

GENDER, COMMUNICATION, AND AVIATION INCIDENTS/ACCIDENTS

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ABSTRACT

Crew communication and crew resource management are readily recognized as critical to safety of flight. With the inclusion of a greater number of female pilots in a traditionally male crew environment, it is imperative to investigate how gender characteristics impact crew communication. This study was a meta-review of existing literature. There have been a number of studies that examined differences in masculine versus feminine communication characteristics in general. Additional work has been done in the field of aviation, some with respect to differences between male pilots and female pilots and some with respect to the role communication deficiencies or breakdown played in aviation incidents or accidents. However, most researchers recognized the relative dearth of current studies of the effect of gender integration with respect to the collaboration and communication necessary for effective use of increasingly more technologically advanced equipment. This study should serve as a framework for examining more current practices in how possible gender differences in communication might be related to aircraft incidents or accidents, with the overarching purpose to inform current and future training programs so that the human side of aviation keeps pace with the increasingly more advanced technological side.

Keywords: gender differences, aviation communication, aviation accidents, aviation incidents

INTRODUCTION

As the world developed into a fast-paced global economy, the aviation industry followed suit to provide efficient and safe transportation for passengers and goods. From the first aviation fatality, investigators have studied every aspect of accidents and incidents to develop an understanding of what went wrong so that aircrew members can be trained not to make the same mistakes. Aircraft developed into more sophisticated machines and aircrews grew in members, leading to the need for examination of how these crews interact and communicate to ensure safety of flight. With the inclusion of a greater number of female pilots in a traditionally male crew environment, it is imperative to investigate how gender characteristics impact crew communication.

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1. LITERATURE REVIEW

1.1. Communication and Aviation Accidents/Incidents

When examining aviation incidents or accidents, investigators traditionally focused on the perspectives of human-human interaction, human-machine interaction, and machine malfunction. Katerinakis (no date), outlined a number of studies that showed pilot error, as the cause for an aviation accident or incident, was more closely aligned with deficiencies in team communication and collaboration (human-human) than in technical proficiency (human-machine). Multiple studies indicated that approximately 70 to 80 percent of aviation accidents could at least in part be attributed to human error (O'Hare, Wiggins, Batt, & Morrison, 1994; Wiegmann & Shappell, 1997). Earlier research by Tompkins (1991) found that more than 60 percent of the incident reports in the Aviation Safety Reporting System (ASRS) reflected communication errors as a causal factor. Kanki and Palmer (1993) reported this statistic as 70 percent when describing a 1981 Billings and Cheaney study of the ASRS reports submitted by aircrew members and air traffic controllers (ATCs) from 1976 through 1981. The study findings indicated information transfer problems were related to lack of transmission due to belief by the individual possessing the information that its transmission was not necessary, or to inaccurate transmission of information (Billings & Cheaney, 1981 in Kanki & Palmer, 1993).

Studies of aviation communication include investigations related to within-crew or cockpit interaction, flight deck (cockpit)-cabin crew communication, and interaction between pilots and ATCs. Driscoll (2002) studied accident reports and cockpit voice recorder transcripts to examine within-crew interaction for three cases in which the accidents were classified as controlled flight into terrain (CFIT), using discourse analysis methods. She found that there was a shared relationship between communication problems and the crew's loss of situational awareness; each led to issues with the other. Endsley and Jones (2012) defined situational awareness as an individual's awareness of "what is happening around" him or her, and the related ability to "understand what that information means ... now and in the future" (pg. 13). Within the discipline of aviation, this construct would relate to how a pilot or flight crew collects, interprets, and uses data during flight operations. Neville and Walker (2005) examined crew conversation, describing a conversation analysis methodology in which typical sound recordings from normal crew communication served as a baseline for analyzing communication recordings from the 1995 Westwind 1124 CFIT accident. Results of the study indicated that incorrectly set descent altitude, recognized as the error that led to the accident, was in part related to faulty communication and interaction processes between crew members.

Communication on an aircraft also includes transfer of information between aircrew and cabin crew. Armentrout-Brazee and Mattson (2004) related the findings of a Purdue University study of communication between flight crews, cabin crews, and aviation maintenance personnel. Issues within the aircraft cabin tended to be communicated to flight crews late in the flight when both groups had multiple task requirements, leading to greater likelihood of incomplete or inaccurate information transmission (Armentrout-Brazee, & Mattson, 2004). In certain cases, the information was recorded on whatever was available, which might mean a cocktail napkin – leading to perceptions about lack of respect for members of another group who would

be receiving the information (Armentrout-Brazee, & Mattson, 2004). The researchers also found that pilots held the self-perception as gatekeepers for information between cabin crew members and maintenance technicians, applying their judgment of information importance to whether or not they transferred that information. A gatekeeper mentality generally reflects a perceived hierarchy of position rather than a team concept. Ford, O'Hare, and Henderson (2013) studied how social categorization and social identity theory could be used to engender more effective teamwork and communication between flight crews and cabin crews, and within cabin crews. They found that cabin crew members who completed a questionnaire in which their organization was the item focus were more willing to participate in coordinated team actions than those who first completed a questionnaire in which items focused on individual or personal perceptions. The implication was that a sense of team or social identity could lead to more effective communication and improved coordination, whether in normal aviation operation or an emergency situation.

