Runway Incursions: Airport Movement Area Driver Training Demographics Suggests Revisions to Airport Driver Training Methods

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Abstract

This paper examines the problem of runway incursions at the (OEP-35) U.S. towered airports. According to the *FAA Runway Safety Report* (2004), vehicle deviations accounted for 20% (291 events) of all runway incursions during the period of 2000 through 2003. The focus of this quantitative correlational study is whether demographic characteristics are a significant factor in the airport movement area driver training that employees receive at Operational Evolution Plan (OEP-35) US towered airports. Airport driver training officials at the OEP-35 airports were surveyed using a five-point Likert-type survey. The data from this study suggested that demographic characteristics are significant factors in the airport driver training that employees receive at Operational Evolution Plan (OEP-35) US towered airports, and vary by geographic region, as well as ethnic and cultural influences prevalent in each region. The data from this study may assist airport operators in identifying significant demographic characteristics that affect the outcomes of their driver training programs, and potential improvements that may enhance airport movement area driver training programs in various geographic regions.

Keywords: Airport Driver Training, Aviation Safety, Runway Safety, Airport Safety, Driver Training Demographics

Introduction

Since the mid-1920s commercial aviation in the United States has achieved a remarkable safety record. Within the National Airspace System (NAS), thousands of passenger trips and aircraft operations are completed safely every year (Federal Aviation Administration, 2002 a). The growing pressure for increased operational rates to reduce system delays, combined with the complexity of airport operations and the requirement for precise timing, combine to make the airport movement area surfaces unforgiving of errors by pilots, air traffic controllers, and vehicle drivers (FAA, 2002b).

According to Clarke (2002), the Federal Aviation Administration (FAA) has developed several training programs for pilots and air traffic controllers to make each group more aware of runway incursion problems. In addition, the FAA instituted Standardized Taxi Routes (STRs) by FAA Order 7110.116, to assist pilots and air traffic controllers with surface movement of aircraft. Finally, air traffic controllers are required to maintain a high level of runway incursion awareness through a monthly computer-based recurrent training program titled *Preventing Runway Incursions.*

Rankin (1994) identified training of ground vehicle operators as the most effective FAA initiative to reduce runway incursions. However, ground vehicle operator training is conspicuously absent from mention in most literature; even though vehicle operators traverse airport movement areas on a daily basis.

On June 21, 2002, FAA issued Advisory Circular (AC) 150/5210-20 to provide guidance to airport operators in developing training programs for vehicle ground operations. This was the first advisory circular providing airport operators with a list of training topics to include in a ground vehicle operator training curriculum (FAA, 2002a).

The FAA (2004) defined runway incursions as “Any occurrence at an airport involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in a loss of required separation with an aircraft taking off, landing, or intending to land” (p. 9). The NAS continues to experience approximately one runway incursion per week, which is classified as significant or a barely avoided collision (FAA 2004).

Runway incursions are divided into three classification types. These types include pilot deviations, operational deviations, and vehicle deviations. In the United States, pilot deviations account for approximately 57% of the total runway incursions, operational deviations account for 23%, and vehicle deviations account for 20% (FAA, 2004). After type, runway incursions are further stratified into four distinct categories by increasing severity, ranging from category D, the least severe, to category A, the most severe. Figure 1 illustrates the runway incursion categories by severity.

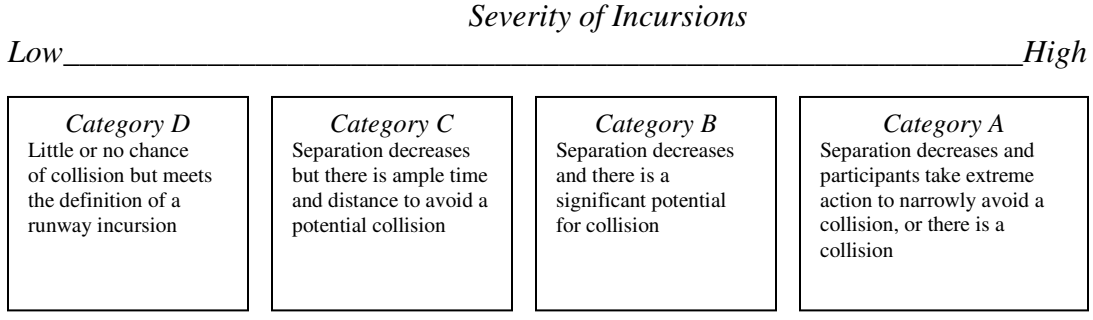

Figure1. Runway incursion categories by increasing severity. (FAA, 2004)

Statement of Problem and Purpose

The focus of this quantitative correlational study is whether demographics are a significant factor in the airport movement area driver training that employees receive at Operational Evolution Plan (OEP-35) US towered airports. Although vehicle deviations represent a smaller portion of the total U.S. runway incursions, the potential risk in the terms of loss of life is significant. The most serious runway incursion to date (a pilot deviation) occurred in Tenerife, Canary Island on March 27, 1977, killing 583 people, and ranking as the worst disaster in aviation history (Clarke, 2002).

