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Examining the Perception and Effectiveness of a System Awareness Briefing During Cruise Flight

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Automation has increased the safety of air transportation by assisting pilots during periods of high workload and during critical phases of flight. However, an unintended consequence of automation proliferation has been the reduction in attention resulting from its use. Prior research has shown that during periods of high automation and low workload, pilots' minds begin to wander and occupy themselves with thoughts other than the current task at hand. This research involved conducting a study to address the following research question: does a system awareness briefing actually improve pilot awareness of automation and aircraft parameters during cruise flight? The results indicated pilots who used the system awareness briefing were more accurate in reporting current heading, fuel flow, and electrical volts, compared to pilots who did not use the briefing. They also reported that they felt more situational awareness compared to the control group.

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The purpose of this study was to determine if a system awareness briefing during the cruise phases of flight may increase pilot diagnostic ability during a hypothetical emergency or issue of automation surprise. The goal was to gain a better understanding of how a pilot's attention may fade during low workload periods of the flight. The system awareness brief may work to re-engage the pilot into the system and decrease response time during the automation surprise event. This briefing was designed to be completed at 5-minute intervals during the cruise phase of flight, a traditionally low workload period for pilots. Similar to an approach briefing, the system awareness briefing reviewed the current flight state. Objects included in the system awareness brief were: current route, upcoming waypoint, and waypoint after that, current automated flight mode status, navigation source, communication frequencies, systems status, fuel load, and flight time remaining. The conceptualization of the awareness briefing was taken from the success of an instrument approach briefing, which is commonly used in both single-pilot and multi-crew operations.

Effects of the Man/Machine Interaction between Automation and Manual Flying Skills

The concept of automation has been described as the opportunity for the pilot to think ahead of the task at hand and not have to focus on manual flying skills (Casner & Schooler, 2014). Multiple studies show that the more reliable the system is, the more the participants were likely to be complacent and subject to latent errors than those who were told their device was less reliable (Bailey & Scerbo, 2007). Operators often rely so much on their systems that it leads them to make shortcuts in the decision-making process. For example, pilots have admitted to not making full use of all the information and cues that are being offered to them in the cockpit when deciding because they are relying on the automation (Mosier, Skitka, Heers, Burdick, 1998)).

Automation is intended to give the pilots extra time to think ahead and analyze the situation; however, many studies have shown that accidents have occurred as a result of poor use of that extra time (Chow, Yortsos, & Meshkati, 2014). There is a widespread belief that pilots lose their manual flying skills because of increased cockpit automation. Some studies showed that while manual flying skills tended to remain the same, there was a decline in cognitive flying skills (Casner, 2014). Research based on the pilots' ability to fly the aircraft manually showed that those manual skills are less likely to be forgotten than cognitive skills over a certain period with no flying experience (Casner, Geven, Recker & Schooler, 2014). A connection was made between the number of hours flown by the pilot and their capacity to control the flight within its tolerances. Additionally, another connection was established between the number of raw data approaches flown by the pilot and the smoothness of their maneuvers (Young, Fanjoy, & Suckow, 2006). The researchers recorded several factors such as instrument crosscheck proficiency, smoothness of control or completion of instrument procedures. A study highlighted that after a period of manual handling, a certain task eventually gets automated, thus not requiring the same amount of monitoring as before (Farrell & Lewandosky, 2000).

Automated systems offer many benefits and were first designed to enhance the safety of the fight by allowing pilots to monitor the computer's calculations and intervene when needed. However, the continuous improvement of autonomous systems has led to the emergence of new types of errors such as difficulties to take over the controls in case of emergency, degradation of manual and cognitive skills when not rehearsed, difficulties to diagnose a situation, errors of the crew in setting up the equipment or errors introduced by the computer not being diagnosed by the crew (Wiener & Curry, 2007).

Pilots' Behavior and Complacency

Several studies have analyzed complacency due to automation and trust in automated systems. The first important factor that affects monitoring performance has been reported to be the attentional capacity of the operator. By varying over a period of time, the lack of attention leads to increased reliance on the automated system, hence allowing errors to occur (Bailey & Scerbo, 2007). Tasks requiring the highest attentional capacity from the operator are the first ones to suffer from a decreased monitoring performance. Bailey and Scerbo (2007) have investigated the concept of trust between humans and machines with extreme levels of trust but also with the impact of early and late failures of the system.

