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THE EFFECTIVENESS OF A PERSONAL COMPUTER AVIATION TRAINING DEVICE (PCATD), A FLIGHT TRAINING DEVICE (FTD), AND AN AIRPLANE IN CONDUCTING INSTRUMENT PROFICIENCY CHECKS

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This project evaluated the effectiveness of a personal computer aviation training device (PCATD), a flight training device (FTD) and an airplane for conducting an instrument proficiency check (IPC). The study compared the performance of pilots receiving an IPC in a PCATD, in a FTD and in an airplane (IPC #1) with performance on a later IPC in an airplane (IPC #2). Chi-square tests were used to analyze the IPC #1 and IPC #2 data to determine whether the treatment (assignment to group) had an effect on the pass/fail ratio for the IPC #1 and IPC #2 flights respectively. The treatment effect on the IPC #1 and IPC #2 pass/fail ratios were not statistically significant. A series of planned-comparison tests were performed both between the experimental groups and between subjects within each experimental group. The PCATD group was compared to the Airplane group and to the FTD group, the Airplane group to the FTD group. None of these comparisons showed statistically significant ($a < .05$) differences between groups. These findings provide compelling evidence for permitting the use of PCATDs to give IPCs.

Introduction

To maintain instrument currency, instrument pilots must meet the recency of experience requirements of FAR 61.57(c) or (d) every six months. The recency of experience requirements may be conducted in an airplane or simulated in an approved flight training device (FTD). If an instrument pilot fails to meet recency of experience requirements within a 12-month period, an instrument proficiency check (IPC) must be accomplished with a certified flight instructor, instrument (CFII) to regain instrument currency.

Taylor et al. (1996, 1999) conducted a study to determine the extent to which a personal computer aviation training device (PCATD) could be used to develop specific instrument skills that are taught in instrument flight training and to determine the transfer of these skills to the aircraft. This research led to an additional study by the Institute of Aviation of the University of Illinois at Urbana-Champaign (UIUC) to determine the effectiveness of PCATDs for maintaining instrument currency (Taylor et al., 2001; Talleur, Taylor, Emanuel, Rantanen, and Bradshaw, 2003). In the latter study, a total of 106 instrument current pilots were divided in four groups. The pilots in each group received an instrument proficiency check (IPC #1). During a six-month period following IPC #1, the pilots in three groups received recurrent training in a PCATD, a Frasca flight training device (FTD), or an airplane, respectively. The fourth (control) group received no training during the six-month period. After this time, the pilots in each group flew an instrument proficiency check (IPC #2). The comparison of IPC #1 and IPC #2 indicated that both the PCATD and the Frasca FTD were more effective in maintaining instrument proficiency when compared to the control group and at least as effective as the airplane. The study also found that of 106 instrument current pilots, only 45 (42.5%) were able to pass IPC #1. Of the group who received an IPC in a Frasca FTD to regain currency, only 22 of 59 were able to subsequently able to pass IPC #1 in an airplane. This study established the effectiveness of PCATDs for use in instrument currency training. However, the question of whether PCATDs are effective for administering the IPC has not been demonstrated. Based on the data above, a question concerning the effectiveness of the Frasca FTD in administrating an IPC also arises.

The purpose of the present study was to compare the performance of pilots receiving an IPC in a PCATD, a FTD or an airplane (IPC #1) with their performance in an airplane (IPC #2). The comparison of performance in a PCATD to that in an airplane investigated the effectiveness of the PCATD as a device in which to administer an IPC. Currently, the PCATD is not approved to administer IPCs. The comparison of performance in a FTD with performance in an airplane will helped determine whether the current rule to permit IPCs in a FTD is warranted. Finally, the comparison of performance of pilots receiving IPC #1 in an airplane and IPC #2 in an airplane with a second CFII permitted the determination of the reliability of IPCs conducted in an airplane.

Method

Subjects

Seventy-five pilots participated in the study (25 subjects in each group; FTD, PCATD and airplane). Most of the participating pilots were instrument current but a few fall into one of three other categories of instrument currency: (1) within one year of currency, (2) outside of one year of currency but within two years of currency, and (3) outside two years but within five years of currency.

