to have high Reporting Culture (Liao, 2015).

**Differences in perspective: Chinese and Western pilots**

Part of the reason for the limited success of CRM in Asian cultures lies in how Asians perceive their superiors in everyday life and the workplace. In her discussions about differences between Asian and Western perceptions of work relationships, Liao (2015) interviewed pilots from Western countries and China as a representative of Asia and introduced five factors: three
factors are specific to primarily Chinese culture (Guanxi, High-power distance, and collectivism) and the other two factors (Rule-oriented culture and Sharing culture) are specific to Western culture. In Chinese culture:

- Guanxi, or creation of more personal relationships with work partners, was very common. In China, business and personal relationships are not separated; instead, they coexist. Guanxi is similar to the phenomenon called “the old boy network” in the United States.

- Power distance index was shown higher than in Western culture. According to Liao, its consequence was that Chinese workers were more concerned about telling the truth to their supervisors, which was also supplemented by the fact that they valued conflict avoidance.

- Collectivism was identified, which is typical of all Asian cultures, and it refers to prioritizing social group needs by an individual over his or her own needs.

On the other hand, in Western culture:

- Pilots were more rule-oriented. As such, Western pilots in Liao’s research showed more trust to the company regulations and felt more protected by the law.

- Pilots were also more open to sharing their flight experience with their co-workers.

Overall, in Liao’s (2015) research, the pilots from Western cultures thought that reporting an unacceptable situation would have a positive impact on the safety culture. Also, they perceived that reporting would not affect personal relationship because it is not a person but the inappropriate behavior that they report. The pilots from Asian cultures, however, deemed reporting as dealing with a person and believed that it would affect their personal relationship,
which is common in Guanxi cultures. Liao’s research also showed that pilots from China had a tendency to think that a new supervisor, not new regulations, would change the company culture and the environment. Hence, these research findings show that:

- Chinese pilots feel uncomfortable to voice their opinion, especially to their supervisors, because of their culture where personal relationships can influence power.
- As a group, it is considered impolite to show individual opinion as this would disturb the group harmony.
- In Western culture, however, pilots tend to not feel uncomfortable to express their views to supervisors because sharing knowledge is considered helpful, and the rules and regulations can protect employees (Liao, 2015).

According to Friedman et al. (2006), Chinese people are more inclined to act depending on the established hierarchy, thus avoiding any confrontation with higher-ups. Therefore, they are more careful when talking to their supervisors. Dutton and Ashford (1993; as cited in Liao, 2015) reported that employees should report feedback promptly when faced with it in their company, but the Chinese failed to do that because it might bring a negative response from their colleagues. However, this sensitivity to hierarchy is specific not only to Chinese but to other East-Asian cultures as well (i.e., Korean and Japanese). Moreover, these cultures may have additional factors that affect worker's behavior (e.g., age hierarchy in Korea).

Asian Culture and Confucianism

Seo, Leather, and Coyne (2012) identified that Confucianism could not be left out when discussing South Korean culture. It originated from the teachings of the Chinese philosopher
Confucius and was central to the philosophy of governing the country and moral system in Korea during the Chosun dynasty (Seo et al., 2012).

Confucianism promotes social hierarchy, authority, and seniority. Obedience and respect for seniors are expected as a social virtue. This culture is often abused in that mistreatment by seniors may be overlooked. Confucianism is related to three factors introduced by Liao, which are: Guanxi, high-power distance, and group harmony (Liao, 2015). As people in higher positions have high power distance, and in Korea, this authority is considered essential even if it is wrong, subordinates are placed in an unfair workplace. Subordinates have to obey to their supervisors for good relationships (Guanxi), and having different attitude or opinions is considered impolite to the group harmony (Collectivism).

In 2016, Seoul Broadcasting System (SBS) covered situations in which first-year college students were often punished or forced by seniors to perform inappropriate actions such as running for two hours for no reason other than that they were lower in rank. According to first-year students who gave an anonymous interview, they could not speak up because it would affect the whole group and not just one individual even though everybody felt unfair about the situation. The interview showed how common universal collectivism and high-power distance were in Korea, which means subordinates cannot have any initiative, but power holders have the absolute privileges (Seo, 2016).

Different Perspectives on the Asiana Crash

Kim (2016) covered the media coverage of the Asiana Crash in both Korea (YTN) and the USA (CNN and CNBC). Korean TV channels reported that two reasons for the crash were that the aircraft had flaws in its automated control system and that the glideslope (GS) at San
Francisco International Airport (SFO) was out of service. The lack of communication in the cockpit because of the cultural impact was never mentioned. However, USA TV channels covered issues of Korean culture as one of the factors that caused the accident (Kim, 2016).

Chow, Yortsos, and Meshkati (2014) discussed the Asiana crash in detail and determined that many factors that caused the accident were related to the cultural background of the crew. Furthermore, this article implied the necessity for improvements in pilot training, considering the cultural differences in Korea when compared to the Western civilizations. However, Asiana Airlines is reluctant to admit these cultural issues, blaming it on lack of experience because this was the first time for the trainee pilot to land at San Francisco Airport. Additionally, Korean news blamed lack of training and deficiencies in airport infrastructure for the crash. In the rest of the world, it was reported that, aside from a lack of training, the lack of communication due to culture issues was a contributing factor to the accident.

**Examination of cultural influence on Safety Culture**

To test the impact of cultural backgrounds on pilots from the safety perspective, Liao (2015) asked questions based on "unacceptable situation" concerning safety. The statements of the survey were:

- “A Dominance & Authority Culture negatively affects a Just culture”;
- “Would you report your higher-ranking crewmember’s rule violation without any hesitation?”;
- “A Keeping in Harmony with Other People Culture negatively affects a Just Culture.”

