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 seeks to evaluate the effectiveness and reliability of a personal computer aviation training device (PCATD) and a flight training device (FTD) in conducting an IPC. The study will compare the performance of pilots receiving an IPC in a PCATD, in a FTD or in an airplane (IPC #1) with performance on an IPC in an airplane (IPC #2). This comparison between a PCATD and an airplane will investigate the effectiveness of the PCATD in administering an IPC. Currently, the PCATD is not approved for IPCs. The comparison between a Frasca and the airplane will determine whether the current rule to permit IPCs in a FTD is warranted. Finally, the performance of pilots receiving IPC #1 in an airplane will be compared with IPC #2 in an airplane with a second CFII. This comparison will permit the determination of the reliability of IPCs conducted in an airplane.

INTRODUCTON

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, Lintern, Hulin, Talleur, Emanuel, and Phillips (1996, 1999) conducted a study to determine the extent to which a personal computer aviation training device (PCATD) can 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 in turn 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, Talleur, Bradshaw, Emanuel, Rantanen, Hulin and Lintern, 2001; Talleur, Taylor, Emanuel, Rantanen, and Bradshaw, in press). 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 is 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 investigates 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 help 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 will permit the determination of the reliability of IPCs conducted in an airplane.

METHOD

Participants

In the initial proposal a total of 105 pilots (35 in each group) were scheduled to participate in the study. Due to funding reductions in the third year funding, the number of pilots in the study was reduced to a total of 75 pilots (25 subjects in each group; FTD, PCATD and airplane). The participating pilots fall into one of four categories of instrument currency: (1) instrument current, (2) within one year of currency, (3) outside of one year of currency but within two years of currency, and (4) outside two years but within five years of currency. All participants will receive 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. A randomization process is being used to balance the order of the familiarization flights. Following the familiarization flights, subjects will be assigned to one of the three groups (FTD, PCATD and Airplane) with a constraint that the currency categories are balanced among the groups. (See Table 1)

Table 1
Randomization Schedule (PCATD = P; Frasca = F; Airplane = A

Replications:

1	2	3	4	5	6
PFA	FAP	APF	PAF	FPA	AFP
FAP	APF	PAF	FPA	AFP	PFA
APF	PAF	FPA	AFP	PFA	FAP
PAF	FPA	AFP	PFA	FAP	APF
FPA	AFP	PFA	FAP	APF	PAF
AFP	PFA	FAP	APF	PAF	

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 are being used in the study. Data output and recording systems have been developed for the PCATD and for the Frasca for development and analysis of objective pilot performance measures. 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 180 hp Beechcraft Sundowner aircraft (BE-C23) which have a single engine, fixed-pitch propeller, and fixed undercarriage are being used as aircraft for IPC #1 and IPC #2. These aircraft are equipped with flight data recorders (FDRs) developed at UIUC (Lendrum et al., 2000) for recording of data for objective pilot performance measures (Rantanen & Talleur, 2001).

Procedure

Following the familiarization flights all 75 pilots receive a baseline IPC flight in either the FTD, PCATD or an airplane (IPC #1) according to the group they are assigned. IPC #1 is flown with a certified flight instructor, instrument (CFII) who acts both as a flight instructor and as an experimental observer. Then all subjects are given a second IPC in the airplane (IPC #2) with a second CFII. 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. A limited number of pilots who were more than two years out currency received training 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. Table 2 depicts the experimental design.

Table 2.
Experimental Design

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

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 for the flight maneuvers required by the PTS is used for the IPC. This scenario is used to collect baseline data and to establish the initial level of proficiency for each subject who participants in the project.

The IPC #1 flight contains 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 use a form that was designed to facilitate the collection of three types of data (Phillips, Taylor, Lintern, Hulin, Emanuel, & Talleur, 1995). First, within each maneuver there are up to 24 variables (e.g., altitude, airspeed) that are scored as pass/fail indicating whether performance on those variables met PTS requirements. Second, the flight instructor judges whether the overall performance of the each maneuver was pass/fail. Third, the CFII records if the overall performance of the subject met the PTS for the IPC. The instructors who administer the IPC #1 flight have been standardized on the scenario to be flown and the scoring procedure.

After a period not to exceed two weeks, all subjects fly a final IPC (IPC #2) in the aircraft to assess instrument proficiency. IPC #2 is conducted by a different CFII than IPC #1 to eliminate experimenter bias. The CFII for IPC #2 is blind to both the group to which the subject belongs and to the subject's performance on IPC #1. In terms of maneuvers, IPC #2 is identical to IPC #1. This final session contains all required maneuvers that a pilot must satisfactorily complete in order to receive an endorsement of instrument proficiency. Completion of IPC #2 marks the end of a subject's involvement in the experiment.

PRELIMINARY RESULTS

At present, 54 of 75 of intended pilots (72%) have completed IPC #1 and 51 of the 75 pilots (68%) have completed the study. The pass/ fail rates by group for IPC #1 and IPC #2 are shown in Table 3.

Table 3.
Pass/Fail rates by group

IPC#1					
Group	N	Pass	(%)	Fail	(%)
Aircraft	18	4	(22)	14	(78)
FTD	19	5	(26)	14	(74)
PCATD	17	3	(18)	14	(82)
Total	54	11	(20)	42	(78)

IPC#2					
Group	N	Pass	(%)	Fail	(%)
Aircraft	17	8	(47)	9	(53)
FTD	17	7	(41)	10	(59)
PCATD	17	10	(59)	7	(41)
Total	51	25	(49)	26	(51)

A total of 42 of 54 pilots failed IPC #1 (78%) and a total of 26 of 51 pilots failed IPC #2 (51%). The percentages of pilots in each of the three groups who failed IPC #1are as follows: for the Airplane group, 78%, for the FTD group 74% and for the PCATD group 82%. The number of participants who have completed IPC 1 is not sufficient to compute statistical analyses.