Situational awareness is described as the perception of surrounding elements concerning time and space. It also implies constant monitoring, which enhances the frequency of workload-related tasks during the flight (Billings & Cheaney, 1981). Damos, John, and Lyall (2005) recorded data concerning what pilots were looking at, what they were touching, or whether or not they were talking at different moments of the flight. The results showed that with increasing level of automation, the frequency of simple actions, such as holding the yoke, was decreasing. Their research supports a Casner, Geven, Recker, and Schooler's study (2014) concerning the pilots' ability to manually fly the aircraft and the forgetting of cognitive skills over a sustained period. It is not uncommon to have instances in which highly experienced pilots chose to manually fly the aircraft shortly before landing (Ebbatson, Harris, Huddlestone & Sears, 2010).

Human-Machine Trust

Thanks to technological advancements, a new type of inactivity are rising: passiveness in the cockpit. Pilots tend to process information by acknowledging correlated cues and tend to omit less obvious or less flexible information (Mosier, Skitka, Heers, Burdick, 1998). Studies have shown that complacency induced by automation reduces the pilot's ability to detect system malfunctions from 70% when flying the aircraft manually to 55% with the help of automation (Farrell & Lewandowsky, 2000). Additionally, the study researched the effect of trust in the automated system on pilots' performance, and the results showed that performance was degraded if the reliability of the system was kept constant instead of varying.

Other research has reported that the level of automation has an impact on the number of time pilots spent looking outside the cockpit (Damos, John, & Lyall, 1999). The higher the reliability of the system, the higher the complacency seems to be, and mental workload decreased throughout the simulation session, as well (Singh, Tiwari, & Singh, 2009). An interesting concept of 'automation surprise' was introduced by a study in which pilots qualified to fly aircraft equipped with automated systems described the surprises they experienced that were related to automation (Sarter, 1994). The research concluded that there is no solution to pilots being 'surprised' by a sudden malfunction or warning in the cockpit without being aware of the overall situation and the interconnectedness between human, machine, and the environment. Fortunately, automation surprise can be reduced with constant monitoring and surveillance of the flight deck associated with the correct use of cockpit communications and cockpit behavior. One study addressed the problematic relationship between crew performance, loss of manual flying skills and reflexes, and seniority (Feaver, 1987). However, complacency and automation biases occur as often in inexperienced pilots as in expert pilots (Parasuraman & Manzey, 2010).

Mind Wandering and Task Efficiency

Although automation allows for more accuracy and faster decisions, it leads to increased passiveness in the cockpit (Casner, Geven, Recker, & Schooler, 2014). Since pilots do not have to fly the aircraft by hand during the entire flight, several researchers have tried to determine how pilots utilize this free time (Casner & Schooler, 2014). They classified the pilots' thoughts into three categories: *task-at-hand* thoughts, which correspond to actions currently being achieved; *task-related* thoughts correspond to planning ahead to something related to the flight; and *task-unrelated* thoughts; which represent something completely unrelated to the flight. As automation increased, pilots were more likely to think about future tasks rather than the current task-at-hand. However, as everything was happening as expected and the flight was running its course, pilots' minds were wandering to task-unrelated thoughts.

The more advanced the automated technology, the more it simplifies the pilot's job of decision-making (Chow, Yortsos, & Meshkati, 2014). However, cultural factors usually intervene and make every situation different regarding how the pilots react. Previous pilot training combined with previous work experiences will cause each pilot to react differently when facing a similar issue. The accuracy of a pilot's reaction and its success in a timely manner is highly related to the state of mind of the pilot performing that action. If a pilot allows their mind to wander, the pilot will inevitably become complacent in their situational awareness. The pilot will be disconnected from the situation, and fail to act correctly following an alarm, or simply fail to act promptly (Wiener & Curry, 2007). The mind starts to wander when the focus is shifted from the dominant task, which leads to a decrease in performance and loss of situational awareness (Smallwood & Schooler, 2006). The authors describe the process of mind wandering as unconscious and initiated by a stimulus that puts the person into a state of reduced consciousness. At that moment, information from the external environment has more difficulty getting to the person who gradually drifts away from the real world. Therefore, it takes more time and effort to snap out of that mind-wandering state in case of a sudden malfunction (Feaver, 1987). During mind-wandering, thoughts can range anywhere from a functional to conceptual nature (Cowley, 2012). The degree of un-relatedness of the thought in comparison with the task being performed can be translated into the hypothesis that the pilot's state of mind wandering has consequences on their flying performance.