The purpose of this study was to identify those demographic characteristics, if any, that are a significant factor in the airport movement area driver training that employees receive at the Operational Evolution Plan (OEP-35) US towered airports.

This study was significant in that no previous study has examined if demographic characteristics are a significant factor in the airport movement area driver training that employees receive at Operational Evolution Plan (OEP-35) US towered airports.

Statement of Hypotheses

In concert with the stated research question, there was one null and alternative hypotheses framed for this study. The hypotheses were formulated as follows:

1. H_{01} : Demographics characteristics are not significant factors in the airport movement area driver training that employee receive at Operational Evolution Plan (OEP-35) US towered airports.
2. H_{11} : Demographics characteristics are significant factors in the airport movement area driver training that employee receive at Operational Evolution Plan (OEP-35) US towered airports.

Review of Literature

Race – understood as *ethnic divergence from the normative community in any society* – is a part of everyday life around the world and the *race question* continues to be an issue for many civilizations, including America. Skin color is only one expression of race: ethnic diversity includes a long list of human variables such as language, customs at home and in business, dress, eating habits, and marriage, religious and sexual mores. A particular expression of ethnic diversity expressed in the education literature – but not operationalized in many official spheres – is the ways in which different ethnic groups learn.

It is now evident and well accepted in education literature that "the development of cognitive skills is closely related to the experiences and demands of the culture in which one grows up" (Salomon 1976, p. 138). The inverse is also true, so that "particular cultural experiences and demands can also be related to the mastery of particular skills and competencies" (Salomon 1976, p. 138), indicating that learning can be both understood and enacted by understanding students' cultural backgrounds. While research has shown that similarities among ethno-linguistic groups are greater than differences (Lambert 1973, ¶ 1) the same research acknowledges that:

> linguistic differences among ethnic groups are real … (and that) the linguistic distinctiveness of a particular ethnic group is a basic component of its members' personal

> identity; thus, ethnicity and language become associated in the thinking of those inside and outside the group. (Lambert 1973, ¶ 1)

A series of studies of English-speaking students[1] studying French showed that French achievement "was dependent upon both aptitude and intelligence as well as a sympathetic orientation toward the other group" (Lambert 1963, p.115). This "sympathetic orientation toward" is described as an "integrative orientation" while more utilitarian aspects of learning are described as having an "instrumental orientation" (Lambert: 1963, p. 114). The association was established Lambert (1963) that:

> Whereas aptitude and achievement were especially important for those French skills stressed in school training … the acquisition of French skills whose development depends on the active use of the language in communicational settings was determined solely by measures of an integrative motivation to learn French. (p. 115)

In summary, this challenges the Skinnerian behaviorist concept of repetition and reward – often reflected in rote learning – and suggests instead that "the learner must want to identify with members of the other linguistic-cultural group and be willing to take on very subtle aspects of their behavior such as their language or even their style of speech" (Lambert 1963, p. 115).

Modern communications (especially digital) has the capacity to be a two-way channel this is especially true in the education and training environment. Recognition and use of this; *two-way symmetric* model, advanced by Grunig and Hunt in 1984 (Johnston and Zawawi (2003 p. 53) leads to more effective communications and thus better learning. In Grunig and Hunt's model[2], "programs that make sure the targeted publics benefit as much as the … originators, are the most effective" (Johnston and Zawawi 2003, p. 55). This challenges a more traditional *one-way, asymmetrical* or even *one-way symmetrical* model which does not invite interaction between the communicating parties.

This is supported by the long-standing educational theory of *praxis*, proposed by Freire (1972) as "reflection and action upon the world in order to transform it" (p. 28) and described by Huesca (2003) as "self-reflexive, theoretically guided practice" (p. 211). To this is added *constructive alignment*, proposed and described by Biggs (1999) as "a design for teaching most calculated to encourage deep engagement" (pp. 25-31). The central element of the *praxis* in Freire's teaching is that the teacher must acquire a critical awareness of the situation of the student by becoming interdependent with the student. Freire (1972) concludes that "the requirement is seen not in terms of explaining to, but rather entering into a dialogue with … people about their actions" (p. 28) and is "animated by authentic humanist (not humanitarian) generosity" (p. 28). Under Freire's praxis orientation, practitioners attempt to close the distance between teacher and student, development agent and client, researcher and researched to enter into a co-learning relationship guided by action and reflection (Huesca 2003). Cohen (1996) suggests group meetings and group discussions, peer communication in groups and individual consultations, and small group media such as slide shows and video productions.