In recent years, several researchers have focused on the interactions between pilots and ATCs. Howard (2008) investigated pilot-ATC communication, observing control tower frequencies at 15 U.S. airports. He found that communication issues or related problems occurred more often in the pilot side than the ATC side of the communication, and increasing the amount of information included in a particular transmission led to problems in the next communication. Howard (2008) also determined that changes to ATC protocol in transmitting information to aircrews led to problems in follow-on communication. Kanki (2010) referenced a 2009 ASRS publication that identified recurring issues in incorrect anticipation of ATC calls based on expectations, issues with language differences, and issues with aircraft call sign confusion. A more recent dissertation by Cummings (2013) focused on pilot-ATC discourse when the pilot learned English as a second language (ESL). English is the internationally-recognized language of aviation, but communication using this language can be difficult or more complicated when it is not the native language of the aviators involved. Cummings used mixed-mode communication (visual and auditory) in ATC transmissions to ESL pilots, measuring response time and accuracy of pilot readbacks. Her findings suggested that use of the mixed-mode transmission yielded significantly better results than auditory communication alone. Barshi and Farris (2013) examined miscommunication between aircrews and ATCs as functions of linguistic properties and lengths of messages, ESL proficiency, and cognitive workload. Their findings indicated that within this area of communication – given that task requirements are being transmitted, under normal conditions working memory capacity is limited to three propositions for 100 percent accuracy of task performance. When workload is increased, or language proficiency is lower, the capacity limit is decreased to two propositions. If such moderating factors are combined (workload is increased for a non-native English speaker), the limit can decrease to one proposition. These findings have a significant impact on how messages are communicated, especially in a stress-infused emergency situation.

The results of these studies indicate the need to continue investigating aviation communication. One focus of such research would be investigation of possible differences in communication traits between male and female aviation professionals.

Vermeulen (2009) discussed a Georgia Institute of Technology study in which gender, social, and cultural differences in communication associated with flight instruction were evidenced in both low-risk and high-risk situations. Findings showed that female pilots were likely to use more two-part phrases or sentences than males, stating a problem and then directing the copilots' actions (Fischer & Orasanu, 1999 in Vermeulen, 2009). The effectiveness of longer discourse or instruction would be directly related to the time available for the communication. In a critically time-sensitive scenario, reducing communication to a set of orders might be more appropriate in mitigating the risk of a hazardous situation. Gender-related communication style, if directly related to time-sensitive action, should be studied more in depth. If the Georgia Institute of Technology findings are replicated in subsequent studies, safety management professionals could use the information to support developing incident/accident scenario directions for pilot training programs. Much like the checklists used in preflight preparation, concise directions or orders could be programmed and formalized to minimize the discourse in a potential incident or accident.

1.2. Male-Female differences in Aviation (with focus on incidents/accidents)

Historically, aviation has been readily described as a male domain, though in recent decades there has been an increase in the number of experienced female pilots. According to Hynes and Puckett (2011), there were some studies of gender issues in aviation in the 1990s and early 2000s, but the research area is still considered a significantly under-developed category. McFadden and Towell (1999) quoted a 1974b Novello and Youssef study that is recognized as seminal research, in which investigators found that personality characteristics of pilots transcended the male-female dichotomy. Female pilots exhibited more traits associated with male pilots than they did with other females in the general population. In the same study, Novello and Youssef (1974a) found male pilots were more prone to exhibit traits such as achievement, exhibition, dominance, change, and heterosexuality than males in the general population. They were less likely to exhibit deference, order, affiliation, succorance, abasement, nurturance, and endurance. Levine, Lee, Ryman, and Rahe (1976) studied military pilot behavioral attitudes, and found that the characteristic of adventurousness, an attribute that one could link to the traits of exhibition and change in Novello's and Youssef's (1974a) study, was highly correlated with aircraft carrier accidents. Aviation history is filled with stories of high risk, from the death-defying antics of the barnstormers to Chuck Yeager's and Jackie Cochran's pursuit of their spots in history breaking the sound barrier to today's commercial race to space, common behavior traits in many aviators continue to be achievement, exhibition, and adventure. These traits are more closely associated with risk-taking than with risk-avoiding. The combination of the hazards associated with flight and risk-taking nature of aviators engender a natural concern that pilot-error might be the predominant cause for incidents and accidents.

