The Extent of Distraction of Cell Phone Conversations for Passengers in Simulated Flight

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THE EXTENT OF DISTRACTION OF CELL PHONE CONVERSATIONS FOR PASSENGERS IN SIMULATED FLIGHT

by

Tianhua Li

A Thesis 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 2017
THE EXTENT OF DISTRACTION OF CELL PHONE CONVERSATIONS FOR PASSENGERS IN SIMULATED FLIGHT

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This Thesis was prepared under the direction of the candidate’s Thesis Committee Chair, Dr. Andrew R. Dattel, Assistant Professor, Daytona Beach Campus, and Thesis Committee Members Dr. Dahai Liu, Professor, Daytona Beach Campus, and has been approved by the Thesis Committee. It was submitted to the Department of Graduate Studies in partial fulfillment of the requirements for the degree of Master of Science in Aeronautics

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Abstract

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Year: 2017

Currently, passengers are forbidden from making cell phone calls during flights in the United States due to cellular electronic interference. However, some related research has demonstrated that the use of cell phones has little interference with avionics. Furthermore, any potential electronic interference can be eliminated by using new technology. Although talking on the cell phone does not cause electronic interference, the distraction of a passenger caused by a cell phone may negatively impact safety. The cell phone calls have been found to affect people’s attention and performance. In-flight announcements are popular methods to inform commercial airliner passengers of their situation and aircraft’s status. If a passenger’s attention is distracted from the announcements by the phone call, it would inhibit the passenger from being aware of important information. Nevertheless, little research is about the distraction of the in-flight announcements caused by cell phone calls. The purpose of this study was to compare the extent of safety compliance (checking seatbelts, raising tray tables) and retention of announcements among three groups: cell phone conversation, face-to-face conversation (i.e., talking with the passenger next to them), and control. Findings revealed that the cell phone group and the face-to-face group memorized less information
from safety announcement and complied with safety behaviors to a lesser degree than the control group. The face-to-face group was not safer than the cell phone group on any measure. Therefore, it is recommended that lifting the ban on in-flight cell phone calls should be considered.
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Chapter I

Introduction

On July 6, 2013, a Korean registered Boeing 777-200ER for Asiana Airlines Flight 214 struck a seawall at San Francisco International Airport (SFO) when approaching to the runway. Three of 291 passengers were fatally injured. Surprisingly, two of the three fatally injured passengers had been ejected from the airplane immediately after the impact and were killed. The reason why they were ejected was because they were not wearing seatbelts during the impact (Aarons, 2014). However, it is not a unique case that passengers do not fasten seatbelts at times when the captain has ordered that all passengers faster their seatbelts. Reportedly, approximately 58 passengers are injured from turbulence in the United States every year while they are not wearing seatbelts. Moreover, at least two-thirds of passengers who were killed during turbulence accidents from 1980 to 2008 were not wearing seatbelts (Davies, 2013). The reason why passengers do not comply with fastening seatbelts when required to do so may not be intentional; rather, it may be due to being distracted during announcements or other indications. Consequently, this study will examine the extent to which conversations distract passengers from complying with safety announcements.

Significance of the Study

Cell phone calls are currently banned on commercial flights by the FCC. The primary reason for the ban is the safety concern due to radio interference (Ritchie, 1996). Nevertheless, Kuriger, Grant, Cartwright, and Heirman (2003) stated that there is no electronic interference with airplane's avionics that is caused by cell phones or other portable electronic devices (PEDs). Moreover, new technology may make electronic
interference of phone calls no longer an issue. Therefore, the ban on in-flight cell phone use could potentially be lifted in the United States.

However, the distraction of in-flight announcements for passengers may also jeopardize safety. Unfortunately, little research has been conducted concerning the distraction of passengers when talking on cell phone on commercial flights. This experiment will help determine the extent of distraction of cell phone calls for passengers when compared with passengers having a conversation with the person sitting next to them. The results of this experiment may provide the necessary information needed to determine if the ban on cell phone calls on commercial flights should be maintained concerning passenger distraction.

Statement of the Problem

Currently, passengers are forbidden from making phone calls on aircraft. Although the cell-phone-caused electronic interference has been proven by some researchers to be non-exist, other factors, such as distraction, should also be under consideration. In comparison to other interactions (e.g. chatting in person), making phone calls is different. To be specific, two passengers, who are talking with each other in person, are under the same environment, and they may be aware of the similar information. In this sense, once one passenger notices the announcements, the passenger can modify or stop the conversation and remind the other passenger to pay attention to the indications. By contrast, the one who is talking with a passenger on the phone is not aware of the situation in the cabin; and as a result, the person on the other side of the phone may keep grabbing the attention of the passengers.
Purpose Statement

Regarding the statements above, there is a possibility that a passenger's situation awareness could deteriorate due to phone calls, and it may cause a delayed response to an emergency. This research identifies the extent to which in-flight phone calls can affect the attention of passengers to announcements in comparison to conversations in person. The purpose of this study is to determine whether the FCC should keep banning in-flight cell phone calls, though the electronic inference may no longer an issue in the near future.

Hypotheses

There are five null hypotheses in the study.

H₀₁: There is no significant difference in the retention of general in-flight announcements between cell phone conversation (cell phone) group and face-to-face conversation (F-F) group.

H₀₂: There is no significant difference in the retention of emergency announcements between cell phone group and F-F group.

H₀₃: There is no significant difference in compliance and reaction time to put tray table down between cell phone group and F-F group.

H₀₄: There is no significant difference in compliance and reaction time to put tray table back between cell phone group and F-F group.

H₀₅: There is no significant difference in compliance and reaction time to fasten or visibly check seatbelts between cell phone group and F-F group.

List of Acronyms

 DOT Department of Transportation
 EU European Union
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>FAA</td>
<td>Federal Aviation Administration</td>
</tr>
<tr>
<td>FCC</td>
<td>Federal Communications Commission</td>
</tr>
<tr>
<td>IFR</td>
<td>Instrument flight rules</td>
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<tr>
<td>PED</td>
<td>Portable electronic devices</td>
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<tr>
<td>POMS</td>
<td>Profile of mood state</td>
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<td>SA</td>
<td>Situation awareness</td>
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Chapter II

Review of the Relevant Literature

Currently, passengers are prohibited from making cell phone calls on commercial airliners in the United States in terms of related regulations. As a premise of this study, the safety considerations as they relate to in-flight cell phone calls will be discussed in this chapter. It includes the electronic interference with avionics systems and the ground network caused by in-flight cell phone calls, feasible solutions to solve electronic interference, and current federal and European regulations. Moreover, the human factor issues that are relevant to in-flight cell phone conversations will be reviewed. They consist of SA, attention, and their definition and methodologies of related studies.

Electronic Interference Caused by Cell Phones

Some research has demonstrated the electromagnetic compatibility of cell phones and important aircraft avionics. For example, the research that was conducted by Kuriger et al. (2003) showed no electronic interference of cell phones with aircraft electronic systems. They investigated the spurious emissions levels in the frequency bands of aircraft communication and navigation equipment. The experimenters put a cell phone at a distance shorter than the distance between any cell phone and aircraft equipment antennas in the real world. Two chambers were set up to test various avionics systems, including VOR, LOC, VHF, GS and GPS. In the experiment, the phone was set to simulate the worst mode of transmission and to transmit at maximum power. Despite this, the radio emissions created by the phones during testing did not interfere with the avionics systems, and spurious emission levels of all phones complied with the FCC regulations.
Li, Xie, Ramahi, Pecht, and Donham also (2002) maintained that avionics systems were qualified with requirements for electromagnetic susceptibility, and there were sufficient margins between the tested susceptibility levels and expected airplane-environment noise levels. However, they stated that it was possible that an uncontrolled source of electromagnetic energy radiated emission levels above the tested levels. Moreover, many other researchers suspected the electromagnetic compatibility of PEDs and important aircraft avionics, and they reached opposite conclusions. Ely and Ross (2001) discovered that a wide variety of PEDs, especially cell phones and laptops, had the potential to cause anomalies with aircraft systems. Strauss, Morgan, Apt, and Stancil (2006) stated similar findings. They demonstrated that the operation of PEDs could potentially interfere with aircraft systems and have a negative effect on flight safety. The interference was due to the electromagnetic emissions that PEDs create. Furthermore, Kreitmair and Tauber (2002) presented that it cannot be guaranteed that the actual limit curve of the standards for aircraft systems was sufficient to be immune to PED emissions.