Kinship as Part of Ethnicity

Some groups and communities tend to operate more like a family than a market – more *gemeinschaft* than *gesellschaft* (Tönnies 1957) and this often denotes the anthropological notion

[1] In Montreal, Canada

[2] Developed originally for the public relations industry but now adopted as valid in more general communications research

of kinship at work. In such communities, the process of communication is "essentially, a social, psychological, possibly also a philosophical, term" and identifies "the individual's place in relation to his or her capacity to connect with others" (Silverstone 2005, p. 2). The present discussion of ethnic diversity is also assisted by an examination of kinship and the value of social networks. In modern, industrialized societies it is not enough to "get by, the goal is to get ahead" (Crow, 2004, pp. 14-15). The more access an individual has to social networks, i.e. a *kin network*, the more *social capital* they are seen to have (Short, 1996b, p. 3; Crow, op. cit.; Austin-Broos, 2006). Social capital (Bourdieu 1972) is the extent and strength of one's social network and the extent to which the individual may utilize it to attain personal and material satisfaction. It is now a policy aim of many government and non-government organizations to improve the social, health and economic circumstances of individual citizens by directly helping them develop their social networks (e.g. Cohen, 1996; Klein, 2004; Perri 6, 2004; Alexander, 2005). Social isolation, or an absence of social capital, i.e. an inability to participate adequately within a social network, renders it difficult for the individual to "get by and impossible to get ahead" (Short, 1996a; Perri 6, 2004 p. 180).

Kinship networks may be based upon blood ties or much, much more. They are inclusive and exclusive, fluid and enigmatic, and *governed* by a moral or legal framework. Until recently, many communicators such as journalists and corporate trainers (among others) seeking to address communities with enhanced kinship characteristics – such as rural and remote towns, special interest groups (such as environmental or religious groups), and especially metropolitan suburbs with high percentages of immigrants from single or various origins – have generally approached populations on the basis that they have universal characteristics (Masterton 1998) and are "culture-free: mutatis mutandis" (Galtung & Ruge 1965, pp. 67-68). However, many communicators in such situations have subsequently reported the need for deployment of *gut instinct*, or public consultative techniques to establish a more viable hierarchy of news values for the selected community. Religious newspapers and broadcast outlets target those groups with information and styles unlike secular media; sporting media recognize team loyalties; internationally, a different hierarchy of news values – a *different model* (Mohamed Al Mashikhi, personal communication, 2006) – operates in the Arab world. Indeed, this is clearly supported by the announcement page of the Al Arabiya news service, which notes "Al Arabiya … is an Arabic station, from the Arabs to the Arabs, delivering content that is relevant to the Arabs" (Allied Media 2007, ¶ 7).

Language is identified as a central driver of national identity as are geographical borders (Klyukanov 2005) and one attempt to harness them in search of this manufactured kinship is the establishment of community newspapers, radio and television, and multicultural outlets, sometimes based at the community level, and others on a more metropolitan, commercial level. Carpentier et al (2003) note that while the concept of *community media* is elusive, it is possible to arrive at a working definition, namely an outlet "which offers a service to the community in which it is located or to which it broadcasts, while promoting the participation of this community in the radio" (p. 51). Dueze (2006) suggests that the growth and success of ethnic and minority media in North America and Western Europe is due to "the worldwide emergence of all kinds of community, alternative, oppositional, participatory and collaborative media practices, in part amplified by the internet" (p. 262). Lin and Song (2006) identify a tendency among ethnic Asian and Latino newspapers in Los Angeles to include a large amount of news related to the audience's home country "in contrast to a relatively small number of geo-ethnic stories that are essential to community building" (p. 362).

Critically, kinship is not a series of identical social linkages between discrete individuals. Kinship could be more readily seen as a *Byzantine* system directly and indirectly connecting members via numerous formal and informal branches of differing strength and degree; some overt and blunt, others extremely subtle and nuanced (e.g., Evans-Pritchard, 1951; Hart, et al., 1988). One property of such a system is that the number of individuals in the kin group is not always fixed, or even simple to determine (e.g., Harris, 1990; Miller, 1990). Individuals may simultaneously belong to one or more kin networks with contrasting needs and expectations (e.g. Miller, 1990; Short, 1996b). This is supported by data (below) that demonstrates that many individuals in contemporary America find it difficult to self-identify in just one ethnic category (US Census Bureau, 2007). In such cases, the individual may need to develop his or her own *kinship hierarchy*, whereby obligations are prioritized not only within a kin network but also between coexisting networks. This hierarchy may depend upon numerous individual and broader variables, such as immediate need, strength of kin tie, threat of sanction and personal ambition. One taxonomy suggests the following four general *spheres*: political, religious, kinship and economic (Harris, 1990). The first two spheres represent authority, power, and *symbolic order*, whereas the later two encompass production and reproduction (Harris op. cit). In any event, it is evident that kinship networks and economic networks do not exist in separate *domains* but are irrevocably intertwined, i.e. the social and the economic are not mutually exclusive (Strathern, 1985; Harris, 1990; Austin-Broos, 2006). Blood relationships, cultural, religious, and professional or numerous other networks operate to help the individual *members* improve their personal economic circumstances. Anthropologists sometimes speak of people, who may not be closely genetically linked, cooperating to achieve some mutual benefit as *corporate groups* instead of kin groups (e.g., Harris, 1990; Miller, 1990).