Just culture implies that employees must know what is acceptable and what is not acceptable for safety. If in any culture an employee does not know what is not acceptable, then this culture negatively affects the Just Culture. Also, even though an employee knows what is
acceptable and what is not acceptable, if he or she does not report or share an unacceptable situation, such as rule violations, because of the ranking, then safety is threatened by the hierarchy culture (Liao, 2015).

**FAA Regulations**

According to the Federal Aviation Administration (FAA) policy on “Tips on Mountain Flying” (FAA-P-8740-60), “Pilots are suggested to fly at an altitude at least 1,000 feet above the pass elevation when they cross mountain passes.” Also, the FAA policy (FAA-P-8740-60) stated that “In a mountainous area, the cloud clearance is required to be at least 1,000 feet below the clouds. Therefore, for a safe flight, pilots should make sure that they have at least a 2,000-foot ceiling over the highest pass they will cross.” (FAA, 1999).

**Summary**

To characterize the influences on CRM, most research experiments performed surveys to collect data (Batteau & Jing, 2015; Liao, 2015; Kernan, Watson, Chen, & Kim, 2011; Zreet & Stark, 2015). However, surveys cannot show direct correlations between pilots’ decision making and their cultural backgrounds because survey results are not reliable enough when compared to the behavior that can be observed (Privitera, 2017). As such, a pilot’s response to a survey question about his or her actions in some situation may differ from what he or she would do in an actual situation. As participants state their expected behavior according to their intuition, a survey is not a valid tool compared to experiments with empirical data (Gavurin, 1972). The closer the research is to the field experiment, the more convincing the data from the result will be (Privitera, 2017).

Hence, for this study, the researcher adopted the statements from Liao’s (2015) research survey and applied the items to the flight simulation in order to observe participants’ behavior. The purpose was to capture empirical data (Simulation) instead of subjective data (Survey).
Participants were given a flight scenario in a situation which would not be considered safe based on the current FAA policy (FAA-P-8740-60).

At the same time, the researcher sampled only Korean participants for the Asian group because Korean culture is one of Asian cultures with the Confucian connection (Seo et al., 2012), and most of previous research related to safety culture in CRM was generally conducted with Chinese participants representing the Asian culture (Bedford, 2011; Liao, 2015; Tsui et al., 2006).
Chapter III
Methodology

The researcher designed the study with a simulated short flight in which she acted as a flight instructor. Twenty student pilots were sampled for the study and assigned to two different groups based on their origin. The research methods and procedures are discussed in further detail below.

Research Approach

An empirical research approach was utilized in this study by observing reactions of student pilots during a simulated flight with a specific flight scenario. A mixed methods approach was used. During the simulation, a qualitative method was used to measure and record participant reaction to an unsafe instruction in four non-numeric categories, which were "Accepted," "Questioned-Accepted," “Questioned-Denied,” and "Denied" with detailed explanations. In the survey, a qualitative method was used to measure participants’ academic level (Freshman, Sophomore, Junior, Senior, or Other), their assessment of the instruction (Safe and Not-safe), pilot certificates acquired, national origin, and expected behavior in a hypothetically unsafe situation involving another pilot (Report and Not-report). A quantitative method (survey) was also used to measure participant age, confidence in decision-making, and flight experience in hours.

The independent variable for hypotheses 0₁, 0₂-a, 0₂-b, and 0₂-c was the culture (Just Culture and/or Cultural Background) to which a participant belonged. Because culture was a pre-existing factor and it was not randomly assigned, this study was quasi-experimental. The reactions were compared between the two groups to determine whether participants’ cultural background would affect their recognition of an unacceptable situation and their decision-making in an unacceptable situation. The unacceptable situation was set by giving an unsafe
instruction to participants. The independent variable for hypothesis 03 was the method of measurement within two groups. Because the participants were included into both groups, this study was also quasi-experimental. The data from both groups were compared within the two groups to determine whether there was a significant difference between participants’ expected behavior from a survey and the behavior observed during a simulation.

**Design and Procedures.** The design of the research in this study was descriptive. The researcher recruited 20 student pilot volunteers with an instrument rating from Western countries (10 student pilots) and Korea (10 student pilots) by posting a flyer announcement on Embry-Riddle Aeronautical University (ERAU) campus (see Appendix A). Western Culture included participants from the USA and Europe. Participants were assigned to one of the two groups (Korean or Western) depending on their origin. Once participants signed the consent form (see Appendix B), each participant was asked to fill out a questionnaire with questions regarding their age, nationality, and, for Korean participants, years spent living outside of Korea to evaluate how much each Korean participant was exposed to Korean culture (see Appendix C-a). Microsoft Flight Simulator X was loaded on a flight simulator station. After answering the questions, each participant flew a short practice flight to gain familiarity with the flight simulator setup. The area for the practice flight was set as Daytona Beach International Airport (KDAB), and the aircraft selected was a Cessna 172 with Garmin G1000 panel, which is the same aircraft that is used in ERAU for training flights.

The test flight was loaded afterward. Participants were presented with the following:

- Oral instructions (see Appendix D for the script).
- A weather report (METAR and pilot reports; see Appendix E).
- A sectional map of KAVL airport area with terrain heights (see Appendix F).
- An instrument approach chart for KAVL airport (see Appendix G).
Participants were told to consider the researcher being in a role of a flight instructor for the flight and were given a route and cruise altitude. Other essential information was provided through weather reports, a map, and an approach chart; the simulated flight was conducted in a mountainous area near Asheville, North Carolina, with the mountain peak heights ranging between 3,000 feet and 5,700 feet. The weather for the simulator was set up in a way so that part of the terrain was obscured by low visibility due to an overcast sky condition with tops at 5,000 feet and base at 3,500 feet. For the test flight, participants started mid-flight at 7,000 feet enroute to Asheville Regional Airport (KAVL). Participants were asked to comply with the researcher’s instructions to the best of their ability, but to consider safety first. When the simulation started, participants were asked to change heading several times and increase or decrease airspeed. Then, participants were asked to descend to 4,500 feet. The altitude of 4,500 feet was selected intentionally – part of the terrain was obscured by low-laying clouds, thus descending below 5,000 feet would result in an unsafe condition, non-compliant with the FAA-P-8740-60 policy. It was possible to measure if participants knew that the descent was unacceptable (Just Culture) and whether they would report or share their opinion with a superior (Reporting and Learning Culture). In her questionnaire, Liao (2015) asked participants questions about their expected behavior under similar unsafe instructions or conditions. In this study, the researcher wrote down participant actions and reactions (whether they complied with the instruction or declined it). After the simulated flight, participants were asked to fill out a short survey with questions about the simulated flight and the decision that they made (see Appendix C-b).