Nevertheless, most cell phones cannot receive a signal from ground cellular stations after a plane reaches cruise altitude in general. Even if a phone call interferes with electronic devices, the cell phones without signal do not interfere with electronic devices. Additionally, some modern technologies have the abilities to prevent the interference of cell phone calls. For example, existing technology, Picocell makes the inflight phone calls possible. It is a low-powered operator-deployed base station, and it has the ability to improve the coverage of hot spots and cell edge with a 10-200 m radius (Kumar, Kalyani, & Giridhar, 2015; Wu, Murherjee, & Ghosal, 2004). When it is installed on aircraft, the cell phone signals pass from the Picocell to a satellite link and
are transmitted to the ground network. This technology prevents transmission from reaching the ground and eliminates the interference with the ground network (Lopano, 2011). Thanks to Picocell technology, the EU planned to allow the passengers to make phone calls over the base stations located on the airplanes (“European Union Approves,” 2008). Now new EU rules and conditions have been established to allow commercial flight passengers to make phone calls in the air.

**Federal Regulations about In-flight Cell Phone Use**

Although in-flight cell phone calls are permitted in Europe, it is still prohibited in the United States. Related regulations were mainly established by the FAA and the FCC. The FAA’s regulations cover the cell phone use in aircraft which are on the ground, and the cell phone use in the air is constrained by the FCC.

**FAA regulation.** In 2006, the FAA sent out Section 91.21-1B, Use of Portable Electronic Devices Aboard Aircraft, to prohibit the use of PEDs that were not installed on civil aircraft while operating under IFR (Federal Aviation Administration, 2006). It was mainly due to the potential that PEDs interfere with aircraft navigation or communication systems. As for cell phones, only the aircraft is at a gate or is awaiting a gate, passengers are allowed to use cell phones; but when the aircraft is taxiing, the cell phone use is prohibited. When the aircraft is in the air, the cell phone use is restricted by the FCC. In 2013, the FAA has allowed airlines to safely expand passenger’s use of PEDs during all phases of flight (Federal Aviation Administration, 2015). Although the operation of PEDs has been permitted, voice communications or cellular connections on cell phones were still forbidden. Passengers were required to use PEDs in airplane mode or with the cellular connection disabled, and they could only use the Wi-Fi connection (Federal
Aviation Administration, 2013). In 2015, the Section 91.21-1B has been canceled, and the Section 91.21-1C became effective. This new rule has approved the operation of particular PEDs that have been demonstrated will not affect the safe operation of the aircraft (Federal Aviation Administration, 2015). This rule also allowed the operation of cell phone use when the aircraft is on the ground. Unfortunately, the FCC still prohibits the use of cell phone while airborne.

**FCC regulation.** According to Title 47 of the Code of Federal Regulations (47 CFR) part 22, § 22.925, cell phone use is not allowed on aircraft in the air without the ones that enable control of onboard mobile devices and eliminate the interference between ground-based cellular stations with airborne cellular devices. In other words, if the aircraft is equipped with new specialized onboard equipment, the restriction will be invalid for the aircraft. Moreover, the DOT stated that the FCC’s current regulations are not effective for the communications via Wi-Fi. The FCC has not prohibited the use of voice communication technologies, such as Skype, Apple FaceTime, and Google Hangouts on planes (Zhang, 2016). In this case, the passengers are actually allowed to make voice calls on commercial airliners. In addition, the DOT announced that the FCC has been considering to list the ban (Zhang, 2016).

**Situation Awareness**

The electronic interference with avionics systems and ground base stations may no longer be a problem. However, there could be another safety factor that should be under consideration. This factor is the effect of the cell phone conversations on passengers’ SA of condition they are under.
SA has been defined in a variety of ways in terms of different operators. A large amount of them has been defined from the perspective of pilots. Endsley (as cited in Endsley & Jones, 2011) defined SA as “the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future.” Endsley (2000) simplified the definition of SA as “knowing what is going on around you”. Durso, Bleckley, and Dattel (2006) provided a more practical definition. That is the people’s comprehension of the situation.

SA originated from aviation and commonly studied across several domains, but the studies about the flight passengers’ SA are infrequent. Although passenger’s SA is not same as the pilot’s SA, passenger’s SA is also in compliance with the Endsley 1995 model, which is one of the most frequently used models of SA. Endsley (2015) believed that one key factor of the model is SA’s three levels, which are perception, comprehension, and projection. The three levels of SA can be applicable to flight passengers as well. When flight announcements are being presented, passengers need to perceive their surroundings and notice the happening of announcements. Then, it is necessary for them to understand what the announcements mean and predict what will happen to them shortly. After that, they are able to initiate responses to the announcements, such as fastening seatbelts.

However, if passengers are focusing on cell phone conversations, they have to conduct dual tasks to listen to flight announcements while conversing on cell phones. In this case, there is more than one thing that passengers need to pay attention to, and there could be a problem with the passengers’ very first level of SA (i.e., perception). Under this kind of situations, mental models can help passengers process the information
accurately. The mental model has been defined by Endsley and Jones (2011) as “a systematic understanding of how something works.” It assists people to determine what information is crucial to focus, and it enables high levels of SA, which are comprehension and projection (Endsley & Jones, 2011). Nevertheless, when information is redundant, people may become less aware of the information. This kind of situation may occur if the in-flight announcements, especially the emergency announcements, are being played while passengers are conversing on the cell phone. Consequently, the passenger may miss the best time to follow the announcement instructions and ensure their own safety. Therefore, passengers’ abilities to shift attention from cell phone conversations to flight announcements need further investigation.

Attention

Attention is different from SA. Attention was defined by Sheridan (2007) as “the focusing of sensory, motor, and/or mental resources on aspects of the environment to acquire knowledge.” It can be voluntary or involuntary, and it can be exteroceptive or non-exteroceptive (Sheridan, 2007).

Study about the attention of flight passengers. Molesworth (2014) conducted a study, which was related to flight passengers’ attention. The primary purpose of this study was to test participants’ memorability for the important safety messages mentioned in different pre-flight safety videos, and the secondary purpose was to identify the changes in participants’ mood when they were watching different pre-flight safety videos. Because only the first purpose is related to the research about passenger’s attention, the methods that were applied to accomplish the second purpose will not be reviewed. In the experiment, there were three videos. Video A was acted by airline employees simply to
address safety messages, and there was no humor in both audio and visual. Video B was similar to Video A, but it contained many audio humors and visual humors. Unlike Video A and B, Video C was acted by a Hollywood actor, and there was only one humor in the video.

Participants in different groups were asked to watch one of three videos. Soon after they had watched the videos, they were asked to complete a comprehension test to measure the passengers’ retention of pre-flight safety videos. Then, participants took their own lectures for two hours. After the lectures, they were requested to finish the second comprehension test. The numbers of key safety messages that passengers could recall were collected and analyzed. The results showed that for both tests, participants recalled more key safety messages in Video B and C than Video A. It revealed that passengers are prone to be attracted by the safety videos with humors or celebrities.