Kinship networks help to lessen the burden of competition for resources and provide advantages over those outside the network (Hart et al., 1988; e.g., Harris, op. cit.; Crow, 2004). For example, directly or indirectly obtaining employment or finance through relatives or close friends is still a common and widely acknowledged part of modern societies (Fox, 1967; Stone, 2006).

Training and Ethnicity

The American Association of Airport Executives (AAAE) notes that it has developed an interactive computer-based employee training system that provides training customized to airports (AAAE website 2007). The AAAE training system is known as IET (Interactive Employee Training). Using digital video to capture images from client airports, educational designers use these images as the training background for each airport cohort. This has resulted in training for more than 600,000 airport and vendor employees on more than 350 workstations at 41 airports (AAAE website 2007).

The current research project addressed the following issues and sought information on whether – during development and implementation of IET: (a) there had been any direct consultation with the various diverse ethnical groups[3] which show up in populations of airside drivers at major US airports (especially in the South) during development and implementation of IET; (b) any literature or previous research had been encountered which suggested that consultation and ethnic *biofeedback* had been effective and might be worth including in the IET;

[3] Such as African-American; Cuban and Hispanic; Italian; Native Americans, other Europeans, various Asian nations, Pacific countries, various African nations, Russians and central Asians, etc

(c) IET explicitly takes into consideration feedback from potential trainees, current trainees and former trainees regarding how they experienced the program and how effective they found it; (d) any feedback received mentioned anything about cultural effectiveness or difficulties which trainees experienced while taking the IET program; (e) anything during roll-out and bedding down of IET, including feedback and testimonials from airport clients, suggested the program included enough customization for ethnic diversity in the program, or could more make the program more effective and thus improve clients' return on investment; and (f) if there are any similar customizable programs for comparison.

The investigators put these issues to IET co-developer Will James (personal communication September 20, 2007) and he noted that AAAE did not take into consideration any ethnic or cultural demographic issues in development of this IET training. He noted that they "just saw the need, developed the product, and put it on the market." Existing feedback since then had not led AAAE to focus on any of the issues raised in this research.

A review has also been conducted by the present researchers of key messages evident in dominant safety and training regimes deployed at major US airports. No clear evidence of any accent on trainees' ethnicity has been identified. The goals of the FAA *Runway Safety Blueprint* (2002a) include: (a) Develop and distribute runway safety education and training materials to controllers, pilots and all other airport users; (b) Increase surface safety awareness throughout the aviation community; (c) Assess and modify procedures to enhance runway safety; (d) Improve runway safety data collection, analysis, and dissemination; (e) Identify and implement enhancements to improve surface communications; (f) Increase situational awareness on the airport surface; (g) Support and deploy new technologies that reduce the potential for collision; and (h) Implement site-specific runway safety solutions in coordination with local aviation communities (p. 4). Another model Kirkpatrick (1983) addresses four aspects of training effectiveness. This model is widely accepted by the American Association for Training Development (Tidler 1999). Kirkpatrick's four aspects of training effectiveness are: (a) Reactions – What trainees' say about the value of the training; (b) Learning – Objectives met, knowledge and skills learned; (c) Behavior – The skills acquired are implemented on-the-job; and (d) Results – Impacts on job performance (Kirkpatrick, 1983, ¶ 6).

Highlights of Methodology

For the purposes of this study, a quantitative and limited qualitative methodology was used. A five point Likert-type survey instrument was used to collect the necessary data and qualitative responses to five end-of-survey questions (see Appendix A). The independent variable consisted of two airport movement area driver training methods – AAAE interactive computer-based airport movement area driver training and traditional airport movement area driver training. The study also identified four dependent variables *runway incursion categories A through D.*

In this study five intermediary independent variables or *demographics* were analyzed. The demographic variables include (a) race, (b) age, (c), education, (d), income, (e), and marital status. The statistical analysis used in this study was multivariate analysis of variance (MANOVA).

Limitations of Study

According to Wells (2004), the National Plan of Integrated Airport Systems (NPIAS) contains a listing of more than 3,334 public funded airports in the United States. Of the 3,334 plus public funded airports listed in the NPIAS, only 490 airports have operating control towers, and only towered airports report runway incursions (FAA, 2004). With respect to the towered airports, FAA (2004) stated commercial aviation aircraft operations at OEP-35 airports are predominantly commercial aircraft, and account for "the majority (87 percent) of category A and category B runway incursions" (p. 36).