**Apparatus and Materials.** A flight simulator station, which consisted of Microsoft Flight Simulator X flight simulator connected to Elite Pro flight control panel, located in Cognitive Engineering Research in Transportation Systems (CERTS) laboratory, was used for the simulation of the flight. The flight simulator allowed setting a flight scenario in any location
with any weather conditions that the researcher wanted to use. The ELITE Pro flight controls panel, connected to the flight simulator station, included primary aircraft and engine controls (e.g., yoke, rudder pedals, engine throttle, and mixture levers), switches for other aircraft systems, and it resembled an aircraft cockpit overall.

Population/Sample

A convenience sampling method was used to collect student pilots at ERAU who had Western or East Asian (Korean) cultural background. Participants were selected based on accessibility and availability to participate. Several flyers, which were advertising the study and offering $20 for participation, were posted on ERAU campus billboards. The researcher also asked one ERAU professor, Dr. Margaret Klemm, to advertise the study among her students and offer extra credit in her class for participation. Additionally, an e-mail with the flyer attached was sent to all student pilots at ERAU with the help of James Cox, a manager at flight training department. The sample size was 20 student pilots – 10 in the Western group and 10 in the Korean group. The results from the sample can be generalized to the similar reaction of Western and Korean (Asian) pilots in an unacceptable (unsafe) situation during the flight.

Sources of Data

The data were collected with the use of two surveys and the researcher’s observation of participants’ reactions during the flight simulation. The survey included open-ended, short answer questions along with questions that required a simple Yes or No response. The first half of the questionnaire asked about participant demographics, such as their age, nation of origin, academic year, and certificates. The final eight questions took participants through their recognition of the unacceptable instructions during the simulation and their expected behavior.

To comply with the appropriate ethical standards, the researcher received approval from the Institutional Review Board (IRB) to conduct the experiment. Also, participants agreed that
their data could be used for the research by signing the consent form which was approved by the IRB.

Each simulated flight was observed by the researcher. The researcher took notes as the flight progressed, as well as when participants were asked to descend to 4,500 feet. Participant reactions to the instruction were recorded and divided into three categories:

- “Accepted” if a participant complied with the instruction, descending to 4,500 feet;
- “Denied” if a participant did not comply with the instruction;
- “Questioned-Accepted” if a participant hesitated before descending and asked back if they were required to descend. A short description was added if a participant questioned the instruction;
- “Questioned-Denied” if a participant hesitated first but did not descend when they were required to descend. A short description was added if a participant questioned the instruction.

**Data Collection Device**

The data collection devices needed for the study were a flight simulator, Microsoft Flight Simulator X, and two surveys. Figure 1 below is the picture of the simulator station.
The experiment was designed to be close to the field experiment. The simulator station, Microsoft Flight Simulator X, was used, which allowed increasing realism with the following:

- Simulated terrain which looked similar to the actual terrain around Asheville airport in North Carolina;
- The aircraft model which is used for pilot training at ERAU (Cessna 172);
- The simulated weather conditions coupled with aviation reports (such as METAR);
- The instruction designed and reviewed by ERAU instructors.

A computer with Microsoft Excel and SPSS programs were also needed to organize and analyze the data.
**Instrument Validity.** The instrument in the study had validity in that simulation conditions and flight materials were reviewed by Dr. Steven Hampton at ERAU. Furthermore, to help the validity of this study, the simulation conditions and instructions were reviewed by three ERAU flight instructors: John Brooks, Samuel Lee, and Dimitrios Gkaris. There was a chance of invalidity due to lack of control between two groups because the researcher delivered instructions in English to both Korean and non-Korean participants. However, three professors, Dr. Steven Hampton, Graduate Capstone Project chair; Dr. Dahai Liu, Graduate Capstone Project advisor; and Dr. Haydee Cuevas, an associate professor at ERAU, agreed that the instructions would need to be delivered in English to all participants because English is the language in aviation. Once all flight conditions, materials, instructions, and surveys were prepared, the simulation environment was equal for all participants.

**Instrument Reliability.** The survey questions were designed based on the previous research conducted by Liao (2015), in which cultural influences on pilot decision making were identified through a survey. Most questions from the survey in this study were qualitative and were aimed at testing participants’ own assessment of their actions.

To test the reliability of the surveys, the researcher distributed the surveys among several pilot and non-pilot ERAU students for review and feedback. All changes recommended by the pilots were discussed and then incorporated. One of the pilots, Mwangi Karury, who is also a Master of Science in Aeronautics program student at ERAU, volunteered to participate in the study for testing purposes; the survey was filled out by the pilot and checked by the researcher as part of experiment testing.

To ensure the dataset was recorded appropriately, Andrey Babin, a Master of Science in Aeronautics program student at ERAU, attended every experiment as an observer and provided
an additional opinion to help assign participant reactions into the proper group (Accepted, Questioned, and Denied) objectively.

**Treatment of the Data**

Participant reactions were recorded on participant scoresheets. All recorded data, such as signed consent forms, participant scoresheets and surveys filled out by the participants, were stored in a file cabinet located in the CERTS laboratory. Consent forms were stored separately from the rest of the documents so that it would not be possible to connect participant names to participant data.