A limited number of pilots who were more than two years out currency received an average of six hours training equally distributed among the FTD, PCATD and airplane to prepare them for the IPC. This procedure was discontinued after the second year to reduce expenses, and no additional subjects of this currency status were added to the project.

Equipment

Two FAA-approved Elite PCATDs and one FAA-approved Frasca 141 FTD with a generic single-engine, fixed gear, fixed-pitch propeller performance model were used in the study. The FTD is approved for instrument training towards the instrument rating, instrument recency of experience training, and IPCs as well as for administering part of the instrument rating flight test. Two single-engine 180 hp Beechcraft Sundowner aircraft (BE-C23) with fixed-pitch propellers and fixed undercarriage were used as the aircraft for IPC #1 and IPC #2.

Procedure

All participants received a familiarization flight and a review of the systems and instrumentation in the FTD, the PCATD and the airplane prior to being assigned to an experimental group. Following the familiarization flights, subjects were assigned to one of the three groups (FTD, PCATD and Airplane) with a constraint that the currency categories were balanced among the groups. All 75 pilots received a baseline IPC flight in the FTD, PCATD or an airplane (IPC #1) according to their group assignment. Table 1 depicts the experimental design.

The IPC is a standardized test of the instrument pilot's instrument skills. The types of maneuvers, as well as completion standards for an IPC, are listed in the instrument rating practical test standards (PTS) (U.S. Department of Transportation, 1998). A flight scenario that follows the current guidelines (at that time) for the flight maneuvers required by the PTS was used for the IPC. This scenario was used to collect baseline data and to establish the initial level of proficiency for each subject who participants in the project.

The IPC flights contained six maneuvers (VOR approach, holding pattern, steep turns, unusual altitude recovery, ILS approach and a partial-panel non-precision approach). ATC communication procedures are also scored. The CFIIs for the IPC #1 flight used a form that was designed to facilitate the collection of three types of data (Phillips et al., 1995). First, within each maneuver there were up to 24 variables (e.g., altitude, airspeed) that were scored as pass/fail indicating whether performance on those variables met PTS requirements. Second, the flight instructor judged whether the overall performance of the each maneuver was pass/fail. Third, the CFII recorded if the overall performance of the subject met the PTS for the IPC. The instructors who administered the IPC #1 flight were standardized on the scenario to be flown and the scoring procedure.

IPC #1 was flown with a certified flight instructor, instrument (CFII) who acted both as a flight instructor and as an experimental observer. The participants are required to refrain from instrument flight following IPC #1 until IPC #2 is completed. They must also agree not to use a PCATD or a FTD for instrument training during this period.

Table 1. *Experimental Design*

Group	Fam. Flight	Initial IPC (IPC#1)	Final IPC (IPC#2)
Airplane	In Airplane In Frasca In Elite	IPC flight in Sundowner	IPC flight in Sundowner
Frasca	In Airplane In Frasca In Elite	IPC flight in Frasca	IPC flight in Sundowner
PCATD	In Airplane In Frasca In Elite	IPC flight in Elite	IPC flight in Sundowner

After a period not exceeding two weeks, all subjects flew a final IPC (IPC #2) in the aircraft to assess instrument proficiency. IPC #2 was conducted by a different CFII than IPC #1 to eliminate experimenter bias. The CFII for IPC #2 was blind to both the group to which the subject belonged and to the subject's performance on IPC #1. In terms of maneuvers, IPC #2 was identical to IPC #1. This final session contained all required maneuvers that a pilot must

satisfactorily complete in order to receive an endorsement of instrument proficiency. Completion of IPC #2 marked the end of a subject's involvement in the experiment.

Results

The pass/ fail rates by group for the 75 subjects for IPC #1 and IPC #2 are shown in Table 2, presenting the number and percentage of pilots that passed/failed IPC #1 and IPC #2 for each of the three experimental groups and for the total subjects.