**Multitasks.** Usually, flight passengers tend to be occupied with something that interests them (e.g., reading books, listening to music, and talking with other passengers) during flights, especially long trips. However, people do not have the capacity to parallel multitasks (Lien, Ruthruff, & Johnston, 2006). If there is an external stimulus, such as an announcement or an abnormality, passengers need to allocate attention. Attention allocation is “a form of decision behavior that depends heavily on stored information about objects and events with respect to their interrelationships in time, space, magnitude, and relevance,” and it decides what things that mental resources should be focused on (Sheridan, 2007). In this case, people have to pay frequent attention to external objects according to their importance or rate of change (Endsley & Jones, 2011). Consequently, passenger’s attention to the most important task will be impaired.
**Cell phone conversations.** Cell phone use is usually one of the tasks when people are conducting multitasks. There are many studies that are about the influence of the cell phone conversations on their primary tasks. Driving is a popular primary task that appears in other studies.

A significant amount of research has demonstrated that cell phone use during driving has a significantly negative influence on driving performance. Drivers using cell phone pay less attention to traffic, less attention to signals, have slower reaction time, the poorer memory of roadside objects, and negative effects of other driving critical issues (Strayer, Drews, & Johnston, 2003). Redelmeier and Tibshirani (1997) concluded that in nearly 24% of car accidents, drivers had used cell phones within a 10-minute period prior to the accidents. When drivers use cell phones while driving, the likelihood of being involved in a car accident increases by a factor of 3. They also asserted that the person who uses a cell phone while driving behaves the same as a person who drives with a blood alcohol level above the legal limit. Furthermore, Strayer and Johnston (2001) concluded that engaging in cell phone conversations largely increases the likelihood of missing traffic signals. Although some cell phone users succeeded in noticing the traffic signals, they still took a longer time to respond to red lights. Strayer et al. (2003) investigated that cell phone conversations impaired the reactions of drivers to frontal vehicles braking. Consequently, some states forbid drivers from using cell phones during driving.

Legislators attributed the bad performance in driving to dialing and holding phones instead of distraction caused by cell phone conversations (Strayer & Johnston, 2001). When drivers are dialing, they have to look away from the road. Under this
situation, the drivers are most likely not as vigilant in their driving tasks, therefore, negatively affecting their responses to emergency situations, such as frontal cars braking. Similarly, when drivers are holding cell phones, their hands are occupied. Even if drivers notice the emergency situations, holding phones would slower their movements to avoid accidents. Although they seem reasonable, they may not be the reasons why cell phone calls lead to accidents. Strayer et al. (2003) argued that the true factor that caused the increase in the likelihood of car accidents should be the distraction caused by conversations from driving. According to a preliminary analysis in a simulated driving task, even if drivers used hand-free phones, there was no significant difference in driving performance in comparison to handheld phones. Therefore, it is possible that the reason why cell phone conversations increase the likelihood of being involved in a car accident is because of increases in diverting attention from the external environment to conversation itself, rather than dialing or holding phones.

Moreover, the difference in the likelihood of accidents between single-task driving and dual-task driving was exacerbated by traffic density. A driving simulation study demonstrated that most accidents happened when participants were conversing on cell phones in high-density traffic conditions; on the contrary, the participants were less likely to be involved in car accidents when they were conversing on cell phones in low-density traffic conditions (Strayer et al., 2003). Similarly, if aircraft passengers are involved in dual tasks, which are conversing on cell phones and listening to in-flight announcements, emergency situations may worsen their performance in following announcement instructions.
Comparison between cell phone conversations and other distracting tasks.

Conversing on cell phones is unlike conversing with passengers in the car. Passengers who sit in the car are aware of the driving situation. They will modify their conversations (e.g., stop the conversation, and remind the driver of dangers in the conversation) according to surroundings and traffic situation. Similarly, in the cabin, when one passenger is conversing with other passengers, other passengers may modify the conversation under different situations; by contrast, when the passenger is conversing on the cell phone, the person on the other side of the phone does not know the situation in the cabin and will not modify the conversation. Furthermore, conserving on cell phones is not similar to listening to radio broadcasts or listening to a tape as well. Although listening to radio broadcasts or a tape may also distract driver’s attention from driving, the effect of phone calls on attention is more detrimental. Strayer and Johnston (2001) examined that listening to radio broadcasts or listening to a book on tape does not impair driving performance. In comparison, driving performance was adversely effected when drivers talk on cell phones.

Importance of attention in the cabin. Regarding possible safety issues in the cabin, there are two main concerns of passenger’s attention. One is their attention to announcements and seatbelt signs, and the other one is their attention to abnormalities. If they fail to attend to these two kinds of information, it may lead to their own and other passengers’ injuries.

Importance of Fastening Seatbelt. Although most in-flight announcements are about meals and advertisements, some may be emergency announcements, which instruct passengers to take precaution measures. For example, fastening seatbelts is one of the
most common types of instruction that emergency announcements present. If flight passengers are distracted by the cell phone conversations from the emergency flight announcements, they may be unaware of the announcement instructions to fasten their seatbelts. The failure to follow the instructions may put themselves and other passengers at risk. If sudden turbulence occurs, a passenger who is not wearing a seatbelt may be suddenly lifted out of their seats and hit armrests, carts, or other passengers (Toohill, 2015). Some may argue that wearing seatbelts could prevent passengers from evacuating from aircraft more quickly after a crash and make passengers stuck. According to the accident of Asiana 214, Hiatt (as cited in Davis, 2013) suggested being stuck by seatbelts after a crash is better than being lifted in the air.

In 2013, Asiana flight 214 was flying from Seoul to San Francisco with 291 passengers, 12 flight attendants, and four flight crewmembers on board. During an unstabilized visual approach, the main landing gear and aft fuselage hit the seawall at the airport at the speed of 122 mph. The injuries of three passengers were fatal. Another 40 passengers, eight flight attendants, and one flight crewmembers were seriously injured. Two of the passengers who received fatal injuries and four of the flight attendants who seriously injured were ejected from the airplane. Unfathomably, these two passengers were not wearing seatbelts during the impact, so they ejected from the cabin. If they had worn the seatbelts before landing, they may have remained in the seats and survived the crash (Aarons, 2014).

There are many other cases that aircraft passengers receive injuries caused by turbulence because of not wearing seatbelts. In 2014, a Singapore Airlines flight SQ 308 encountered turbulence and dropped 65 feet. Eleven passengers and one crewmember
were injured. Brown (as cited in Davis, 2013) announced approximately 58 people in the United States are injured in the event of turbulence every year while they are not wearing seatbelts. She also concluded that three passengers were killed due to turbulence accidents between 1980 and 2008, and at least two of them downplayed the seatbelt signs and did not fasten seatbelts.

**Importance of noticing abnormalities.** Moreover, the failure to follow the announcement instructions is not the only hazard the passengers may encounter when they are distracted by cell phones. Sometimes, passengers need to notice the dangers on their own. Chang and Yang (2010) asserted that most of the passengers would be aware of abnormal conditions before the flight crewmembers informed them. By watching videos and analyzing data, they found before an evacuation was issued, passengers had already started to evacuate. Although flight crewmembers are the professionals who have the ability to perceive abnormal conditions, there are too few of them; by contrast, the number of passengers is much more than flight crewmembers, and passengers are located everywhere (Chang & Yang, 2010). Therefore, passengers are more prone to notice abnormal conditions in comparison to the crewmembers.

In this case, passengers’ attention is more important. The distraction of cell phone conversations is not merely from the announcements, but also from their surroundings. If they succeed in noticing abnormal conditions, they may save all the occupants in the cabin, including passengers, flight attendants, and even pilots.

**Summary**

Legislation currently bans passengers from using cell phones on commercial flights. The ban was introduced because of potential electronic interference with the
communication and navigation equipment on the aircraft and the interference with cellular stations on the ground. However, some researchers suggest that the interference with avionics systems is minimal or nonexistent. Moreover, new technology can protect the ground base stations from being interfered with by in-flight cell phone calls, and voice calls are allowed over aircraft -based Wi-Fi. Therefore, lifting the ban of the passenger cell phone conversation is under consideration.