This study was limited to an analysis of vehicle deviations that cause runway incursions at OEP-35 airports. According to the FAA (2004), "vehicle/pedestrian deviations represented 18 percent of the runway incursions at the OEP-35 airports, which is in proportion to their national representation (20 percent)" (p. 36).

There were several potential limitations with respect to the survey instrument. These included (a) the effective sample size of participants, (b) the accuracy of the data provided by the participants, and (c) the pitfall of correlation versus causation for forming conclusions.

Selection of Participants

The population sampled for this study was comprised of employees that completed airport movement area driver training from 18 of the airports responding to the survey - FAA Operational Evolution Plan Airports (OEP-35). Targeted participants included 390 randomly selected employees who have successfully completed airport movement areas driver training and who are authorized to drive vehicles onto and within the airport movement areas. A scaled survey instrument was used to gather the data on the demographic (see Appendix A).

Discussion of Data Processing

Power analysis software obtained from the UCLA Department of Statistics was used to estimate the required number of *completed* surveys. The calculations showed that at least 194 completed surveys needed to be collected from participants at OEP-35 airports to estimate the mean response values for questions 1 through 26 within a desired precision of .10 (University of California, 2005).

FAA (2004) considers runway incursions rare events relative to total aircraft flights over finite periods of time (5.6 incursions per half million aircraft flights per year). According to Aczel and Sounderpandian (2002) "if we count the number of times a rare event occurs during a fixed interval, then that number would follow a Poisson distribution" (p. 151). Using software obtained from the UCLA Department of Statistics webpage (University of California, 2005), a Poisson power analysis was used to estimate the number of years of runway incursion data needed from the 2004 FAA *Runway Safety Report*.

The statistical analysis used in the study included multivariate analysis of variance (MANOVA). For MANOVA the independent variable was specified as *method of training* and the covariates were specified as *demographics*. The dependent variables were specified as *runway incursions categories A through D.*

Since more than one dependent variable was specified, the multivariate analysis of variance using Pillai's trace, Wilks' lambda, Hotelling's trace, and Roy's largest root criterion

with approximate *F* statistic was provided as well as any subsequently needed univariate analysis of variance for each dependent variable (Norusis, 2003).

Reliability of Survey Instrument

The fist step was to determine the reliability of the survey instrument. According to Norusis (2003):

> In classical theory, a subjects' response to a particular item is the sum of two components: the true score and the error. The true score is the value of the underlying construct that is being measured; the error is the part of the response that is due to question-specific factors. The index most often used to quantify reliability is Cronbach's Alpha. Good scales have values larger than 0.8. (pp. 437-438)

In the case of this study, SPSS© software was used to calculate the Cronbach's Alpha value of 0.864 shown in Table 2 for the 26 survey questions used to study driver training methods.

Table 2
Cronbach's Alpha Reliability Statistics

Cronbach's Alpha	N of items
.864	26

Distribution of the Dependent Variables

The second step was to determine what distribution the dependent variables (runway incursion categories A through D) followed. As previously stated, FAA (2004) considers runway incursions rare events relative to total aircraft flights over finite periods of time (5.6 incursions per half million aircraft flights per year). According to Aczel and Sounderpandian (2002) "if we count the number of times a rare event occurs during a fixed interval, then that number would follow a Poisson distribution" (p. 151).

Multivariate Analysis of Variance (MANOVA) Results

The third step was to examine if demographic characteristics (ethnic and cultural diversity) are a significant factor in the airport movement area driver training that employees receive at the Operational Evolution Plan (OEP-35) US towered airports.

MANOVA Analysis of the Effects of the Demographic Characteristics for all OEP-35 US Towered Airport.

The MANOVA analysis identified the effects of the covariates in the model for all US airports. The variable *race* was not found to be statistically significant at the 0.228 level. This

variable measured the participants' races in the categories of white, African-American, Hispanic, Asia-Pacific Islander, and Native American. The variable *age* was found to be statistically significant at the 0.000 level. This variable measured the participants' age in the categories of 18-25 years, 25-35 years, 35-45 years, 45-55 years, and 55+ years. The variable *education* was found to be statistically significant at the 0.000 level. This variable measured the participants' education in the categories of no high school, high school/GED, some college, two year college, four year college, Master Degree, Doctoral Degree, professional degree JD, MD. The variable *income* was found to be statistically significant at the 0.037 level. This variable measured the participants' income in the categories of 20k or less, 20k – 30k, 30k – 40k, 40k – 50k, 50k +. Finally, the variable *marital* was not found to be statistically significant at the 0.316 level. This variable measured the participants' marital status in the categories of single, married, separated, divorced, widowed. See Appendix B for the results of the multivariate (MANOVA) analysis.