The data from the scoresheets with participant reactions were transferred to an SPSS dataset for analysis. Statistical analysis tests were performed using SPSS software to identify the difference in reactions between participants with Korean and Western cultural backgrounds. SPSS was also used to analyze participant demographics data, such as age, flight experience, and time spent living outside of Korea (for Korean participants).
Chapter IV

Results

Descriptive Statistics

**Demographic Data.** Twenty student pilots (10 from Korea and 10 from other cultures which are considered Western) were sampled for this study. For Korean participants, the average time spent outside of Korea was $M = 10$ years ($SD = 5.33$). Participant age was $M = 22.90$ years ($SD = 2.315$). Figure 2 below is a histogram which shows the age frequencies for all participants.

![Histogram of Participant Age](image)

*Figure 2. Participant age (All groups: 20 participants).*
The mean flight experience for all participants was $M = 294.80$ hours ($SD = 234.74$). Participants from Korean group had higher mean flight experience (381.50 hours) than Western group (208.10 hours). Figure 3 shows the frequency of flight experience for all participants.

*Figure 3. Flight experience (All groups: 20 participants).*
Participant academic year was composed of one sophomore, three juniors, 14 seniors and two graduates. Figure 4 is a pie chart which describes participant academic year for all groups.

![Pie chart](image)

**Figure 4.** Participants’ academic year (All groups: 20 participants).

There was one female from Korean group and there were two females from Western group. Nine participants in Korean group and eight participants in Western group were males. Figure 5 is the description of gender components of participants.
All participants were instrument-rated. According to the answers from the survey which was given to participants after the test flight, 13 participants answered that they have felt uncomfortable working with colleagues of a higher rank (Yes) and seven students answered that they have never felt uncomfortable (No). Figure 6 is a description of the percentage of the answers to the Question 5 from Survey 2. See Appendix 2-b for a copy of the survey.

**Figure 5.** Gender (All groups: 20 participants).

**Figure 6.** Answers to the Question 5 from Survey 2 (All groups: 20 participants).
Participants were asked to rate their confidence in the decisions made during the flight from 1 (Not confident at all) to 10 (Very confident). The mean confidence rating for all participants was $M = 8.55$ ($SD = 1.67$). Figure 7 shows the frequencies of each confidence level of the participants.

*Figure 7. Confidence (All groups: 20 participants).*

Table 1 shows the descriptive data for uncomfortable experiences of working with higher-rank colleagues at ERAU, flight hours, and confidence in decisions during the flight experiment. The data are separated according to participant cultural background. Table 1 also includes a data set for years out of Korea (for Korean participants).

Table 1
Description of Cultural Background by demographic variables

<table>
<thead>
<tr>
<th>Background</th>
<th>Years out of Korea (Years)</th>
<th>Uncomfortable (1 = Yes, 2 = No)</th>
<th>Flight Hours (Hours)</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western</td>
<td></td>
<td>1.50</td>
<td>208.10</td>
<td>8.00</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td></td>
<td>.527</td>
<td>67.655</td>
<td>1.886</td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td>10.00</td>
<td>1.20</td>
<td>381.50</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td></td>
<td>5.333</td>
<td>.422</td>
<td>308.293</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>10.00</td>
<td>1.35</td>
<td>294.80</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>10</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td></td>
<td>5.333</td>
<td>.489</td>
<td>234.738</td>
</tr>
</tbody>
</table>

*Note.* N = Number of samples; Background = Cultural background; Uncomfortable = Uncomfortable experiences of working with higher-rank colleagues at ERAU; Confidence = Confidence during the flight simulation; Confidence was coded from 1 (Not confident at all) to 10 (Very confident).

Table 2 below shows the descriptive data for age, academic year, and gender of participants according to their cultural background.
Description of Cultural Background by demographic variables 2

<table>
<thead>
<tr>
<th>Background</th>
<th>Age (Years old)</th>
<th>Academic Year</th>
<th>Gender (1 = Male, 2 = Female)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western</td>
<td>22.00</td>
<td>3.90</td>
<td>1.20</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>2.582</td>
<td>.876</td>
<td>.422</td>
</tr>
<tr>
<td>Korea</td>
<td>23.80</td>
<td>3.80</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>1.687</td>
<td>.422</td>
<td>.316</td>
</tr>
<tr>
<td>Total</td>
<td>22.90</td>
<td>3.85</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>2.315</td>
<td>.671</td>
<td>.366</td>
</tr>
</tbody>
</table>

Note. N = Number of samples; Background = Cultural background; Academic Year was coded as 1 (Freshman), 2 (Sophomore), 3 (Junior), 4 (Senior), 5 (Graduate), or 6 (Others).

Just Culture by Cultural Background. The extent of student pilots’ ability to recognize an unacceptable situation was examined according to the cultural background with two levels – Korean and Western. On average, Korean group ($M = 1.90, SD = 0.316$) showed a higher degree of Just Culture than Western group ($M = 1.50, SD = 0.527$) when Just culture was coded as 1 if participants answered the flight simulation was safe or 2 if participants answered the flight simulation was not safe. The average extent of Just Culture was $M = 1.70 (SD = 0.470)$ in total. Table 3 shows the means and standard extent of Just Culture more in detail according to the two different groups.
Background | N | Mean | Std. Deviation |
---|---|---|---|
Western | 10 | 1.50 | .527 |
Korean | 10 | 1.90 | .316 |
Total | 20 | 1.70 | .470 |

*Note. Background = Cultural Background; N = Number; Just culture was coded as 1 when participants answered the flight simulation was safe or 2 when participants answered the flight simulation was not safe.*

**Reporting Culture by Just Culture * Cultural Background.** The extent of student pilots’ denial of the unsafe instruction to descend to 4,500 feet was examined according to two independent variables – Just Culture and Cultural Background. Just Culture factor was composed of Low and High groups. Cultural Background factor had two different groups – Korean and Western. Table 4 below describes the descriptive data of Reporting Culture by two factors (Just Culture * Cultural Background). Reporting culture was coded as 1 (Complied), 2 (Questioned and Complied), 3 (Questioned and Denied) or 4 (Denied). Among the four combinations, participants from the “Western Culture * High Just Culture” combination showed the highest degree of Reporting Culture on average ($M = 3.80, SD = 0.447$) followed by the “Korean Culture * High Just Culture” combination ($M = 1.44, SD = 0.726$). “Korean culture * Low Just Culture” combination showed the least degree of Reporting Culture ($M = 1.00, SD = 0.00$) following the “Western culture * Low Just Culture” combination ($M = 1.40, SD = 0.894$).