The pass/fail rates for IPC #2 in the airplane show fewer failures for each group and for the total when compared to the pass/fail rates for IPC #1. Of the 51 pilots who have taken IPC #2, twenty-five passed (49%) and 26 failed (51%). The failure rate by group was 53% for the Airplane group, 59% for the FTD group and 41% for the PCATD group.

The pass/fail rates by currency status are shown in Table 4. A total of 37 current pilots took IPC #1 and 8 passed (22%) while 29 failed (78%). A total of 35 current pilots have taken IPC #2 and 15 passed (43%) while 20 failed (57%).

A matrix that shows IPC #1 and IPC #2 pass/ fail rates is presented in Table 5. The preliminary data show that 20 pilots who failed IPC#1 passed IPC#2, 18 failed both IPC#1 and IPC#2, 4 passed both IPC#1 and IPC#2 and 9 failed IPC#2 after passing IPC #1.

Table 4.
Pass/Fail rates by currency

IPC #1					
Currency	N	Pass	(%)	Fail	(%)
Current	37	8	(22)	29	(78)
Within 1 year	6	2	(33)	4	(67)
Within 1-2 years	--	--	--	--	--
2-5 years (Frasca)	5	1	(20)	4	(80)
2-5 years (PCATD)	5	1	(20)	4	(80)

IPC #2					
Currency	N	Pass	%)	Fail	(%)
Current	35	15	(43)	20	(57)
Within 1 year	6	5	(83)	1	(17)
Within 1-2 years	--	--	--	--	--
2-5 years (Frasca)	5	1	(20)	4	(80)
2-5 years (PCATD)	5	4	(80)	1	(20)

Table 5.
IPC #1 vs. IPC #2 Pass/Fail

		IPC#2		
		Pass	Fail	Total
IPC#1	Pass	4	9	13
	Fail	20	18	38
	Total	24	27	51

DISCUSSION

The Federal Aviation Administration permits the use of flight training devices in general aviation training and education. In 1997 the FAA published an advisory circular concerned with the qualification and approval of PCATDs (U.S. Department of Transportation, 1997). The advisory circular permits the use of PCATDs in instrument training programs conducted under FAR Part 61 and Part 141 and authorizes the use of a PCATD to be substituted for 10 of the 15 hours authorized for an approved flight training device (FTD). The advisory circular did not authorize the use of PCATDs for practical tests or for recency of experience requirements. The studies by Taylor et al. (2001) and Talleur et al. (in press) found that a PCATD and a Frasca FTD were significantly more effective in maintaining recency of experience than a control group that received no training for 6 months. The two groups of pilots who received recency of experience in the two training devices performed at least as well as the group trained in the airplane. This study also showed that 58% of the 106 instrument current pilots in the study failed IPC #1 in an airplane. Thirty-two of these were instrument current then they started their involvement in the study and 56% of these failed an IPC in an airplane. Forty percent of the 15 pilots who were more than 6 but less than 12 months out of currency and who received the recurrent training in a Frasca FTD to regain currency failed an IPC in an airplane. Of the 59 pilots who were more than 12 months out of currency and received about five hours of training in a Frasca and subsequently passed an IPC in a Frasca, 63% failed an IPC in an airplane. The percentage of instrument pilots who failed IPC #1 in the current study, 74%, exceeded the percentage previously observed in Taylor, et al. (2001) and Talleur et al. (in press).

The purpose of the current study is to show the effectiveness and reliability of an FTD, a PCATD, and an airplane in conducting IPCs. To date, 78% of pilots who are legally current have failed the initial IPC. Of the pilots who took IPC #1 in the FTD, 14 of 19 pilots (74%) failed the IPC and of the pilots who took the IPC in the PCATD, 14 of 17 pilots (82%) failed the IPC. The percentage of pilots who failed the initial IPC check flight in the aircraft (78%) was between the percentage for the FTD and the PCATD. The number of subjects in the study who have taken the initial IPC is not sufficient to determine if these results are statistically reliable. The percentage of current subjects failing the IPC in the airplane, 74%, is larger than the percentage of those failing in the Taylor et al. (2001) and Talleur et al. (in press) studies (56%).

Instrument current pilots, regardless of group assignment, are more likely to fail IPC #1 (78%) than to pass it. This finding clearly shows that instrument currency does not necessarily equate proficiency. The data thus far indicates that pilots are more likely to pass IPC #2 in the aircraft than pass IPC #1 in either the PCATD, the FTD, or the airplane. To the extent that all three groups pass rates improve on IPC #2, an overall training effect cannot be ruled out. There is very minimal evidence that pilots retrained to proficiency in the PCATD will pass an IPC #2 in the aircraft, but the data are not sufficient to provide any meaningful

statistical inferences at this point (see 2-5 years PCATD row in Table 4).

If a ground-based device is harder to fly than an airplane, then training in such devices may produce a pilot who has an easier time passing an IPC in the aircraft. Current data shows that pilots across all currency groups and experimental groups are as likely to pass IPC #2 as to fail it, regardless of performance on IPC #1. This differs from the results found in the previous project (Taylor, et al., 2001; Talleur et al., in press) where IPC #1 performance was the best predictor of IPC #2 performance.

The data outputs from the FTD and PCATD and the FDRs on board the Sundowner aircraft will be used to examine the possibly different flying characteristics of the different devices and their effects on pilot performance. In addition to the metrics developed and used by Rantanen and Talleur (2001), novel measures based on a time series analysis of the data will be developed. These measurer and analyses will augment the subjective pilot performance evaluation by the CFIIs and help in determining the detailed constituents of pilot performance (or lack thereof) during IPC flights.

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