McFadden (1996) studied the possibility that pilot-error accident rates differed for male and female U.S. pilots working for major airlines. An initial look at the data indicated that female pilots working for major airlines from 1986 through 1992 had a significantly higher accident rate than males. However, when McFadden developed a logistic regression model for male pilot-error accidents and then adjusted variables

incorporated in the model, the accident rates for male and female pilots were not significantly different. It appeared that age, experience in terms of total flying hours, risk exposure defined as flying hours within the previous six months, and whether the pilot worked for a major or non-major airline, were the variables most closely related to significant differences in accident rates. McFadden (1996) suggested that the reason for female pilots appearing to have higher accident rates than males in the initial examination was that during the data collection period, women were only beginning to fly for major airlines. Previous studies (Baker, Lamb, Li, & Dodd, 1993; Golaszewski, 1983; Kay, Harris, Voros, Hillman, Hyland, & Deimler, 1993; McFadden, 1993) indicated that accident rates decreased as pilot age increased, as flying experience increased, and for pilots employed by major carriers versus non-major airlines. Given that more than 20 years have passed since the timeframe of McFadden's data collection, a follow-on study is necessary to examine possible gender-related differences now that there are more female pilots with higher experience levels who could be included in the sample.

Recent studies of gender differences in aviation have examined accidents in the general aviation (GA) arena. Baker, Lamb, Grabowski, Rebok, and Li (2001) presented findings that GA accidents involving male pilots were more likely due to inattention or flawed decision-making; those involving female pilots were more likely due to mishandling of the aircraft. Bazargan and Guzhva (2011) also examined possible relationships between the variables of gender (described as male or female), age, and experience level, and pilot error and fatal accidents within the GA community. Their findings indicated no difference in pilot-error accidents between male and female pilots, but that male pilots were more likely to have fatal accidents than female pilots. A general conclusion from the review of these studies, combined with the previously discussed examinations of differences in personality traits for males and females, would be that younger or less experienced pilots (male or female) tend to be involved in more incidents and accidents than those who have more experience. However, the reasons behind the incidents and accidents, and the consequences or outcomes, seem to follow different patterns for males and females. Males seemed to make mental mistakes (flawed decisions) that could prove fatal. Females seemed to make procedural or physical mistakes (handling errors). Given the technological advances in more modern aircraft and related equipment, the aircraft might be more forgiving of a handling error than a bad flying decision.

1.3. Gender and Communication

A common perception of the term gender essentially defines it as sex. One would categorize individuals as male or female. Reeder (1996) questioned this simplistic view of the construct of gender in her examination of how gender differences had been investigated and described in communication research. She described gender as a social construction in which individuals exhibit behaviors that fall somewhere on what Pearson and Cooks (1994) defined as a continuum of characteristics that are psychological, social, and interactive. Reeder (1996) discussed Bem's (1974) findings that gender behaviors could be classified as having more masculine characteristics, such as aggressiveness or confidence and leadership, or more feminine characteristics, such as affection or empathy and emotionality. These characteristics could be

exhibited by both men and women. As such they could be used to examine aspects of communication such as “problem solving, self-disclosure, communication competence, affective response, communication apprehension, and dominant and submissive nonverbal cues” (Reeder, 1996, p. 319). Haring (2013) discussed studies in which a group’s collective intelligence improved when the percentage of women in the group increased. Researchers involved in the studies suggested the feminine characteristic of ‘social sensitivity,’ how well an individual can interpret the emotions of others, might be one explanation for the improved performance of the group. The studies showed that groups including more women exhibited a more level distribution of communication among members, and that these groups had higher collective intelligence ratings than groups where communication was dominated by one member or a smaller proportion of the group.

In Cooks’ study (1994), the masculine style of communication was viewed as most appropriate in a work environment, while the feminine style would be more effective in interpersonal relationships. One of the resultant problems from this classification was that within many cultures, success in the work environment (using masculine communication) generally has greater value than success in personal relationships (using feminine communication). It would be critical to develop some sort of framework for aviation communication that not only addresses these differences, but draws from them to facilitate a more effective discourse. A host of impacting constructs, from crew resource management to flight deck – cabin interaction to aircrew – air traffic control, would have to be considered in the successful development of the framework. However, developing this framework should lead to improved communication which in turn could result in fewer pilot errors and fewer incidents/accidents.