The constant improvement of technology in the cockpit has led to the creation of automation systems more powerful than ever in both general aviation and commercial aircraft; however, automation can be seen as a blessing and a curse. It allows pilots more free time to focus on important aspects of the flight without having to hand fly for a sustained period, but it can also lead pilots to lose situational awareness due to lack of focus. Studies have shown that the more advanced the automated system, the more the pilots were likely to rely on it and be complacent, which results in degraded performance. The performance of the pilot and safety of the flight are closely related and depend on factors such as communications in the cockpit. General observations, inquiries or agreements are examples of communications between pilots, which are extremely effective in keeping them aware of their surroundings at any point of the flight. In the absence of communications, when complacency is easy, mind-wandering can come into play, endangering the safety of the flight.

Current Study

A review of the literature reveals that as automation increases, such as in technologically advanced general aviation aircraft and commercial airliners, an unintended consequence has been a decrease in pilots' manual flying skills, cognitive awareness, and an increase in mind-wandering during flight, especially during highly-automated phases. These concerns have been addressed in light of many recent commercial airline accidents and incidents. However, to date, there does not appear to be any system awareness briefing that is required by the FAA or the major airlines.

The purpose of this study is to address the following research question:

> Does a system awareness briefing actually improve pilot awareness of automation and aircraft parameters during simulated cruise flight when using a sample of university aviation pilots?

In this study, we attempted to capture information on the following data points after the simulator flight ended: current heading, current altitude, distance in nautical miles to the next waypoint, fuel flow in gallons per hour, time remaining until destination in hours and minutes, indicated airspeed, engine revolutions per minute, groundspeed, main electrical bus voltage, and gallons of fuel remaining.

Methods

Design

The study used a between-participants experimental design. Participants were randomly assigned to either the control or experimental condition.

Participants

Sixty-nine (11 females) participants completed the study. The mean age was 22.26 (*SD* = 3.14) years old. Participants indicated that they had an average of 302.83 (*SD* = 289.98) total flight hours. All participants were student pilots at a large southeastern university with a flight school. To participate in the study, participants must have been at least a private pilot with prior experience using the Garmin G1000 avionics suite and autopilot experience. These requirements were self-reported by participants.

Procedure and Materials

Participant were recruited through advertisements posted across the subject university's campus, email notifications, and in-class announcements. The study was completed in the Aviation Human Factors lab. When participants arrived, they were presented with and signed a consent form. In both the control and experimental condition, participants were directed to sit at a desktop computer workstation and told to complete the self-guided on-screen tutorial. In the control condition, the presentation was related to an aviation x-price competition hosted by Boeing to create a personal flying device, such as a jetpack. In the experimental condition, participants were presented with a tutorial on how to use the system awareness briefing. Both presentations were matched to include the same length, amount of content, and same verbal and non-verbal cues.

Upon completion of the computer-based session, all participants were presented with a flight briefing packet. This packet contained information on the flight route, a flight plan form, and weather information for the intended flight from the Winter Haven's Gilbert Airport in Winter Haven, Florida (KGIF) to the Early County Airport in Blakely, Georgia (KBIJ). Participants in the experimental condition were presented with a system awareness briefing handout to use during the flight (Appendix A). The Elite Flight Training Device (FTD) was configured as a Cessna 172, and it was prepositioned on runway 29 at KGIF with all the avionics programmed. The weather for the scenario was visual meteorological conditions (VMC). The lab assistant provided each participant with a handout offering instructions on the flight (Appendix B).