MANOVA Analysis of the Effects of the Demographic Characteristics for South Florida OEP-35 US Towered Airports.

The MANOVA analysis identified the effects of the covariates in the model for South Florida OEP-35 airports. The variable *race* was the only variable found to be statistically significant at the 0.002 level (see Appendix C).

Analysis and Evaluation of Findings

The MANOVA analysis identified the effects of the covariates in the model for all US towered airports. The variable *race* was not found to be statistically significant at the 0.228 level. The variable *age* was found to be statistically significant at the 0.000 level. The variable *education* was found to be statistically significant at the 0.000 level. The variable *income* was found to be statistically significant at the 0.037 level. Finally, the variable *marital* was not found to be statistically significant at the 0.316 level. See Appendix B for the results of the multivariate (MANOVA) analysis. However, *race* was found to be statistically significant at the 0.002 level for South Florida OEP-35 US towered airports (see Appendix C).

As a result, MANOVA analyses supported the alternative hypothesis that demographics characteristics are significant factors in the airport movement area driver training that employee receive at the Operational Evolution Plan (OEP-35) US towered airports.

Qualitative Comments from Survey

Qualitative comments were grouped by common threads as follows:

1. The typical comments with regard to the most favorable aspects of training centered on computer-based technology and the ability of the training to show the types of signs used in the airfield environment as follows: "The AAAE system is an excellent computer based training system that is user friendly." and "The use of PowerPoint to show signs locations at MIA provides a clear understanding of what they mean." The "overheads used where great."
2. Typical comments with regard to the least valuable aspects of the training centered on the lack of staffing, standardization, funding and technology as follows: "We need full time trainers" and "Driver training programs are different for airports statewide

including resources to maintain or increase operator knowledge. Staffing, training and technology are limited based on fiscal funding." Finally, another common response was "We need more money allocated to driver training programs. Training programs have been historically cut in favor of construction programs."

3. Typical comments with regard to what improvements could be made centered mostly on technology and regulation as follows: "More use of computer interactive software would make it much easier to provide a better environmental awareness than when listening to a trainer." and "movement area licenses should be regulated and monitored by the FAA to uniformly address incursions and compliance from a common FAA standard."
4. Typical comments with regard to ethnic and cultural diversity obstacles that stand in the way of knowledge and skills learned centered on diversity of the workforce issues at the South Florida airports as follows: "We have a variety of different languages and English is the only language used in aviation; we should use Spanish as well." and "English is my second language." and "There is a vast diversity of the people that take the training, and for many English is their second language." Finally, one common problem was "it is difficult to understand air traffic control instructions."

Conclusions

The MANOVA analysis supported the alternative hypothesis that demographic characteristics are significant factors in the airport movement area driver training that employee receive at the Operational Evolution Plan (OEP-35) US towered airports.

FAA efforts to date have not focused on the study of demographic characteristics associated with airport movement area driver training. All the airports responding to the survey offer primary and recurrent training on a yearly basis. There are two fundamental precepts that are essential for a successful approach to airport movement area driver training; (a) training is not a one-time event, and (b) the most effective way to teach vehicle drivers safety on movement areas is to simulate the actual environment they work in on a reoccurring basis. Training at the OEP-35 airports satisfies these two fundamental precepts.

There was no surprise that education, age, and incomes were found to be statistically significant demographic characteristics at all OEP-35 US airports. Although many non-movement area employees change jobs frequently due to low wage rates, this is not typical for employees licensed to drive on the movement areas. Airport employees that operate ground vehicles in and onto the movement areas of airports typically have a professional certification or a college degree (ie. electricians, firefighters, airport operations personnel, etc.). One explanation for these demographics characteristics being significant for movement area drivers is that the longer employees work in a given job the more annual recurrent driver training they receive. As the years past, the employee's age and earnings increase. As a result, the three demographics of education, age, and income appear to be interrelated and may support the conclusion that many of those employees authorized to drive onto movement areas of airports have stable employment records and receive annual recurrent training on a regular basis. It is also no surprise that highly educated employees with movement area driving privileges are likely to hold higher positions within their respective company, are older, and earn more income.

With regard to *race* being identified as the only significant variable at the OEP-35 US towered airports in South Florida, lack of understanding ATC communications may prove to be

the primary issue related to driver training deficiencies in this geographic region do to ethnic and cultural diversity. This is highlighted by US Census Bureau data that 74.6% of the language spoken at home in South Florida is other than English, while the US norm is 17.9% (U.S. Census Bureau, 2007). From the airport movement area driver training perspective, communication, or the use of consistent terminology is a primary concern among different ethnic and cultural groups or population centers.

This conclusion is supported by the qualitative responses which indicated that English is a second language for many South Florida employees with airport movement area driving privileges. Since English is the industry adopted language for aviation operations worldwide, this finding is problematic. This is evidenced by Clarke (2002) who stated "The use of consistent terminology (in ATC communication) is recommended for all involved" (p. 14).