Although few studies are about the distraction of cell phone calls from flight announcement, some research has examined the distraction caused by cell phone for drivers. Related research demonstrated conversing on cell phones adversely affected drivers’ performance in driving. If cell phone conversations have an effect on performance in driving, it would very likely influence passengers’ attention to in-flight announcements. In this case, passengers may not be able to listen to and adhere to announcement instructions, which could instruct passengers to fasten seatbelt and raise tray tables. Moreover, conversing with other passengers may also affect their attention, but the influence is lesser than conversing on cell phones because other passengers will modify conversations regarding the situations they are under.

This study will determine if participants talking on cell phones in a simulated commercial flight distract attention to a greater degree than participants talking to a passenger seated next to them. Specifically, this study will test participants’ retention of the in-flight announcements (general and emergency) and their compliance and response time for certain actions (e.g., fastening seat belts).
Chapter III
Methodology

Population

Fifty-two participants were selected for this study. Requirements for participation included fluency in English, and all participants had flown on a commercial flight within recent memory. All the participants had normal hearing abilities, which were assessed by simply asking the participants if they have any hearing deficiencies. Participants were students enrolled at Embry-Riddle Aeronautical University (ERAU). Participants were randomly assigned to one of three groups: Group A (cell phone communication group), Group B (face-to-face conversation with a confederate playing the role of a passenger), and Group C (control group).

Confederates and Experimenters

A confederate is a coresearcher or an actor who pretends to be a participant in the research study. There were three confederates and two experimenters. Experimenter A conversed with Group A participants on the cell phone (remotely located), and Confederate B sat next to Group B participants. Confederates C and D were seated next to participants. Participants and confederates switched seats after each session to counterbalance. Experimenter E played the role of a flight attendant and stood behind the seats. Confederates C and D, and Experimenter E memorized participants’ compliance with instructions and recorded the time it took each participant to check that seatbelts were fastened and put tray tables down and back. Also, Experimenter E reminded participants to lower tray tables before emergency announcements played.
Materials.

The experiment was conducted in the Cognitive Engineering Research in Transportation Systems (CERTS) Lab. A room in the lab was set up to simulate a commercial aircraft cabin.

Seats. Four sets of aircraft seats, a total of 12 seats, were placed in the room. The seats were equipped with seatbelts and tray tables. For the purpose of ensuring that participants could use seatbelts and tray tables, only the seats in the back row were utilized. The seat layout is shown in Figure 1. Group seating positions were counterbalanced across the seats. To minimize the influence of crosstalk, participants in the cell phone group and the face-to-face group were always seated on opposite side of the aisles (see Appendix B).

<table>
<thead>
<tr>
<th>(Empty)</th>
<th>(Empty)</th>
<th>(Empty)</th>
<th>Aisle</th>
<th>(Empty)</th>
<th>(Empty)</th>
<th>(Empty)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant Or Confederate</td>
<td>Participant Or Confederate</td>
<td>Participant Or Confederate</td>
<td>Participant Or Confederate</td>
<td>Participant Or Confederate</td>
<td>Participant Or Confederate</td>
<td>Participant Or Confederate</td>
</tr>
</tbody>
</table>

Figure 1. Participants and confederates seat layout.

Speaker. A mechanical speaker was placed in the front of the room to play the announcements. The speaker was able to connect with a cell phone by Bluetooth. In this sense, the experimenter was able to control the speaker from outside the room.
**Announcements.** There were three pre-recorded simulated in-flight announcements played during the experiment (see Appendix C). The first announcement was a general in-flight announcement. The general in-flight announcement provided in-flight meal information and in-flight entertainment information. The second announcement was an emergency announcement, which was about a potential engine failure. The final announcement stated the engine problems had been resolved, and it was also the sign of the end of each session.

**Cell phones.** Two cell phones were needed in this experiment. One cell phone was used by Experimenter A to make conversations. The other one was for the participants in Group A to converse with Experimenter A.

**Stopwatch.** Three cell-phone-based stopwatches were used to measure the time it took participants in each group to lower the tray table, raise the tray table, and visibly check and fasten the seatbelt. During the experiment, Confederate C and D pretended to be playing with cell phone games, so the participants did not know these two confederates were co-researchers. The experimenter E stood behind all participants. Participants did not know they were being observed.

**Conversation script.** Confederates followed a script to stimulate dialogue during the simulated flight. The script included questions about the participants’ background information (e.g., how many classes they are enrolled in this semester, what their majors are, where are they from). The conversation script was presented in Appendix D.

**Comprehension test.** Ten questions were developed to test participants’ comprehension of the information provided in the announcements. Five questions were from the general in-flight announcement, and five questions were from the emergency
announcement. Questions were only about the information that was stated in the general in-flight announcement and the emergency announcement, and they did not involve the information that was provided in the final announcement or the conversations (see Appendix E).

**Group Instructions.** Instructions were different for each of the three groups. The participants in the cell phone conversation group were told to assume that they would receive a phone call from an acquaintance and then start a conversation. The face-to-face conversation group was told that passenger next to them would start a conversation with them. The control group was allowed do anything they would like to do (as per FAA regulations) except using a cell phone or making conversation with any other people. All three groups were asked to obey all current in-flight regulations and assume cell phone calls had been permitted. Participants were also asked to listen to and adhere to the information provided in the announcements. The instructions for three groups are shown in Appendix F.

**Design and Procedures.**

This experiment was a 3 x 2 mixed design. The between-subjects variable was group, including the cell phone conversation group, the face-to-face conversation group, and the control group. The within-subjects variable was announcement, which included emergency and general in-flight announcements. Specific instructions were read to participants per an instruction sheet. The cell phone group was told that they would be engaged in a conversation with an acquaintance. The F-F group was instructed to assume that the person who seats next to them is a friend who they are traveling with. The control group was allowed to do anything they would like to do except using cell phones
or making conversations with any other people. After the simulation started, the participants and confederates started conversations and continued to the end of the experiment. The dialogue was designed to engage participants to provide a reasonable length answers to short questions asked by the confederates. The general in-flight announcement started playing at the first minute of the experiment. During the general in-flight announcement, all passengers were asked to lower their tray tables as soon as practical, so the flight attendant was able to serve quickly. One minute later, the flight attendant reminded participants to lower tray table and made sure everyone had put tray table down. The emergency announcement started playing at the 2 minute and 30 seconds of the experiment. During the emergency announcement, all passengers were instructed to raise the tray tables immediately and then physically check that their seatbelts were fastened and tightened.

One minute after the emergency announcement had been played, a final announcement was played saying that the emergency had been resolved. Soon after this last announcement had been played, participants were told informed that they had reached the destination and the simulation was over. Afterward, participants were then given the 10-item comprehension test to complete. The questions on the comprehension test were only about the general in-flight announcement and the emergency announcement.

Eighteen periods were conducted for this experiment. Each period included one participant from Group A (i.e., cell phone group), one participant from Group B (i.e., F-F group), and one participant from Group C (i.e., control group).
After the experiment, the participants were informed of the intentions of the study.