When the participants were ready, the lab assistant told them they could take off. Participants were instructed to climb to 4,500 feet mean sea level (MSL) and proceed on course. Upon reaching cruising altitude, participants were instructed to engage the autopilot. In both conditions, pilots were instructed to act as they would in a real aircraft. Participants in the experimental condition were additionally asked to complete the system awareness briefing every 5 minutes, while participants in the control condition were asked to complete the flight as they would in a real aircraft. At minute 43 of the simulator session, the lab assistant paused the simulation and blacked out the flight displays. Participants were removed from the simulator and instructed to complete the study post-test assessment, which asked participants to report the values of selected instruments (Appendix C). The lab assistants reported the difference between the participant's reported value for each instrument and the actual value that was recorded on the aircraft at the time the simulation was paused. The participant completed a post-test assessment, the Post-Trial Participant Subjective Situation Awareness Questionnaire (PSAQ) instrument (Strater, Endsley, Pleban, & Matthews, 2001), which is a self-reported measure of workload, performance, and awareness, was compensated $50, debriefed, and dismissed.

Results

Prior to conducting an independent samples *t*-test on the data, an initial data analysis examined for outliers. Cases that were determined to be extreme cases were removed before the analysis. The variable of *heading* had 2 cases removed, *altitude* had 2 cases removed, *distance from destination* had 8 cases removed, *fuel flow* had one case removed, *engine RPM* had 5 cases removed, *groundspeed* had 2 cases removed, *electrical volts* had 2 cases removed, and the *PSAQ Awareness* had 8 cases removed. No other extreme outliers were detected.

Significant Findings

Current heading. An independent samples *t*-test revealed the experimental group (M = 0.33, SD = 0.61) was significantly more accurate in reporting their current heading than in the control group (M = 7.25, SD = 11.94), $t(33.193) = 3.374$, $p = .002$, $d = .82$, indicating a moderate to large effect size between the two conditions.

Fuel flow. An independent samples *t*-test revealed the experimental group (M = 0.63, SD = 0.88) was significantly more accurate in reporting current fuel flow than in the control group (M = 2.17, SD = 2.43), $t(42.79) = 3.442$, $p = .001$, $d = .84$, indicating a moderate to large effect size between the two conditions.

Electrical volts. An independent samples *t*-test revealed the experimental group (M = 3.14, SD = 3.80) was significantly more accurate in reporting electrical volts than in the control group (M = 7.10, SD = 7.55), $t(38.99) = 2.289$, $p = .028$, $d = .66$, indicating a moderate effect size between the two conditions.

PSAQ Awareness. an independent samples *t*-test revealed the experimental group (M = 4.08, SD = 0.49) did report significantly better awareness than in the control group (M = 3.59, SD = 0.86), $t(54.29) = -2.778$, $p = .007$, $d = .70$, indicating a moderate effect size between the two conditions.

Non-Significant Findings

Current altitude. There was no variation in answers between participants, and therefore, no statistical analysis was possible.

Distance from destination (NM). An independent samples *t*-test revealed the experimental group (M = 6.10, SD = 5.04) was not significantly more accurate in reporting their distance than in the control group (M = 8.86, SD = 8.85), $t(46.86) = 1.305$, $p = .198$.

Remaining rime to destination (min). An independent samples *t*-test revealed the experimental group (*M* = 6.59, *SD* = 6.51) was not significantly more accurate in reporting their time remaining than in the control group (*M* = 8.62, *SD* = 8.76), *t*(64) = 1.060, *p* = .293.

Indicated airspeed. An independent samples *t*-test revealed the experimental group (*M* = 1.91, *SD* = 2.01) was not significantly more accurate in reporting their indicated airspeed than in the control group (*M* = 1.78, *SD* = 2.32), *t*(64) = -0.237, *p* = .814.

Engine RPM. An independent samples *t*-test revealed the experimental group (*M* = 3.06, *SD* = 4.60) was not significantly more accurate in reporting their engine RPM than in the control group (*M* = 4.03, *SD* = 4.90), *t*(60) = 0.802, *p* = .426.