Recommendations

Study, education, and strict enforcement are the tools currently being used by airport operators to address the problem of vehicle deviations. This system of addressing vehicle deviations is sometimes called *study, educates, enforces* (SEE) and has been successful in many areas, not just aviation (Clarke, 2002). The first recommendation from the present article is that a more detailed study (than the one conducted for this article) of airport movement area driver demographics by geographic regions is needed to provide additional insights into problem of runway incursions by specific regions of the United States. For example, certain regions (such as South Florida, as this study shows) have racial and ethnic differences that lead to communications barriers not necessarily experienced in other regions of the United States. The second recommendation is that concerted efforts (assisting or complementing those of the present research team) be devoted to constructively aligning the requirements of airport movement area driver education / training with the ethnically diverse characteristics of the drivers themselves. It is clear that adoption of this recommendation will tend to reduce the need for the third aspect of SEE, enforcement.

Finally, since the data suggested that there is potential to increase knowledge through annual recurrent training, all airports should be required to provide recurrent airfield movement driver training on an annual basis to reduce the likelihood of inconsistent terminology / communications, especially in those regions with ethnically diverse populations.

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Appendix A
Driver Training Survey

Driver Training Effectiveness Survey

Name of Airport_____Date_____

Guidelines: Read each of the following questions and circle the number that most appropriately represents your opinion. For the qualitative questions on the final page, please clearly print your responses in the space provided. N/A is not applicable.

LEARNING OBJECTIVES MET	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	N/A
When you completed the Driver training, you were able to:						
1. Understand the meaning of runway/taxiway signs, surface markings and lighting	1	2	3	4	5	N/A
2. Understand ATC language, clearances, instructions, and light signals	1	2	3	4	5	N/A
3. Understand Notice to Airmen (NOTAMS)	1	2	3	4	5	N/A
4. Understand and use airport diagrams to navigate on the surface	1	2	3	4	5	N/A
5. Use of new surface navigation technologies	1	2	3	4	5	N/A
6. Understand FAR Part 139 and Advisory Circular Safety Regulations	1	2	3	4	5	N/A
KNOWLEDGE INCREASE	**None**	**Basic**	**Good**	**Sound**	**Expert**	
7. My average level of knowledge and skill on movement area driving **before** completing driver training was:	1	2	3	4	5	
8. My average level of knowledge and skill on movement area driving **after** completing driver training was:	1	2	3	4	5	
ON-THE-JOB CONFIDENCE	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**N/A**
After I completed the driver training, I was confident I would be able to:						
9. Understand the meaning of runway/taxiway signs, surface markings and lighting	1	2	3	4	5	N/A
10. Understand ATC language, clearances, instructions, and light signals	1	2	3	4	5	N/A
11. Understand Notice to Airmen (NOTAMS)	1	2	3	4	5	N/A
12. Understand and use airport diagrams to navigate on the surface	1	2	3	4	5	N/A
13. Use of new surface navigation technologies	1	2	3	4	5	N/A
14. Relate FAR Part 139 and Advisory Circular Safety Regulations to driving on the airport surface	1	2	3	4	5	N/A
EFFECTIVENESS OF MATERIALS & METHODS	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**N/A**
15. The driver-training program was clear and easy to follow.	1	2	3	4	5	N/A
16. The materials used provided enough information to facilitate the learning objectives	1	2	3	4	5	N/A
17. The overheads used are clear and easy to follow	1	2	3	4	5	N/A
18. The driver training video used is successful in illustrating the learning objectives	1	2	3	4	5	N/A
19. The exercises effectively cover the learning objectives	1	2	3	4	5	N/A
Type of Training						

20. This is traditional training (not computer interactive based training) Yes No (Circle)
21. This is AAAE interactive computer-based training? Yes No (Circle)

Demographic Information

22. Race White – 1 African-American – 2 Hispanic – 3 Asian-Pacific Islander – 4 Native American – 5 (Circle One)
23. Age 18yrs -25yrs – 1 25yrs – 35yrs – 2 35yrs – 45yrs – 3 45yrs – 55yrs – 4 55+yrs – 5 (Circle One)
24. Education No High School – 1 High School/GED – 2 Some College – 3 2yr College Degree – 4
4yr College Degree – 5 Master Degree – 6 Doctoral Degree – 7 Professional Degree JD, MD – 8 (Circle One)
25. Income 20k or less - 1 20k – 30k – 2 30k – 40k – 3 40k – 50k – 4 50k+ - 5 (Circle One)
26. Martial Single – 1 Married – 2 Separated – 3 Divorced – 4 Widowed – 5 (Circle One)