**Data Collection and Analysis**

During the simulations, the general in-flight announcement told participants to lower the tray tables, and the emergency announcement instructed participants to check that seatbelts were fastened and to raise tray tables. Confederate C, Confederates D, and Experimenter E observed different participants in three groups respectively. These researchers memorized participants’ compliance with the instructions and recorded the time it took for participants to initiate responses. All the results were input to SPSS. Descriptive statistics were conducted to describe (a) the numbers of participants in each group who complied with the instructions, (b) the response time it took to lower tray table, raise tray table, and check or fasten seatbelts, and (c) the numbers of questions correctly answered on the comprehension test. Moreover, chi-square tests for independence were conducted to determine the relationship between participants’ compliance with the instructions and the groups they were in. One-way between-subjects Analysis of Variance (ANOVAs) were run to measure the deviation in reaction time among groups. Additionally, a two-way mixed ANOVA was conducted to test the difference in the participants’ performance on comprehension tests. For all the tests, the alpha-value was set at 0.05. The values that were no more than 0.05 were considered significant results, and the values that were between 0.05 and 0.10 were considered marginal results.
Chapter IV

Results

Eighteen sessions were conducted for this experiment. For two of the sessions, participants did not show up for the control group. Therefore, there were 52 participants (38 m, 14 f) who participated in this study. The mean age of the participants was 20.79 years (SD = 2.73). The minimum age was 18, and the maximum age was 30.

Participant Response to Announcement

During the simulation, the announcements instructed participants to initiate three responses. They were (a) lower the tray tables, (b) raise the tray tables, and (c) fasten or visibly check their seatbelts. Reaction time to initiate the response was recorded.

Participant compliance with instructions. The numbers of participants who complied with each instruction are shown in Table 1. Chi-square tests for independence were conducted for (a) participants’ compliance with lowering tray table instruction, (b) participants’ compliance with raising tray table instruction, and (c) participants’ compliance with fastening or visibly checking seatbelt. Group was the independent variable.

Table 1

Descriptive Statistics of Participant Compliance

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Completed</th>
<th>Did not Complete</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percentage (%)</td>
</tr>
<tr>
<td>Lowering Tray Table</td>
<td>24</td>
<td>46.15</td>
</tr>
<tr>
<td>Raising Tray Table</td>
<td>46</td>
<td>88.46</td>
</tr>
<tr>
<td>Fastening Seatbelt</td>
<td>32</td>
<td>61.54</td>
</tr>
</tbody>
</table>
Lowering tray table. The first test looked at the relationship between participants’ compliance with lowering tray table instruction as a factor of group. The results showed a marginal relationship, $\chi^2(2) = 4.860$, $p = 0.088$ ($V = 0.306$). The observed frequencies and the expected frequencies are shown in Table 2.

Table 2

Chi-Square Test for Independence for Lowering Tray Table

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Phone</td>
<td>F-F</td>
</tr>
<tr>
<td>Completed</td>
<td>Observed</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Expected</td>
<td>8.3</td>
</tr>
<tr>
<td>Did not Complete</td>
<td>Observed</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Expected</td>
<td>9.7</td>
</tr>
<tr>
<td>Total</td>
<td>Observed</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Expected</td>
<td>18.0</td>
</tr>
</tbody>
</table>

Note. F-F = Face-to-Face, Observed = Observed Frequencies, Expected = Expected Frequencies

Three pairwise comparisons for chi-square tests for independence were run. The result showed the control group was more likely to comply than the phone group, $\chi^2(1) = 4.250$, $p = 0.039$ ($\phi = 0.354$). The observed frequencies and expected frequencies are shown in Table 3.
Table 3

**Chi-Square Test for Lowering Tray Table When Comparing Phone and Control Groups**

<table>
<thead>
<tr>
<th>Group</th>
<th>Phone</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observed</td>
<td>6</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>Expected</td>
<td>9.0</td>
<td>8.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Did not Complete</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observed</td>
<td>12</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Expected</td>
<td>9.0</td>
<td>8.0</td>
<td>17.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observed</td>
<td>18</td>
<td>16</td>
<td>34</td>
</tr>
<tr>
<td>Expected</td>
<td>18.0</td>
<td>16.0</td>
<td>34.0</td>
</tr>
</tbody>
</table>

*Raising tray table.* A chi-square test found a significant difference between groups for raising the tray table, $\chi^2(2) = 7.369, p = 0.025$ ($V = 0.376$). The observed frequencies and the expected frequencies are shown in Table 4.

Table 4

**Chi-Square Test for Independence for Raising Tray Table**

<table>
<thead>
<tr>
<th>Group</th>
<th>Phone</th>
<th>F-F</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observed</td>
<td>17</td>
<td>13</td>
<td>16</td>
<td>46</td>
</tr>
<tr>
<td>Expected</td>
<td>15.9</td>
<td>15.9</td>
<td>14.2</td>
<td>46.0</td>
</tr>
<tr>
<td>Did not Complete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observed</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Expected</td>
<td>2.1</td>
<td>2.1</td>
<td>1.8</td>
<td>6.0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observed</td>
<td>18</td>
<td>18</td>
<td>16</td>
<td>52</td>
</tr>
<tr>
<td>Expected</td>
<td>18.0</td>
<td>18.0</td>
<td>16.0</td>
<td>52.0</td>
</tr>
</tbody>
</table>

*Note.* F-F = Face-to-Face, Observed = Observed Frequencies, Expected = Expected Frequencies

To determine which two groups contributed to the significance, three pairwise chi-square tests for independence for the pairing of each type of group were run. There was a significant relationship when comparing the face-to-face group with the control.
group, $\chi^2(1) = 5.211, p = 0.022 \ (\varphi = 0.391)$. The participants in the control group were more likely to raise the tray table than the participants in the face-to-face group. The observed frequencies and the expected frequencies are shown in Table 5. Moreover, there was also a marginal result when comparing the phone group with the face-to-face group, $\chi^2(1) = 3.200, p = 0.074 \ (\varphi = 0.298)$. The phone group performed better than the face-to-face group. The observed frequencies and the expected frequencies are shown in Table 6.

Table 5

*Chi-Square Test for Raising Tray Table When Comparing Face-to-Face and Control Groups*

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Face-to-Face</td>
<td></td>
</tr>
<tr>
<td>Completed</td>
<td>Observed Frequencies</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Expected Frequencies</td>
<td>15.4</td>
</tr>
<tr>
<td>Did not Complete</td>
<td>Observed Frequencies</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Expected Frequencies</td>
<td>2.6</td>
</tr>
<tr>
<td>Total</td>
<td>Observed Frequencies</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Expected Frequencies</td>
<td>18.0</td>
</tr>
</tbody>
</table>
Table 6

Chi-Square Test for Raising Tray Table When Comparing Phone and Face-to-Face Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Phone</th>
<th>Face-to-Face</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed</td>
<td>Observed Frequencies</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Expected Frequencies</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Did not Complete</td>
<td>Observed Frequencies</td>
<td>17</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Expected Frequencies</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Total</td>
<td>Observed Frequencies</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Expected Frequencies</td>
<td>18.0</td>
<td>18.0</td>
</tr>
</tbody>
</table>

Fastening seatbelt. The last test was run to determine the relationship between participants’ compliance to fastening seatbelt instruction as a factor of group. The result demonstrated that there was a marginal relationship, $\chi^2(2) = 4.850$, $p = 0.088$ ($V = 0.305$).

The observed frequencies and the expected frequencies are shown in Table 7.

Table 7

Chi-Square Test for Independence for Fastening Seatbelt

<table>
<thead>
<tr>
<th>Group</th>
<th>Group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Phone</td>
<td>F-F</td>
</tr>
<tr>
<td>Completed</td>
<td>Observed</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Expected</td>
<td>11.1</td>
</tr>
<tr>
<td>Did not Complete</td>
<td>Observed</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Expected</td>
<td>6.9</td>
</tr>
<tr>
<td>Total</td>
<td>Observed</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Expected</td>
<td>18.0</td>
</tr>
</tbody>
</table>

Note. F-F = Face-to-Face, Observed = Observed Frequencies, Expected = Expected Frequencies
Three pairwise chi-square tests for independence for the pairing of each type of group were run. There was a significant difference between the phone group and the control group, $\chi^2(1) = 4.859, p = 0.028 (\Phi = 0.378)$, where the control group was more likely to check their seatbelts than participants in the phone group. The observed frequencies and the expected frequencies are shown in Table 8.