Groundspeed. An independent samples *t*-test revealed the experimental group (*M* = 2.90, *SD* = 3.23) was not significantly more accurate in reporting their groundspeed than in the control group (*M* = 3.40, *SD* = 3.84), *t*(62) = 0.561, *p* = .577.

Total fuel remaining (gal). An independent samples *t*-test revealed the experimental group (*M* = 10.04, *SD* = 12.82) was not significantly more accurate in reporting their gallons remaining than in the control group (*M* = 12.03, *SD* = 15.50), *t*(58) = 0.533, *p* = .596.

Workload on PSAQ. An independent samples *t*-test revealed the experimental group (*M* = 1.88, *SD* = 0.89) did not report significantly more workload than in the control group (*M* = 1.82, *SD* = 0.76), *t*(65) = -0.273, *p* = .785.

Performance on the PSAQ. An independent samples *t*-test revealed the experimental group (*M* = 3.94, *SD* = 0.86) did not report significantly better performance than in the control group (*M* = 4.00, *SD* = 0.78), *t*(65) = .302, *p* = .764.

General Discussion

Four of the measures that were captured turned out to be significant, and all four were in the direction that favored the system awareness briefing. That is, when pilots used the awareness briefing, they were more accurate in reporting current heading, fuel flow, and electrical volts. They also reported that they felt more situational awareness compared to the control group. Pilots also did not report any significant difference in workload between the two conditions. Therefore, we can conclude that not only did pilots feel that the system awareness briefing was doing what it was designed to do, but that it also improved actual performance in several areas of important information. Of particular interest was the improvement to heading awareness. It is critical for pilots to be aware of their heading, as this determines where they are going. For pilots to lose track of heading during autopilot flight can lead to dangerous events where they encroach in airspace where they do not belong. The additional variables of fuel flow and electrical volts may not typically be items included in the main scan of pilots, and it is possible that the awareness briefing helped pilots pay more attention to these important values. Due to the mixed findings, it is recommended that additional research is completed to explore the use of a system awareness briefing further to examine its effects on pilot performance. Additionally, the authors disclose that certain parameters which were found to not be significant, such as indicated *airspeed*, *distance*, and *fuel remaining*, are also very important variables to the safe outcome of flight. This further suggests the need for additional research to provide more context into what variables may be influenced by a system awareness briefing and also, if there is any significant effect of pilot decision-making resulting from a systematic and reoccurring briefing.

The use of automation provides a valuable resource to pilots which often results in them being able to think ahead of the aircraft (Casner & Schooler, 2014), but this is also not without some detriments as not all pilots may use this time effectively. Some may suffer from complacency (Bailey & Scerbo, 2007) or suffer from reductions in their ability to detect issues (Farrell & Lewandosky, 2000) or omit less obvious issues (Mosier, Skitka, Heers, Burdick, 1998). The system awareness briefing was designed to try and compensate for some of these unintended issues of increased automation usage. Participants who used the system awareness briefing were more accurate in their reporting of current heading, fuel flow, electrical volts, and perceived awareness. Additionally, participants who used the system awareness briefing did not report an increased perception of workload compared to the control group. It is possible that the system awareness briefing helped pilots' minds wander less (Casner & Schooler, 2014) and stay focused on the flight activities. A leading concern of mind wandering is the pilot's inability to properly diagnose a failure, especially during periods of high automation (Wiener & Curry, 2007). It is possible that the system awareness briefing could help prevent mind wandering, and thus increase pilot's ability to diagnose a failure during periods of high automation accurately. Participants who used the system awareness briefing did report a significantly higher level of awareness compared to those participants in the control group.

However, while the system awareness briefing was effective for some variables, there were also some other variables for which there were no differences in reporting between the two conditions. Variables such as altitude, time remaining to the destination, airspeed, engine RPM, ground speed, total fuel remaining, and perceived performance all had null effects. While it is possible that there is an underlying pattern which may help identify why some variables were significant and others were not, the current study is limited in its interpretative abilities of these differences. Although, it is important to consider that the current study used a very limited (less than 5-10 minutes) self-guided training tutorial of the system awareness briefing. In future studies, a more formal and thorough training program of the awareness briefing may increase its effectiveness.