Table 2. *Pass/Fail rates by group*

IPC#1					
Group	N	Pass	(%)	Fail	(%)
Aircraft	25	6	(24)	19	(76)
FTD	25	9	(36)	16	(64)
PCATD	25	9	(36)	16	(62)
Total	75	24	(32)	51	(68)

IPC#2

Group	N	Pass	(%)	Fail	(%)
Aircraft	25	13	(52)	12	(48)
FTD	25	14	(56)	11	(44)
PCATD	25	15	(60)	10	(40)
Total	75	42	(56)	33	(44)

Figures 1 and 2 show the differences between pass rates for the three groups for IPC #1 and IPC #2, respectively. Inspection of Figures 1 and 2 indicate few differences between groups for the number of participants who passed IPC #1 and IPC #2. A total of 24 of 75 subjects (32%) passed the IPC #1 flight in the airplane, FTD and PCATD and a total of 42 of 75 subjects (56%) passed the IPC #2 flight.

Chi-square tests were used to analyze the IPC #1 and IPC #2 data to determine whether the treatment (assignment to group) had an effect on the pass/fail ratio for the IPC #1 and IPC #2 flights respectively. The treatment effect on the IPC #1 pass/fail ratios, c2 (2, N=75) = 0.32, p = 0.85, and on IPC #2 pass/fail ratios, c2 (2, N=75) = 1.1, p = 0.58 were not statistically significant. A series of planned-comparison tests were performed between and among the experimental groups but one showed significant differences between the groups (p > .10).

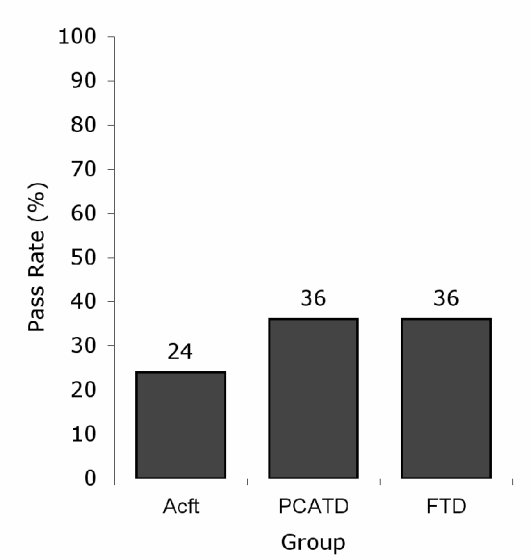

Figure 1. *Pass rates in IPC #1 for the experimental groups*

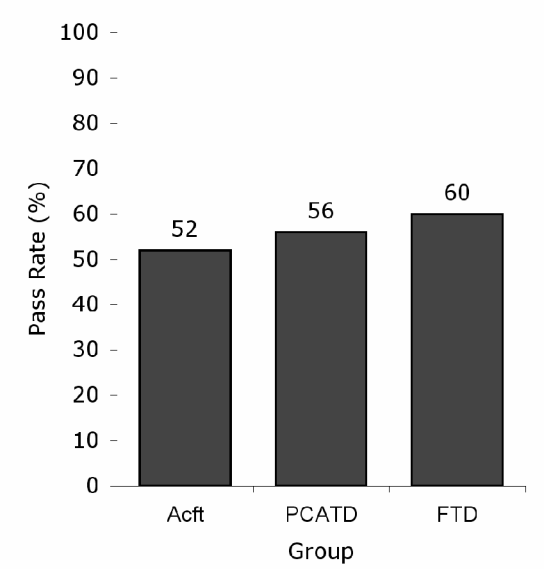

Figure 2. *Pass rates in IPC #2 for the experimental groups.*

The pass/fail rates by currency status are shown in Table 3. A total of 53 current pilots took IPC #1 and 19 passed (36%) while 34 failed (64%). Of the 53 current pilots taking IPC #2 and 30 passed (57%) while 23 failed (43%).

Analysis of the change of performance that took place between the IPC #1 and IPC #2 flights was made in order to understand the effectiveness of the three devices for conducting IPCs. Chi-square tests for changes in performance between IPC #1 and IPC#2 were used to determine if subjects'

performance had improved or deteriorated between the two sessions. All three experimental groups showed no significant changes in performance between IPC #1 and IPC #2, ($p > .05$).