Table 4

*Description of Reporting Culture by Just Culture * Cultural Background*
<table>
<thead>
<tr>
<th>Safety Recognition (Just Culture)</th>
<th>Background</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe (Low Just Culture)</td>
<td>Western</td>
<td>1.40</td>
<td>.894</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Korean</td>
<td>1.00</td>
<td>.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1.33</td>
<td>.816</td>
<td>6</td>
</tr>
<tr>
<td>Not Safe (High Just Culture)</td>
<td>Western</td>
<td>3.80</td>
<td>.447</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Korean</td>
<td>1.44</td>
<td>.726</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>2.29</td>
<td>1.326</td>
<td>14</td>
</tr>
</tbody>
</table>

| Total                            | Western    | 2.60 | 1.430        | 10 |
|                                  | Korea      | 1.40 | .699         | 10 |
|                                  | Total      | 2.00 | 1.257        | 20 |

*Note.* Background = Cultural Background; N = Number; Reporting culture was coded as 1 (Complied), 2 (Questioned and Complied), 3 (Questioned and Denied) or 4 (Denied).

When Just Culture was the only independent variable, the Low Just Culture group ($M = 1.33, SD = 0.816$) had less Reporting Culture than the High Just Culture group ($M = 2.29, SD = 1.326$). Table 5 below shows the Reporting Culture by Just Culture factor.

### Table 5

*Frequency of Reporting Culture by Just Culture*

<table>
<thead>
<tr>
<th>(Count)</th>
<th>Safety Recognition</th>
<th>Total</th>
</tr>
</thead>
</table>
Safe  Not Safe  
(Low just culture) (High just culture)  
Report Observed 
Complied 5 6 11 
Questioned and Complied 0 2 2 
Questioned and Denied 1 2 3 
Denied 0 4 4 
Total 6 14 20 

Note. Background = Cultural Background; N = Number; Reporting culture was coded as 1 (Complied), 2 (Questioned and Complied), 3 (Questioned and Denied) or 4 (Denied).

When Cultural Background was applied as the only factor, Western group ($M = 2.60$, $SD = 1.430$) showed higher degree of Reporting Culture than Korean group ($M = 1.40$, $SD = 0.699$). Frequency of Reporting Culture by Cultural Background is described in Table 6.

Table 6

*Frequency of Reporting Culture by Cultural Background*

<table>
<thead>
<tr>
<th>(Count)</th>
<th>Background</th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Western</td>
<td>Korea</td>
<td></td>
</tr>
<tr>
<td>Report Observed</td>
<td>Complied</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Questioned and Complied</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Questioned and Denied</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Denied</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Note. Background = Cultural Background; N = Number; Reporting culture was coded as 1 (Complied), 2 (Questioned and Complied), 3 (Questioned and Denied) or 4 (Denied).

**Reporting Culture by the Measurement.** The data sets for the degree of reporting culture were compared between the two groups according to the way of measurement, which was an expectation from the answers to the survey questions and observation of the participants’ behavior during the simulation. The average degree of Reporting Culture which was expected
was $M = 1.80$ ($SD = 0.41$), and the average degree of Reporting Culture which was observed was $M = 1.35$ ($SD = 0.49$). Table 7 describes the description of the data sets.

Table 7

*Description of Reporting Culture by the Measurement*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report Expected</td>
<td>1.80</td>
<td>20</td>
<td>.410</td>
<td>.092</td>
</tr>
<tr>
<td>Report Observed</td>
<td>1.35</td>
<td>20</td>
<td>.489</td>
<td>.109</td>
</tr>
</tbody>
</table>

*Note.* N = Number; Report Expected and Report Observed were coded as 1 (Complied) or 2 (Denied).

**Inferential Statistics**

Hypotheses $0_1$, $0_{2-a}$, and $0_{2-b}$ were tested using the one-way between-subjects analysis of variance (ANOVA) test, and hypothesis $0_{2-c}$ was tested using two-way between-subjects ANOVA test. The alpha level was 0.05 throughout all research with four assumptions: (a) Normality, (b) Random Sampling, (c) Independence, and (d) Homogeneity of Variance.

Hypothesis $0_3$ was tested using a paired sample $t$-test with the 0.05 alpha level. Paired sample $t$-test had three assumptions: (a) Normality, (b) Random Sampling, (c) Equality of variance. For this research, not all assumptions held true because the variances were significantly different and convenience sampling was used for data collection.

**Just Culture by Cultural Background.** Table 8 shows the results of the ANOVA for the null hypothesis $0_1$ – the mean extent of Just Culture did not vary by Cultural Background. Not all of the assumptions held true for this set of data because variances were significantly different within the extent of just culture at $F(1,19) = 5.684, p < .05$. Therefore, the null hypothesis $0_1$ was rejected.
Table 8

*Description of one-way between subjects ANOVA test for Just Culture by Cultural Background*

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>7.200</td>
<td>1</td>
<td>7.200</td>
<td>5.684</td>
<td>.028</td>
</tr>
<tr>
<td>Within Groups</td>
<td>22.800</td>
<td>18</td>
<td>1.267</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30.000</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. df = Degrees of freedom*

The significant difference for just culture between two groups is graphically shown in Figure 8 below.