Practical Applications

General aviation (GA) pilots represent many of the pilots flying in the National Airspace System. Unfortunately, GA pilots also represent a large proportion of aviation accidents and incidents. A critical factor is the role of increasing levels of automation on aviation safety. While, automation has been lacking in general aviation aircraft for a long period of time, since the early 2000s, there has been a proliferation of technologically advanced aircraft developed for general aviation that has tools such as glass cockpits and autopilots. Although automation offers many benefits, potential consequences include automation complacency, automation surprises, and pilot skill degradation. The system awareness briefing investigated in this research aimed to address these issues by helping pilots become re-engaged with the current status of the flight at regular intervals during periods of low workload and high automation. The study attempted to experimentally examine the application of the system awareness briefing in a laboratory setting.

The findings from this study were mixed but warrant further investigation. It is possible that the insights gained from this line of research may be far-reaching, potentially enhancing aviation safety, reducing the effect of automation surprises, and ultimately saving lives. Beyond general aviation, the system awareness briefing could be adapted for other complex domains that rely on automation and possess variable levels of operator workload. For example, the system awareness briefing could be applied to unmanned system operators to maintain situation awareness during long missions. Similarly, the system awareness briefing could benefit other industries which have extended periods of low workload and high automation.

Recommendations for Future Research

Follow-on research should include conducting further studies to evaluate the utility of the system awareness briefing in different abnormal situations. Examples of further scenarios to be investigated include exposing pilot participants to slowly deteriorating weather or an auxiliary system failure (e.g., fuel gauge malfunction). New measures of task performance and situation awareness should also be developed and evaluated, such as the measures used to examine pilot mind wandering (Casner & Schooler, 2014). Additionally, future research could examine if the system awareness briefing has a “macro-scale” effect on pilot’s decision-making or views toward safety. The majority of the variables measured in this study relate to system status indications, and therefore, pilot’s responses to various stimuli such as diversions, flight path adjustments, and emergencies may be influenced and could be manipulated when using the system awareness briefing.

Future research can also explore how the system awareness briefing could be adapted for other complex domains, such as unmanned aircraft system (UAS) long endurance missions. An expanded version of the system awareness briefing also may be evaluated as a useful tool to support UAS crew shift change activities during these operations.

Limitations

The study was limited through the use of a convenience sample of participants from the subject university. These students complete the majority of their flight training in a university’s professional pilot program, and their knowledge, skills, abilities, and training may restrict the generalizability of the findings. However, this was the first study in which the system awareness briefing was used so we wanted to start with a local sample of pilots to examine for any effects before working on replication studies to expand the generalizability of the findings. Care should be given in the generalizability of these findings for this reason, and it is recognized that samples consisting of pilots with differing demographic factors from the sample used in this study may be affected differently. Therefore, replication of the current study is encouraged.

This study was supported through an internal university grant program designed to offer seed funding for the beginning stages of new research ideas. It is for these reasons that we selected to use university pilots, despite the resulting restrictions to the generalizability of the findings. The research was also conducted using a fixed-base flight simulator, and the use of the simulator could change the responses of participants compared to how they would perform in an actual aircraft. Additionally, the system awareness briefing was completed at 5-minute intervals. It is recognized that to be applied in a commercial aviation setting; this time interval would have to be expanded in-between administrations of the briefing. The current study was limited in administration time of the total experimental procedure, and thus, the interval between briefings was 5 minutes. In future studies, the length of time between briefings in another variable that could be investigated to help determine the ideal period in between briefings.

Conclusions

The purpose of this research was to investigate the application of a system awareness briefing. The system awareness briefing was designed to help keep pilots engaged mentally during periods of low workload and high automation. In laboratory trials, participants were asked to report their answers on a post-test of current flight status after performing in either the control or experimental conditions. The findings from the study presented mixed results as to the effectiveness of the system awareness briefing. Participants using the system awareness briefing were significantly more accurate when reporting current heading, fuel flow, electrical voltage, and their perceived awareness when compared to the control group. Participants in the system awareness briefing group also did not express a significant increase in their workload compared to the control group. However, there were no significant differences between the two groups in the reporting of current altitude, time to destination, indicated airspeed, engine RPM, ground speed, total fuel remaining, and perceived performance. Further research is recommended to examine how the system awareness briefing may influence pilot performance.