Reeder (1996) recognized that gender differences did not exist in isolation, but were molded by surrounding social and cultural issues, including language, stereotypes, reality, and ideology. Gender differences in communication have also been identified through the perspective of communication barriers. In a 2007 dissertation, Schneider related findings from multiple studies regarding four predominant communication barriers: (1) males were more likely to interrupt conversations while women tended to take turns in communicating; (2) males were more individualistic in their communication behaviors while females were more collaborative; (3) females modeled language that is considered non-gendered more often than males; and (4) males’ communication indicated more linear thought patterns while females’ communication evidenced a web-like construction that allowed for more detailed narratives. Usheroff (2002) presented findings that males tended to focus on a process or method for achieving a specific goal, with limited to no expression of emotion, while females communicated on an emotional level, developing a more personal level of communication. Females valued relationship building and communicate through collaboration, while males did not need consensus for decision making. Usheroff (2002) also found that female communication included more details and description, which males could view as superfluous or too involved.

Reeder (1996) also examined the idea of difference. From the parsed word and its Latin roots, difference implies divergence of one individual or thing relative to someone

or something else. That someone or something else is most commonly the center of reference and in social research would be the dominant group. Reeder (1996) found that when researchers discussed gender-based differences, they described how women differed from men. The implication here was that male behaviors were considered the norm or expectation, and women's behaviors were studied for how they differed from that expectation.

2. DISCUSSION AND RECOMMENDATIONS

There have been a number of studies that examined differences in masculine versus feminine communication characteristics in general. Additional work has been done in the field of aviation, some with respect to differences between male pilots and female pilots and some with respect to the role communication deficiencies or breakdown played in aviation incidents or accidents. However, most researchers recognized the relative dearth of current studies of the effect of gender integration with respect to the collaboration necessary for effective use of increasingly more technologically advanced equipment.

NextGen technology is no longer somewhere on the horizon; it is being integrated now. The resultant increased need for effective and efficient communication makes investigating and understanding possible differences in communication styles of aviation professionals imperative so that training programs can be developed proactively to take advantage of collaborative differences and to mitigate potential hazards. This paper was an initial foray into compiling findings from the bodies of literature on gender communication, and gender differences in aviation communication and incidents/accidents, to develop a framework for examining more current practices in how possible gender differences in communication might be related to aircraft incidents or accidents. The purpose of such investigation would not be solely for identifying weaknesses in an industry affected by the broadness of modern socio-cultural norms, but to inform those who develop crew resource management training and curricula.

The first recommendation is that research, both qualitative and quantitative must be performed. Interviews with current aviation professionals would be useful tools for researchers to design survey instruments to identify communication styles and the linked personality characteristics. Additional observational research, perhaps using audio and video recordings of pre-flight, inflight, and post-flight interactions, as well as detailed analysis of historical data would provide a rich base for development of appropriate empirical studies in aviation communication. These empirical studies might be more difficult to conduct. Imposing hazardous scenarios on crews to 'see how they respond and communicate' would never pass muster in terms of research ethics. However, simulations of such activities could be used. The disadvantage of using simulations would be that participants would know they are not in imminent danger or a life-threatening situation, so their sense of urgency might be less real and their stress level might not be as heightened, leading to a less realistic outcome in communication. Even with this drawback, the research findings would still inform training and curricula development.

The second recommendation would be that both preparatory and ongoing aviation training programs use research-based content to design CRM course modules in which students assume opposite-gender roles in scripted incident/accident scenarios. The module would begin with an assessment of individual students' gender-communication traits. Personality and behavior assessments could be used, in tandem with instructor review. To facilitate effective instructor review and classification, instructional staff would need training and some sort of characteristic – evidence checklist for use during activities and/or discussions in previous modules. The module would then include research and instruction in collaborative communication, with specific emphasis on communication in aviation. Training videos showing examples and non-examples of effective communication would greatly enhance this instructional piece. After the content development, students would be assigned roles for the scripted incident/accident scenario. Some students would have roles within the script while others would be assigned as peer reviewers. Developing multiple scenario scripts would allow for all students to participate in a scenario and as a peer reviewer. Using such an activity would allow student pilots and student air traffic controllers to develop a better understanding of how important communication and collaboration are to the mitigation of catastrophe. The peer-reviewer piece would enhance the activity's effectiveness because students would have further opportunity to develop their communication skills.

As the number of female pilots increases over time, it is imperative that training programs from privately-owned flight schools to major university programs include modules on understanding communication from an inclusive perspective. Improving training should enhance the safety of everyone involved in the aviation environment.

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