*Figure 8. The comparison of Just Culture between Korean and Western groups.*
**Reporting Culture by Just Culture * Cultural Background.** The two-way between subjects ANOVA was used to test the null hypothesis \( H_0 \) to compare the difference in Reporting Culture variable according to Just Culture and Cultural Background factors. The two-way between-subjects ANOVA test included two one-way between-subjects ANOVA tests for the null hypothesis \( H_{0a} \) and the null hypothesis \( H_{0b} \) to compare the following:

- Reporting Culture variables according to the Just Culture factor;
- Reporting Culture variables according to the Cultural Background factor.

Table 9 shows the results of the null hypothesis \( H_{0c} \) testing, including the null hypotheses \( H_{0a} \) and \( H_{0b} \) for its main effect tests.

Table 9

*Description of two-way between-subjects ANOVA test for Reporting Culture*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Observed Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>3</td>
<td>7.259</td>
<td>14.126</td>
<td>.000</td>
<td>.999</td>
</tr>
<tr>
<td>Intercept</td>
<td>1</td>
<td>38.672</td>
<td>75.253</td>
<td>.000</td>
<td>1.000</td>
</tr>
<tr>
<td>Safety Recognition</td>
<td>1</td>
<td>5.354</td>
<td>10.419</td>
<td>.005</td>
<td>.857</td>
</tr>
<tr>
<td>Background</td>
<td>1</td>
<td>5.025</td>
<td>9.778</td>
<td>.007</td>
<td>.835</td>
</tr>
<tr>
<td>Safety Recognition * Background</td>
<td>1</td>
<td>2.531</td>
<td>4.925</td>
<td>.041</td>
<td>.550</td>
</tr>
<tr>
<td>Error</td>
<td>16</td>
<td>.514</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** df = Degrees of freedom; Background = Cultural background

Not all of the assumptions held true for this set of data because variances were significantly different within the extent of reporting culture at \( F(1,19) = 4.925, p < .05 \) for the
null hypothesis $0_{2-c}$. Hence, the null hypothesis of $0_{2-c}$ was rejected. Figure 9 shows the significant differences of mean Reporting Culture by each group of four combinations.

![Bar chart showing mean Reporting Culture by Cultural Background*Just Culture Combinations](image)

*Figure 9. The comparison of Reporting Culture by Cultural Background * Just Culture.*

The main effects of significant difference between the four combination groups (Just Culture * Cultural Background) were from Just Culture factor and Cultural Background factor:

- $F(1,19) = 10.419, p < .05$ for the null hypothesis $0_{2-a}$;
- $F(1,19) = 9.778, p < .05$ for the null hypothesis $0_{2-b}$.

Thus, both hypotheses, $0_{2-a}$ and $0_{2-b}$, were rejected. Figure 10 shows the significant difference of mean Reporting Culture between Korean and Western groups. The graph showed a larger degree of mean Reporting Culture in Western group than Korean group.
Figure 10. The comparison of Reporting Culture between Korean and Western groups.

Figure 11 below shows the significant difference of mean Reporting Culture between High Just Culture and Low Just Culture groups. According to the graph, High Just Culture group showed larger degree of mean Reporting Culture than Low Just Culture Group.
Figure 11. The comparison of Reporting Culture between Low and High Just Culture groups.

**Reporting Culture by the Measurement.** To compare the difference in Reporting Culture variable according to the measurement factor, a paired-samples $t$-test was used. Not all of the assumptions held true for this set of data because variances were significantly different within the extent of reporting culture at $t(1,19) = 3.943$, $p < 0.05$ for the null hypothesis $0_3$. Hence the null hypothesis of $0_3$ was rejected. Below is Table 10 which describes the results of the $t$-test.
Description of paired samples t-test for Reporting Culture

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>t</th>
<th>df</th>
<th>sig</th>
</tr>
</thead>
</table>

*Note.* df = Degrees of freedom.

Figure 12 below shows the significant difference of mean Reporting Culture between expected data and observed data. According to the graph, observed Reporting Culture showed less degree of mean Reporting Culture than the expected Reporting Culture.

![Graph](image)

*Figure 12.* The comparison of Reporting Culture within subjects.

**Reliability testing.** Only participants with instrument rating were sampled for the experiment. However, more experienced, older, with higher academic grade, and more confident pilots in one group than another would possibly affect the recognition of safety and decision-
making for that group. Gender would be possibly influential on just culture and reporting culture.

To test for reliability of the results and check for confounds, independent samples $t$-tests were performed between Korean and Western groups with age, academic year, flight hours, confidence, and gender as factors. The tests revealed no significant difference in mean age, mean academic year, mean flight hours, mean confidence, and gender between the two groups, meaning that neither group included participants who had significantly different age, knowledge, experience and/or confidence. At the same time, there was no significant difference in gender components between the two groups. Table 11 shows the results of $t$-tests in more detail.

Table 11

*Description of independent samples $t$ tests for Korean and Western groups*

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>-1.846</td>
<td>18</td>
<td>.081</td>
<td>-1.800</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>-1.846</td>
<td>15.497</td>
<td>.084</td>
<td>-1.800</td>
</tr>
<tr>
<td><strong>Academic Year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>.325</td>
<td>18</td>
<td>.749</td>
<td>.100</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>.325</td>
<td>12.961</td>
<td>.750</td>
<td>.100</td>
</tr>
<tr>
<td><strong>Flight Hours</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>-1.737</td>
<td>18</td>
<td>.099</td>
<td>-173.400</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>-1.737</td>
<td>9.865</td>
<td>.113</td>
<td>-173.400</td>
</tr>
<tr>
<td><strong>Confidence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>-1.524</td>
<td>18</td>
<td>.145</td>
<td>-1.100</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>-1.524</td>
<td>15.888</td>
<td>.147</td>
<td>-1.100</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>.600</td>
<td>18</td>
<td>.556</td>
<td>.100</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>.600</td>
<td>16.691</td>
<td>.557</td>
<td>.100</td>
</tr>
</tbody>
</table>

*Note.* df = Degrees of freedom; Gender was coded as 1 (Male) or 2 (Female).
Chapter V

Discussion, Conclusions, and Recommendations

Through analyzing the results in Chapter IV, the researcher was able to assess the effects of the observation method to measure Reporting Culture, the effects of Cultural Background on Just Culture and Reporting Culture in CRM, and the effects of Just Culture and Cultural Background on Reporting Culture. The following sections discuss pertinent observations associated with the data collected and recommendations for further research.