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Appendix A

Awareness Briefing

The Awareness Briefing is designed to increase your situational awareness of the flight environment during low workload, high automation phases of flight, such as cruise and en-route. It can be used for both single pilot resource management (SRM) and Crew Resource Management (CRM).

Similar to an instrument approach briefing, the Awareness Briefing is intended to have you verify key and pertinent sources of information related to aircraft status, heading, and automation settings and modes. A checklist of items to include in your Awareness Briefing and an example Awareness Briefing is provided below:

Awareness Briefing Checklist:

- Identify Current Heading
- Identify Current Altitude
- State of Automation
    - Verify and describe automation mode settings
- Current source of navigation information
- Current routing from present position to destination
- Name of upcoming waypoint
    - Estimated Time Enroute to Waypoint
    - Distance to Waypoint
- Name and location of the following waypoint and any changes to flight route
- Verify engine instruments and systems displays
- Confirm fuel flow rate and fuel remaining
- Any questions

Example Awareness Briefing:

"We are currently flying heading 180 at FL350. The autopilot is currently engaged and flying the aircraft. The current modes of operation are NAV mode and altitude hold. We are tracking the GPS course based off of our flight management system. We are currently 35NM north of the Orlando VOR (ORL) and tracking directly to that waypoint. We are scheduled to pass over the VOR in 7 minutes. After passing the VOR, we will turn left to a heading of approximately 140 and join V159 southeast toward our destination of Miami while maintaining FL350. The next waypoint after Orlando is PRESEK intersection. Our engine instrument and system indicators are all functional and in the green. Fuel flow and amount of fuel remaining are accurate per our flight plan. Do you have any questions?"

Appendix B

Participant Instructions

Thank you for your participation in our study. In this experiment, you will be asked to fly the simulator on a specified flight route in VFR conditions.

Important: Please read all instructions before beginning the study!

- After you enter the simulator, program to the Early County Airport in Blakely, Georgia (KBGE) via the following routing: KGIF to KBIJ.
- During this experiment, fly the aircraft as you normally would, but do not worry about ATC communications nor airspace restrictions.
- When you are ready to depart, notify the lab assistant.
- Take off and join your course.
- Climb and maintain 4,500 feet MSL.
- Please direct any questions to the lab assistant.

Appendix C

Participant Post-Experiment Survey/Interview Questions

Instructions: Please answer the following questions. Your responses will be kept confidentially, and you may opt out at any time.

What is your age?___________________

Are you an ERAU pilot or a local pilot? _________________

What is your degree program (if applicable)?_______________

What is your total number of flight hours?_____________________

How many hours do you typically fly per year?_________________

What are the most common aircraft that you fly (manufacturer and model)?_________________

Which pilot certificates do you hold (check all that apply):

_____: Student Pilot

_____: Private Pilot

_____: Instrument Rating

_____: Commercial Pilot

_____: Airline Transport Pilot

_____: Multi-Engine rating

_____: Certified Flight Instructor

_____: Certified Instrument Instructor

_____: Multi-Engine Instructor

What is your gender (please circle)? Male Female Prefer Not To Say

Interview Questions:

Overall, describe how you felt your level of awareness was during the flight?

Would you say this level of awareness more, less or the same as what you would consider a traditional flight?

What are some techniques you commonly use to maintain awareness during flight?

Do you have any final thoughts or comments on your simulator flight?

Flight Status Questions:

1) Identify the current heading of the aircraft:__________
2) What was the current altitude in MSL?__________
3) What distance, in nautical miles, were you from the next waypoint?__________
4) What was the fuel flow in GPH?__________
5) What was the time remaining until your destination in hours:minutes?_________
6) What was the airspeed in KIAS?__________
7) What was the engine RPM?__________
8) What was your ground speed?__________
9) How many volts were being drawn on the main electrical bus?__________
10) How many gallons of fuel were remaining?__________