Table 8

<table>
<thead>
<tr>
<th>Group</th>
<th>Observed Frequencies</th>
<th>Expected Frequencies</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed</td>
<td>Phone = 11</td>
<td>Control = 13</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.7</td>
<td>11.3</td>
</tr>
<tr>
<td>Did not Complete</td>
<td>Observed Frequencies</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Expected Frequencies</td>
<td>5.3</td>
<td>4.7</td>
</tr>
<tr>
<td>Total</td>
<td>Observed Frequencies</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Expected Frequencies</td>
<td>18.0</td>
<td>16.0</td>
</tr>
</tbody>
</table>

**Reaction time.** The time was recorded from when the action keyword (i.e., put down your tray tables, put tray tables back, and make sure your seatbelt is fastened and tightened) to when the participant complied with the demand. The mean time, standard deviation, minimum time, and maximum time for each requirement are shown in Table 9. To test the difference in reaction time between the groups for each requirement, a one-way between-subjects ANOVA was run.
Table 9

Reaction Time for Each Instruction

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowering Tray Table</td>
<td>7.50</td>
<td>6.30</td>
<td>0.32</td>
<td>25.81</td>
</tr>
<tr>
<td>Raising Tray Table</td>
<td>4.27</td>
<td>3.94</td>
<td>0.02</td>
<td>17.96</td>
</tr>
<tr>
<td>Fastening Seatbelt</td>
<td>8.12</td>
<td>6.73</td>
<td>1.03</td>
<td>25.38</td>
</tr>
</tbody>
</table>

Note. SD = Standard Deviation

The results showed no significant difference in reaction time between groups. For lowering tray table, $F(2, 21) = 0.221$, $p = 0.804$; for raising tray table, $F(2, 43) = 2.306$, $p = 0.112$; and for fastening seatbelt, $F(2, 29) = 1.391$, $p = 0.265$. The mean reaction time, standard deviation, minimum reaction time, and maximum reaction time are presented in Table 10.

Table 10

Reaction Time for Each Group

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowering Tray Table</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone</td>
<td>6.24</td>
<td>5.22</td>
<td>1.01</td>
<td>15.07</td>
</tr>
<tr>
<td>F-F</td>
<td>7.19</td>
<td>4.48</td>
<td>1.80</td>
<td>14.90</td>
</tr>
<tr>
<td>Control</td>
<td>8.39</td>
<td>7.99</td>
<td>0.32</td>
<td>25.81</td>
</tr>
<tr>
<td>Raising Tray Table</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone</td>
<td>4.43</td>
<td>3.39</td>
<td>0.02</td>
<td>11.80</td>
</tr>
<tr>
<td>F-F</td>
<td>5.96</td>
<td>4.96</td>
<td>0.60</td>
<td>17.96</td>
</tr>
<tr>
<td>Control</td>
<td>2.89</td>
<td>3.18</td>
<td>0.21</td>
<td>11.98</td>
</tr>
<tr>
<td>Fastening Seatbelt</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone</td>
<td>7.24</td>
<td>6.40</td>
<td>1.25</td>
<td>20.97</td>
</tr>
<tr>
<td>F-F</td>
<td>11.50</td>
<td>8.11</td>
<td>1.75</td>
<td>25.38</td>
</tr>
<tr>
<td>Control</td>
<td>6.79</td>
<td>5.86</td>
<td>1.03</td>
<td>20.26</td>
</tr>
</tbody>
</table>

Note. F-F = Face-to-Face, SD = Standard Deviation
Retention of Announcements

As the conclusion of the simulation, participants’ retention was measured by asking them questions about the announcements. Ten questions were designed for the comprehension test. However, during the experiment, it was found that one question from the emergency announcement had an influence on participants’ compliance with the announcements, so the question was removed. Therefore, data analysis only included four questions that were about the emergency announcement. In other words, five questions were asked about the general in-flight announcement, and four questions were related to the emergency announcement. A 3 (group: phone, face-to-face, control) x 2 (announcement: general, emergency) two-way mixed ANOVA was conducted to determine the difference in the retention among the groups. Because there was one more question about the general in-flight announcement than the emergency announcement, retention was analyzed with the percentage of questions correctly answered rather than the actual number.

Main effect of group. There was a significant main effect of group, $F(2, 49) = 6.908, p = .002, \eta^2 = 0.220$. Table 11 shows the descriptive statistics for the number of questions correctly answered for the general in-flight announcement. There were three levels in this variable, so a Bonferroni post-hoc test was run. The result demonstrated that the control group was significantly better than the cell phone group and the face-to-face group, but there was no significant difference between the cell phone group and the face-to-face group.
Table 11

Retention among Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Num</td>
<td>Per (%)</td>
<td>Num</td>
<td>Per (%)</td>
</tr>
<tr>
<td>Phone</td>
<td>2.94</td>
<td>32.67</td>
<td>1.55</td>
<td>0.00</td>
</tr>
<tr>
<td>F-F</td>
<td>3.06</td>
<td>34.00</td>
<td>2.18</td>
<td>0.00</td>
</tr>
<tr>
<td>Control</td>
<td>5.25</td>
<td>58.33</td>
<td>2.24</td>
<td>11.11</td>
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</table>

Note. SD = Standard Deviation, Num = Number, Per = Percentage, F-F = Face-to-Face

Main effect of announcement. The result showed a significant main effect of announcement, $F(1, 49) = 9.692, p = .003, \eta^2 = 0.165$. The accuracy of the questions about the emergency announcement was greater than the accuracy of the questions about the general in-flight announcement. Table 12 shows the descriptive statistics for the number of questions correctly answered for the emergency announcement.

Table 12

Retention Between Announcements

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Num</td>
<td>Per (%)</td>
<td>Num</td>
<td>Per (%)</td>
</tr>
<tr>
<td>General</td>
<td>1.69</td>
<td>33.80</td>
<td>2.06</td>
<td>0.00</td>
</tr>
<tr>
<td>Emergency</td>
<td>2.00</td>
<td>50.00</td>
<td>1.88</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>3.69</td>
<td>41.00</td>
<td>4.96</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Note. SD = Standard Deviation, Num = Number, Per = Percentage

Interaction between group and announcement. The results showed no significant group x announcement interaction, $F(2, 49) = 2.416, p = .100, \eta^2 = 0.090$. 

Hypothesis Testing

The first hypothesis stated that there was no significant difference in the retention of general in-flight announcements between the cell phone communication (cell phone) group and the face-to-face communication (F-F) group. The hypothesis was retained. Although the control group performed significantly better than the phone group, there was no significant or marginal difference between the cell phone group and the face-to-face group.

The second hypothesis was that there was no significant difference in the retention of emergency announcements between the cell phone group and the F-F group. This hypothesis was also retained. The result revealed that the control group had significantly better retention of emergency announcements than the F-F group; however, there was no significant or marginal difference between the cell phone group and the F-F group.

The third hypothesis was that there was no significant difference in compliance and reaction time to put the tray table down between the cell phone group and the F-F group. The hypothesis was retained. There was no significant difference in compliance and reaction time to lower the tray table between the phone group and the face-to-face group.

The fourth hypothesis was that there was no significant difference in compliance and reaction time to put the tray table back between the cell phone group and the F-F group. The hypothesis was retained. However, there was a marginal difference in reaction time to raise the tray table between the phone group and the face-to-face group.
The last hypothesis stated that there was no significant difference in compliance and the reaction time to fasten seatbelts between the cell phone group and the F-F group. The hypothesis was retained as well. There was no significant or marginal difference between the phone group and the face-to-face group.
Chapter V
Discussions, Limitations, and Conclusions

Discussions

**Compliance with instructions.** For the compliance with the instructions from the announcements, the control group always performed better than the cell phone group or the face-to-face group. More control group participants complied with the lower tray table instruction than the cell phone group, and the control group did better on complying with the raise tray table instruction and the visibly check seatbelt instruction than the face-to-face group. One reason could be the control group was not involved in conversations, and they were not distracted by conversation. The results revealed that the conversations drew passengers’ attention to the in-flight announcements. This finding complied with the studies about the driver’s attention that demonstrated that the cell phone conversations could cause bad performance in driving.