Table 3. *Pass/Fail rates by currency*

IPC #1					
Currency	N	Pass	(%)	Fail	(%)
Current	53	19	(36)	34	(64)
Within 1 year	7	2	(29)	5	(71)
Within 1-2 years	1	1	(100)	0	(0)
2-5 years	14	2	(14)	12	(86)

IPC #2					
Currency	N	Pass	%)	Fail	(%)
Current	53	30	(57)	23	(43)
Within 1 year	7	6	(86)	1	(14)
Within 1-2 years	1	1	(100)	0	(0)
2-5 years	14	5	(36)	9	(64)

It was expected that performance on IPC #1 would be a good predictor of performance on IPC#2. Table 4 shows a comparison of the pass/fail rates for IPC #1 and IPC #2. Of the 24 participants who passed IPC #1 only 14 also passed IPC #2 (58%), and of the 51 participants who failed IPC #1 only 23 (45%) subsequently failed IPC #2 (a total of 37). Twenty-eight participants, who failed IPC #1 subsequently passed IPC #2 and 10 of the participants who passed IPC #1 subsequently, failed IPC #2 (a total of 38). Therefore, performance on IPC #1 predicted the performance on IPC# 2 only at the chance level. Indeed, the McNemar change in performance analysis between IPC #1 and IPC #2 for all participants was significant; $c2 (1, N = 75) = 8.53$, $p = .004$.

Table 4. *IPC #1 vs. IPC #2 Pass/Fail*

		IPC#2		
		Pass	Fail	Total
IPC#1	Pass	14	10	24
	Fail	28	23	51
	Total	42	33	75

Discussion

Reliability of FTDs and PCATDs for IPC

This study revealed no significant differences in performance by instrument pilots on an IPC given in either a PCATD, and FTD or an airplane. No significant difference was found on IPC #1 among the three groups, which indicates that the participants were likely to pass or fail an IPC in an Airplane as often as either the PCATD or the FTD. In addition there was no significant difference on IPC #2 indicating that the device in which the participants had IPC #1 had no influence on their pass/fail rates on IPC #2 in the airplane. The planned comparisons showed that pass/fail rates on IPC #2 of the PCATD group was statistically indistinguishable from both the airplane and the FTD groups. In addition, there was no difference in pass/fail rates between the aircraft and the FTD groups. These findings present compelling evidence for permitting the use of PCATDs to give IPCs.

Pre-Test—Post-Test Reliability

It was expected that performance on IPC #1 would be a good predictor of performance on IPC#2. However, a comparison of the pass/fail rates for IPC #1 and IPC #2 indicated that the performance on the baseline IPC did not predict performance on the final IPC. Only 58 percent of the participants who passed IPC #1 also passed IPC #2 and only 45 percent of the participants who failed IPC #1 also failed IPC #2. Only 49 percent of the participants either passed both tests or failed both tests, while 51 percent of the participants passed IPC #1 and failed IPC #2 or failed IPC #1 and passed IPC #2. Therefore performance on IPC #1 predicts performance on a second IPC at a chance level.The McNemar change in performance between IPC #1 and IPC #2 for all participants was significant but the comparisons for the individual three groups were not significant. Some of the failures may be related to a lack of familiarity with the PCATD, the FTD and the Sundowner airplane, since few of the participants had flown either of the devices prior to the study. The familiarization flights in each of the devices were expected to provide sufficient familiarity with the devices to eliminate the problem but may have failed to do so. It is possible that additional familiarity with instrument flying in each device, in addition to the VFR familiarization, was needed. The former was not done in order to minimize a possible training effect on group assignment.

Instrument Currency vs. Instrument Proficiency

Of the 53 participants who were instrument current, only 19 (36 %) passed IPC #1. The earlier study by Taylor et al. (2001) and Talleur et al. (2003) showed that 42 % of the instrument current pilots passed the initial IPC. The results from the current study are only slightly worse in this regard than those from earlier studies. In addition, most of the participants tested in the previous study had not taken an IPC after the test was standardized to include required

maneuvers (thereby increasing the difficulty of the IPC test). This finding raises questions concerning the relationship between instrument currency and instrument proficiency. Less than half of the participants were able to demonstrate instrument proficiency in an IPC in the airplane. This suggests the need for the FAA to consider changing the recency of experience requirements for instrument currency. Taylor et al., (2001) made the same observation and the current study reinforces the concern that currency rules are inadequate for instrument pilots to maintain proficiency. As Taylor et al., (2001) suggested, an alternative approach would be to require a periodic IPC to demonstrate instrument proficiency in addition to the current currency requirements.

Acknowledgments

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