Discussion

**Just Culture by Cultural Background.** After the analysis of the experiment data was completed, it was found that not all student pilots considered the flight setting and the instruction in the experiment to be unsafe. This finding was unexpected as the flight conditions and the instruction for the experiment were intentionally designed to be non-compliant with the FAA regulations. Therefore, the researcher presumed that the participants knew that the instruction was unsafe. However, a survey that was provided to the participants after the simulated flight revealed that most participants did not recognize that the flight setting and the instruction were not compliant with the FAA regulations and generally unsafe. Furthermore, there was a significant difference between participants with different cultural backgrounds. Korean participants recognized that the simulated flight was unsafe more frequently than Western participants. By generalizing these findings to the population, it is suggested that Korean pilots can detect potential danger during the flight with higher probability than pilots from Western cultures.

**Reporting Culture by Cultural Background * Just Culture.** The rejected null hypothesis $0_{2\cdot c}$ means that Reporting Culture varied between Cultural Background and degree of Just Culture factors. Generally, pilot participants from the Western culture with High Just
Culture showed the best Reporting Culture. On the other hand, Korean pilots with Low Just Culture showed the worst Reporting Culture.

Cultural Background had a main effect on a student pilots’ decision to report unsafe conditions. This implies that, generally, when it comes to Korean culture, a pilot may have difficulties in expressing their opinion. A Western pilot, however, may feel less difficult to speak out their opinion. In fact, the way the participants questioned the experimenter’s unsafe instruction was different between Korean and Western groups. Korean participants were more careful to represent their opinion regarding the instruction. Most frequently, Korean participants asked the researcher to confirm the instruction, e.g., “Did you say 4,500 feet?” or “Do you want me to descend to 4,500 feet?”. Participants from Western group, on the other hand, either denied the instruction (e.g., “Unable”) or tried to “negotiate” with the researcher, e.g., “I will descent to 6,500 feet only, not to 4,500 feet.”

Just Culture was also found to influence Reporting Culture. The Low Just Culture group showed less Reporting Culture than the High Just Culture group. Thus, better Just Culture implies that a pilot better recognizes an unsafe situation, and better Reporting Culture implies that a pilot is ready to willingly report an unsafe situation.

When two factors (Cultural Background and Just Culture) affect Reporting Culture, just Culture has a more positive impact on Reporting Culture than Cultural Background. The observed power of Just Culture was 0.857, and the observed power of Cultural Background was 0.835. This explains the fact that among the combinations of two factors, pilots with High Just Culture from Korean group showed better Reporting Culture than pilots with Low Just Culture from Western group.

**Reporting Culture by the Measurement.** With the assumption that there would be a significant difference between the data set from experiments (observed data) and surveys
(expected data), the researcher compared the mean difference between two sets of data with the same objective. The objective was to identify how many participants refuse the unsafe instruction which is coming from a person of higher rank (in this experiment, it was the researcher). The difference between observed data and expected data was significant. In general, participants tend to exaggerate in their answers to surveys. More participants said that they would report an unsafe action than those who did report it during the experiment. Thus, it is recommended to utilize experiments, as opposed to surveys, to analyze pilot behavior. Using experiments can lead to more objective results.

Conclusions

This research looked at differences in behavior between people of Western and Korean cultures. Most research performed on East Asian culture focused primarily on Chinese culture (Liao, 2015; Bedford, 2011; Tsui et al., 2006). East Asian cultures do differ from each other, thus it is worth exploring each culture in particular.

A different approach is required for application of CRM in Asian and Western cultures. Pilots from Asian cultures need to focus on having better Reporting Culture because other factors can affect their behavior. Namely, hierarchy, authority, and collectivism may stop an Asian pilot from reporting an unsafe act or observation. However, pilots from Western culture need to focus on having a better Just Culture. If Western pilots are good at recognizing unsafe conditions, the Reporting Culture will also improve because they will have fewer problems to report.

Hence, it is recommended that ICAO regulations for CRM consider cultural differences. At the same time, the researcher recommends that aviation industry and airlines from countries with Asian culture to try to avoid extreme hierarchy levels and train pilots to be more open to speaking up their opinion. It is also suggested for the aviation industry and airlines from
countries with Western culture to intensify safety education of pilots for better recognition of unsafe acts and behavior.

Hence, the researcher concluded that Korean culture may have a positive impact on pilot’s ability to detect an unsafe situation during the flight, while Western culture may not have similar impact.

**Recommendations**

Further research with increased sample size for each group is recommended. This research study was limited in that all participants, including the Korean group, were students of ERAU, which is located in the USA. Therefore, all Korean participants have spent time in the United States and may have been influenced by Western culture. To increase the clarity of the results, further research is suggested by sampling Korean participants from Korea. The next recommended step is to randomly sample participants from the airline pilot population, as opposed to student pilots. Additionally, to reach a broader audience and raise the awareness of cultural impacts on safety, other cultures, such as Arabic, African, and South American, should also be included in further research. More details can be added to the experiment to determine what specific cultural factors influence safety culture and behavior in pilots. This research can be elaborated with focus on Asian culture by comparing participants of different age, gender, and rank, who are sampled from Korea, China, and Japan.
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Appendix A

Flyer

Looking for Pilot Volunteers for a Paid Research Study!