Nevertheless, when comparing the cell phone group with the face-to-face group, there was no significant difference in participants’ compliance with the instructions. These two groups always performed equally poor. The only difference is a marginal difference in the compliance with the instruction which instructed them to raise the tray table, and the phone group did marginally better than the face-to-face group. For drivers, it is believed that the cell phone conversations have more negative impact on driving performance in comparison to conversing with other passengers. However, the passengers’ behaviors were not the same as drivers’ because passengers who engaged in face-to-face conversation did not perform better than the passengers’ who were involved in cell phone conversations. A reason could be that drivers are the operators of the
vehicles, and they are aware of the traffic situations. By contrast, the flight passengers in the cabin have the limited view of the surroundings of the aircraft. Passengers cannot notice the approaching of the dangers, and they can only be aware of happening of the abnormalities. Another probable reason was that although the passengers who were conversing face-to-face shared their SA with the ones who they were conversing with, those passengers had to look at each other, so they have limited view angles; however, the passengers who were involved in cell phone conversations were able to look anywhere and perceive more information about their surroundings.

**Reaction time.** Interestingly, the results did not show any differences in the reaction time among three groups. The results revealed that if passengers noticed the instructions in the announcements, the conversations did not have an effect on the reaction time. When the participants were instructed to put the tray table down, both the participants in the phone group and the face-to-face group were equally fast as the participants in the control group. However, many participants did not initiate responses to these instructions. As mentioned above, only the reaction time of the participants who complied with the announcement instructions was used for the data analysis. Consequently, the numbers of reaction time data dramatically decreased, and the collected data of reaction time were not many as expected. The decrease in the numbers reduced the power of the data, so the powers were not high enough to validate the result. Therefore, although no significant result was discovered in reaction time, it did not demonstrate these three groups had the same performance in reaction time.

Nevertheless, in this experiment, the confederates who did timing simply recorded their reaction time (i.e., the time from the instructions to the time the participants started
to make movements) rather than the completion time (i.e., the time from the instructions to the time participants fully completed the instructions). The participants in the cell phone group were holding phones with one hand throughout the simulation. Although holding cell phones did not have an influence on the time to initiate the responses, it may take participants longer time to complete the responses than any of the other two groups. In other words, even if the powers were high enough to validate that these three groups had the same reaction time to initiate responses, it may slow the cell phone group’s movements and take them a longer time to finish the responses. Therefore, if passengers are allowed to make phone cell calls on commercial flights, airlines need to encourage passengers to wear earphones when conversing on cell phone on flights. In this case, passengers’ completion time would not be lengthened by holding cell phones, and other passengers would be less disturbed. Despite this, the purpose of this study was to test passengers’ attention to the in-flight announcements instead of their responses, so the difference between the reaction time and the completion time did not impact the results of this studies.

**Retention of announcements.** As for the retentions of the announcements, participants’ performance was determined by groups and the type of the announcement, but there was no interaction between the group and the announcement. Among the groups, the control group correctly answered more questions about the announcements than both of other groups. The phone group had answered almost the same number of the questions correctly as the face-to-face group had. It showed that the distraction caused by cell phone conversations was the same as the distraction caused by face-to-face conversations. In other words, the extent to which participants listened to and
remembered the announcements when talking on a phone was similar to the extent to which participants listened to and remembered the announcements when conversing face-to-face.

Furthermore, participants memorized more information about the emergency announcement than the general in-flight announcement. A probable reason was that the word “emergency” was a trigger, and when people heard this word, they tended to focus on the announcement. Consequently, they would pay more attention and had better performance. If this reason is corroborated, it would be better for flight crewmembers to add several words that would be more arousing to passengers when they are making emergency announcements.

**Limitations and Future Study**

A limitation of this experiment was that the experiment was conducted in a lab room, and the participants were not passengers who were sitting on a flying aircraft. Therefore, there were some differences from a real flight.

For future studies, it would be beneficial to extend the period of each session. In this case, it would be possible to play more announcements and have more conversations. Moreover, only between-subjects comparisons were made in this experiment, so it would be better to make another study with several within-subjects comparisons. For example, a participant may be talking during the first announcement and stop talking before the next one. Additionally, by playing more announcements, the experimenters would be able to instruct participants to make a larger variety of responses.

Moreover, for the following studies that focus on the time it takes participants to make responses, it would be beneficial to collect both reaction time and completion time.
In this case, the result could show how holding a cell phone would impact the time to finish raising tray table and fastening seatbelt, and the results would be more comprehensive.

Conclusions and Recommendations

The purpose of this study was to determine the difference in participants’ attention to announcements when talking on a cell phone and when talking face to face. Their attention was measured with two main methods. One method was to observe whether participant complied with the instructions that were stated in the announcements, and the other one was to test their retention of the announcements. The results revealed that the control group was significantly better than the other two groups on compliance with the instructions and the retention of the announcements. There was no significant difference between the phone group and the face-to-face group in any of these dependent variables. In other words, there was no significant difference in the attention to the announcements.

Since previous studies demonstrated that the cell phone had little electronic interference with aircraft avionics, the distraction cell phone calls cause could be a major concern that is related to civil aviation safety. This experiment revealed that cell phone conversations did not have any greater influence on passenger’s attention to the announcements in comparison to the face-to-face conversations. Therefore, the ban on cell phone calls may not be necessary. Additional studies that may corroborate these findings are warranted. Similar findings may support consideration for lifting the bans on cell phone calls for commercial flight passengers.
References


Appendix A

Permission to Conduct Research
Embry-Riddle Aeronautical University  
Application for IRB Approval  
Exempt Determination

**Principle Investigator:** Tianhua Li  
**Other Investigators:** Research advisor: Andy Dattel,  
Other Investigators: Qianru Yang, Amber Davis, Andrey Babin, Stefan Melendez Santiago, and Jie Chen  
**Role:** Student  
**Campus:** Daytona Beach  
**College:** COA

**Project Title:** The Extent of Distraction of Cell Phone Use for Passengers in Simulated Flight

**Submission Date:** 9/13/2016  
**Determination Date:** 9/23/2016

Review Board Use Only

**Initial Reviewer:** Dr. Tim Holt/M.B. McLatchey

Exempt: Yes

Approved:

<table>
<thead>
<tr>
<th>Pre-Reviewer Signature</th>
<th>Chair of the IRB Signature</th>
<th>Date of Approval / Expiration Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M.B. McLatchey</td>
<td>September 29, 2016</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expires: September 28, 2017</td>
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**Brief Description:** Currently, passengers are forbidden from making cell phone calls on commercial flights within United States by Federal Aviation Administration (FAA) and Federal Communication Commission (FCC) due to the electronic interference of cell phones with aircraft-installed navigation system. This experiment is conducted to identify the extent of distraction of cell phone calls for passengers when compared to passengers having a conversation with the person sitting next to them. Four null hypotheses will be tested in the study. They are: (a) there is no significant difference in the retention of general announcements between cell phone group and face-to-face (F-F) group, (b) there is no significant difference in the retention of emergency announcements between cell phone group and F-F group, (c) there is no significant difference in reaction time to put tray table back between cell phone group and F-F group, and (d) there is no significant difference in reaction time to fasten seatbelts between cell phone group and F-F group. This experiment is a 2 x 2 mixed design (Between-subjects variable: Conversation group - Cell phone and Face-to-face; and Within-subjects variable: Message group - emergency and non-emergency). Participants will be given specific instructions, as per the instruction sheet. Sixteen periods will be conducted for this experiment. Each period will include one participant from Group A (cell phone group), one participant from Group B (F-F group), and one participant from Group C (control group). Each participant will be paid $15. If any participant asks to quit the experiment at any time, the participant can quit without penalty. Moreover, a comprehension test will be given. The questions concern several details that are mentioned in general and emergency announcements. Each participant’s answered test will be scored to test the retention of two announcements. There are no known risks in this study. If participants feel psychologically or physically uncomfortable during any phase of the
experiment, they can request to terminate the session. They may withdraw from the study at any time with no penalty.