Comments

1. What did you find **most** valuable about your driver training program? Please indicate why.
2. What did you find **least** valuable about your driver program? Please indicate why.
3. What improvements could be made to make your driver training program more effective?
4. The obstacles that stand in the way of the successful application of the knowledge and skills learned in this program are:
5. Overall Comments:

Appendix B

Multivariate Analysis of Variance Results for Significance of Association between Independent Variable, and Covariates across All Classes of Runway Incursions

Effect		Value	F	Hypothesis df	Error df	Sig.
Race	Pillai's Trace	.024	1.421(a)	4.000	227.000	.228
	Wilks' Lambda	.976	1.421(a)	4.000	227.000	.228
	Hotelling's Trace	.025	1.421(a)	4.000	227.000	.228
	Roy's Largest Root	.025	1.421(a)	4.000	227.000	.228
Age	Pillai's Trace	.095	5.965(a)	4.000	227.000	.000
	Wilks' Lambda	.905	5.965(a)	4.000	227.000	.000
	Hotelling's Trace	.105	5.965(a)	4.000	227.000	.000
	Roy's Largest Root	.105	5.965(a)	4.000	227.000	.000
Education	Pillai's Trace	.130	8.503(a)	4.000	227.000	.000
	Wilks' Lambda	.870	8.503(a)	4.000	227.000	.000
	Hotelling's Trace	.150	8.503(a)	4.000	227.000	.000
	Roy's Largest Root	.150	8.503(a)	4.000	227.000	.000
Income	Pillai's Trace	.044	2.594(a)	4.000	227.000	.037
	Wilks' Lambda	.956	2.594(a)	4.000	227.000	.037
	Hotelling's Trace	.046	2.594(a)	4.000	227.000	.037
	Roy's Largest Root	.046	2.594(a)	4.000	227.000	.037
Martial	Pillai's Trace	.021	1.191(a)	4.000	227.000	.316
	Wilks' Lambda	.979	1.191(a)	4.000	227.000	.316
	Hotelling's Trace	.021	1.191(a)	4.000	227.000	.316
	Roy's Largest Root	.021	1.191(a)	4.000	227.000	.316
Method	Pillai's Trace	.243	18.206(a)	4.000	227.000	.000
	Wilks' Lambda	.757	18.206(a)	4.000	227.000	.000
	Hotelling's Trace	.321	18.206(a)	4.000	227.000	.000
	Roy's Largest Root	.321	18.206(a)	4.000	227.000	.000

a Exact statistic
b Design: Intercept+Race+Age+Education+Income+Martial+Method

Appendix C

Multivariate Analysis of Variance Results for Significance of Demographic Variables for South Florida OEP-35 US Towered Airports

Effect		Value	F	Hypothesis df	Error df	Sig.
Race	Pillai's Trace	.159	10.436(a)	1.000	55.000	.002
	Wilks' Lambda	.841	10.436(a)	1.000	55.000	.002
	Hotelling's Trace	.190	10.436(a)	1.000	55.000	.002
	Roy's Largest Root	.190	10.436(a)	1.000	55.000	.002
Age	Pillai's Trace	.024	1.356(a)	1.000	55.000	.249
	Wilks' Lambda	.976	1.356(a)	1.000	55.000	.249
	Hotelling's Trace	.025	1.356(a)	1.000	55.000	.249
	Roy's Largest Root	.025	1.356(a)	1.000	55.000	.249
Education	Pillai's Trace	.015	.836(a)	1.000	55.000	.365
	Wilks' Lambda	.985	.836(a)	1.000	55.000	.365
	Hotelling's Trace	.015	.836(a)	1.000	55.000	.365
	Roy's Largest Root	.015	.836(a)	1.000	55.000	.365
Income	Pillai's Trace	.027	1.518(a)	1.000	55.000	.223
	Wilks' Lambda	.973	1.518(a)	1.000	55.000	.223
	Hotelling's Trace	.028	1.518(a)	1.000	55.000	.223
	Roy's Largest Root	.028	1.518(a)	1.000	55.000	.223
Martial	Pillai's Trace	.011	.608(a)	1.000	55.000	.439
	Wilks' Lambda	.989	.608(a)	1.000	55.000	.439
	Hotelling's Trace	.011	.608(a)	1.000	55.000	.439
	Roy's Largest Root	.011	.608(a)	1.000	55.000	.439

Appendix D

Estimated Marginal Means

Dependent Variable	Method Used	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Category A	Traditional	.528	.039	.451	.605
	AAAE Interactive	.129	.065	.000	.258
Category B	Traditional	2.260	.139	1.986	2.535
	AAAE Interactive	.809	.232	.352	1.265
Category C	Traditional	4.767	.223	4.328	5.206
	AAAE Interactive	2.975	.370	2.245	3.705
Category D	Traditional	4.852	.320	4.221	5.483
	AAAE Interactive	4.323	.532	3.274	5.372