- Looking for undergraduate student pilots from Korea, USA, Canada, or Europe!
  - Takes 30-45 minutes to complete
  - You will receive $20 for participation
- The study includes a flight in a flight simulator and a survey

If you would like to participate, contact Jiyeon Song at
songj3@my.erau.edu or (386) 310-9948

Appendix B
Consent Form

AGREEMENT TO PARTICIPATE IN

The Effects of Cultural Background on Decision Making in Pilots STUDY LEADERSHIP.

I am asking you to take part in a research that is part of a Graduate Capstone Project that is part of a thesis study led by Jiyeon Song, graduate student, EmbryRiddle Aeronautical University. PURPOSE. To evaluate the effects of culture on pilot decision making during flight. ELIGIBILITY. To be in this study, you must be at least 18 years old, have a private pilot’s license or higher and be a citizen of South Korea or any of the countries considered Western (i.e., USA, Canada, or European countries). PARTICIPATION. You will fly a short flight in a flight simulator. You will be provided with all necessary information for the flight. Your participation in this study should not take longer than 1 hour to complete. RISKS OF PARTICIPATION. The risks of participating in this study are minimal, no more than from using a computer on a daily basis. The main risk associated with using a flight simulator is the development of motion sickness. The symptoms of motion sickness are fatigue, dizziness, and vomiting. If you are noticing any of the aforementioned symptoms, please inform the researcher and discontinue the use of the flight simulator. BENEFITS OF PARTICIPATION. I do not expect the study to benefit you personally. Your assistance in this project will help identify the effect that cultural differences may have on pilot actions during the flight. These findings may potentially improve pilot training in the future. COMPENSATION. You will receive $20 as a compensation for participating in the study. VOLUNTARY PARTICIPATION. Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which the participant is otherwise entitled. Should a participant wish to discontinue the research at any time, no information collected will be used from that participant. PARTICIPANT PRIVACY. Your individual information will be protected in all data resulting from this study. Your responses to the questionnaire will be stored in a locked file cabinet. You will be assigned a participant number, and all data collected during the study will be associated with the participant number. No names will be collected to be further associated with participant data. No one other than the researcher will have access to any of the responses. FURTHER INFORMATION. If you have any questions or would like additional information about this study, please contact Jiyeon Song, songj3@my.erau.edu, or the faculty member overseeing this project, Dr. Steven Hampton, hamptons@erau.edu. The ERAU Institutional Review Board (IRB) has approved this project. Should you have any concerns regarding your participation in this research, you may contact the ERAU IRB Office at (386) 226-7179 or via email to teri.gabriel@erau.edu. ERAU’s IRB is registered with the Department of Health & Human Services – Number – IORG0004370. CONSENT. Your signature below means that you understand the information on this form, that the researcher has answered any and all questions you may have about this study, and you voluntarily agree to participate in it.

Signature of Participant ___________________________________ Date ____________________

Printed Name of Participant ________________________________

Signature of the Researcher __________________________________ Date ____________________

Printed name of the Researcher _______________________________
Appendix C-a
Survey 1
Participant # ____

1. What is your age?
   _______ years

2. You are:
   a. Freshman
   b. Sophomore
   c. Junior
   d. Senior
   e. Graduate student
   f. Other: ________________

3. List all pilot licenses that you currently have:

   __________________________________________________________________________

4. How many flight hours do you have?

   __________________________________________________________________________

5. What is your country of origin?

   __________________________________________________________________________

6. If your country of origin is Korea, how many years have you spent living outside of Korea?

   __________________________________________________________________________
Appendix C-b
Survey 2

Participant # _____

1. On a scale from 1 to 10, how confident are you in the decisions you made during the flight?

   1  2  3  4  5  6  7  8  9  10

   Not confident at all                              Very confident

2. When you were instructed to descend, did you comply with the instruction or refuse it?

   Complied                                       Refused

3. What was/were the reason(-s) for this decision?

   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

4. Would you report another ERAU pilot’s rule violations regardless of their rank and age?

   Yes / No

5. Have you ever felt uncomfortable working with a colleague who had a higher rank, position, etc.? Provide details if possible

   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

Appendix D

Oral Instructions

For this experiment, I will be your flight instructor. We are starting mid-flight, at 7000 feet, and we will be performing an approach to Asheville Airport. In front of you, you have weather information in the area and all relevant charts for the flight – feel free to use them any time during the flight. As your flight instructor, I will be issuing several instructions during the flight, and I ask you to comply with them to the best of your ability. Try to maintain airspeed of 100 kts unless I ask you to decelerate or accelerate. Maintain last assigned altitude until you receive the next instruction. I will also be asking you several questions. Assume that this is a real flight, so please consider safety as well. You are not required to maintain ATC communication; also, please ignore any airspace restrictions for this flight. Let me know when you are ready.

0. Descend to 6,000 feet
1. Turn left heading 0-9-0 degrees
2. What is your current airspeed?
   a. _____________
3. Climb to 6,500 feet
4. Increase speed to 105 knots
5. Turn right heading 1-5-0 degrees
6. What is your current altitude?
   a. _____________
7. Turn right heading 1-8-0 degrees
8. Reduce airspeed to 95 knots
9. Increase speed to 100 knots again
10. Descent to 4500 feet
11. Turn left heading 1-0-0 degrees

12. Overall, how safe do you think the instructions and flight are? (in your own words)
   a. _____________

“Okay, let’s stop the flight session.”
Appendix E
Weather Report (METAR)

KAVL DDHHMMZ 16001KT 10SM BKN030 17/9 A2992

Other flights in the area reported a layer of broken clouds with top at 5000 feet and base at 3000 feet

SIGMETs.... None

Icing.... None reported or expected

Turbulence.... None reported or expected
Appendix F

Sectional map of KAVL airport area with terrain heights
Appendix G

Instrument approach chart for KAVL airport