This research falls under the **exempt** category as per 45 CFR 46.101(b) under:

- ☐ (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

- ☑ (2) Research involving **only** the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures (of adults), interview procedures (of adults) or observation of public behavior. Participant information obtained will remain anonymous or confidential.

- ☐ (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

- ☐ (4) Research involving the collection or study of **existing** data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

- ☐ (5) Research and demonstration projects which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) Public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

- ☐ (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

An exempt research project does not require ongoing review by the IRB, unless the project is amended in such a way that it no longer meets the exemption criteria.
Informed Consent

An Agreement to Participate in
The Extent of Distraction of Cell Phone Use for Passengers in Simulated Flight Study

Eligibility. You are selected to participate in a research study that is being conducted by Tianhua Li, an MSA student at Embry-Riddle Aeronautical University. To be in this study, (a) English must be your primary language, (b) be 18 years old or older, (c) have normal hearing ability, and (d) have flown on a commercial flight at least once within recent memory.

Introduction. This is an in-flight simulation experiment. You will be randomly assigned to one group, and will need to (a) receive a phone call, (b) make a conversation with the passenger next to you, or (c) do anything you like except talking. During the entire experiment, you are required to obey all current in-flight regulations unless otherwise directed, but you are not allowed to leave the seat. There will be several announcements, which are similar to real in-flight announcements. Your involvement in this simulation will be approximately 30 minutes. After the simulation, you will be asked to take a ten-question test.

Risks. There are no known risks by participating in this experiment. If you feel psychologically or physically uncomfortable during any phase of the experiment, or if you feel any negative side effects from stress and motion sickness, you can request to terminate the session. You may withdraw from the study at any time with no penalty.

Benefits. Your participation will help us understand how communication affects safety in the airplane.

Compensation. You will receive $15 for your participation in this study. The participants who start but fail to complete research will be paid $15, but those who show up but refuse informed consent will not get paid.

Privacy. Your responses in this study will be confidential. The simulation will be recorded, but only myself and other researchers directly involved in this study will have access to the data. In order to protect the confidentiality of your responses, I will provide each participant with a random ID for the study. Any collected data or personal information will be entered and stored in a password-protected file on a password-protected computer. The data will be stored for 3 years after any publication, and then will be shredded.

Further information. If you have any questions or would like additional information about this study, please contact Tianhua Li at (386) 212-3718 or lit3@my.erau.edu, or my faculty advisor, Dr. Andy Dattel, at (386) 226-7795 or andy.dattel@erau.edu. The ERAU Institutional Review Board (IRB) has approved this project. You may contact the ERAU IRB Chair M. B. McLatchey with any questions or issues at mclatchm@erau.edu.

Consent. Your signature below means that you understand the information on this form, that any and all questions you may have about this study have been answered, and you voluntarily agree to participate in it.

Signature of Participant __________________________ Date __________________________

Print Name of Participant __________________________
Appendix B

Seat Configuration

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<tr>
<th>Sessions</th>
<th>Left Side</th>
<th>Aisle</th>
<th>Right Side</th>
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<tbody>
<tr>
<td>1, 7, 13</td>
<td>Participant B observed by Confederate E</td>
<td>Confederate B</td>
<td>Confederate C</td>
</tr>
<tr>
<td>2, 8, 14</td>
<td>Participant C observed by Confederate E</td>
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<tr>
<td>3, 9, 15</td>
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<td>4, 10, 16</td>
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<td>5, 11, 17</td>
<td>Confederate D</td>
<td>Participant A observed by Confederate D</td>
<td>Confederate C</td>
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<tr>
<td>6, 12, 18</td>
<td>Confederate B</td>
<td>Participant B observed by Confederate D</td>
<td>Confederate D</td>
</tr>
</tbody>
</table>

Figure A1. Seat configuration.
Appendix C

Simulated In-flight Announcements

General In-flight Announcement

Ladies and gentlemen, in a few minutes, we will be serving dinner. To help flight attendants serve quickly, please put down your tray tables as soon as possible. We will be serving beef, turkey, and chicken. Our dinner menu is in the seat pocket in front of you. Our plane is equipped with entertainment devices. Our entertainment program has movies on seven different channels. For further details on the service, please refer to your in-flight magazine. If you have any questions, please let us know. Thank you!

Emergency Announcement

Ladies and gentlemen, this is your captain. We are presenting an emergency announcement. We have detected possible low oil pressure on the right outer engine. The crew is now sorting out the problem. As a precautionary, we will descend to 16,000 feet. Please be seated, put tray tables back, and make sure your seatbelt is fastened and tightened as soon as possible. Thank you!

Final Announcement

Ladies and gentlemen, the crew has resolved the engine problems. The issue was a faulty indicator. You may relax now. The seat belt sign has been turned off. Enjoy the rest of the flight.
Appendix D

Conversation Script

Conversation Script Question List

What is your name?

Are you undergraduate or graduate student?

What is your major?

Do you have any specializations in your major?

How many courses are you taking this semester?

What are these courses?

What is your favorite course you have taken?

Which professor do you like the most?

How long have you been studying in Embry-Riddle?

Tell me a little about your hometown.

Where is your favorite place in your city where you are from?

How long have you been staying in Florida?

What other states have you traveled to?

What are your top five favorite cities?

Which of these cities do you like most?
Appendix E

Comprehension Tests

Comprehension Test Questions

General announcement questions.

What type of meal will be served (e.g., snack, breakfast, lunch, dinner)?

How many different channels have movies?

In addition to turkey and chicken what additional entrée will be served?

Where can you find additional information about the services offered?

Where (in what location) can the dinner menu be found?

Emergency announcement questions.

Who made the emergency announcement (e.g., captain, first officer, flight attendant)?

Which of the four engines is concerned the emergency issue?

What particular concern was there of the engine?

What altitude was the plane going to descent to?
Appendix F

Instructions

Instruction for Cell Phone Group

This is an in-flight simulation experiment. Assume you are flying on a commercial airliner. You will receive a phone call from an acquaintance and start a conversation. During the experiment, you are required to obey all current in-flight regulations (assume phone calls are permitted). On the premise that you obey all the rules, you are allowed to do anything you need or you want (except leaving your seat). There will be several announcements, which are similar to real in-flight announcements. Please listen to and adhere to the information provided in the announcements. If you feel uncomfortable during experiment, you can quit at any time.

Instruction for Face-to-face Group

This is an in-flight simulation experiment. Assume you are flying on a commercial airliner. Your adjacent passenger will start a conversation with you. During the experiment, you are required to obey all current in-flight regulations. On the premise that you obey all the rules, you are allowed to do anything you need or you want (except leaving your seat). There will be several announcements, which are similar to real in-flight announcements. Please listen to and adhere to the information provided in the announcements. If you feel uncomfortable during experiment, you can quit at any time.

Instruction for Control Group

This is an in-flight simulation experiment. Assume you are flying on a commercial airliner. During the experiment, you are required to obey all current in-flight regulations. On the premise that you obey all the rules, you are allowed to do anything
you need or you want (except leaving your seat or talking). There will be several
announcements, which are similar to real in-flight announcements. Please listen to and
adhere to the information provided in the announcements. If you feel uncomfortable
during experiment, you can quit at any time.