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## FLIGHT INSTRUCTORS AND PILOT EXAMINERS PERCEPTIONS OF OLDER AND YOUNGER PILOT COMPETENCY AND SAFETY CONCERNS

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A national online survey was developed to examine differences in competency issues between younger and older pilot groups as perceived by flight instructors and pilot examiners. With their expertise in pilot competencies and a broad age-range of clientele, flight instructors and pilot examiners were considered a rich source of untapped data. Results indicated that respondents were more likely to identify *decision-making* and *problem solving* as a concern for younger pilots. *Error recognition* and *procedural knowledge* were more likely to be highlighted as concerns for older pilots. In addition, *physical ability to fly the aircraft* during training and currency review was three times more likely to be selected as a concern for older pilots. Patterns in perceived competency differences between age groups can inform targeted flight safety strategies.

This study examined how flight instructors' and pilot examiners' perceptions of competency and safety issues differed for younger (<25 years) and older (>59 years) general aviation pilots. Literature pertaining to general effects of age on cognition would specify cognitive slowing, disinhibition, and reduced working memory capacity (Bolstad & Hess, 2000), and provides insight into what factors might be associated with older pilot competency concerns. In general, poorer performance by older pilots is reported for tasks such as recall of air traffic control information (Morrow et al., 1992; 1994) and missed critical cockpit and nearby traffic events (Coffey, Brown & Herdman, 2007). Taylor, Kennedy, Noda and Yesavage (2007) conducted a three-year longitudinal simulator study of general aviation pilots and found that older pilots performed significantly lower at baseline and during the study period for following air-traffic controller commands, traffic avoidance, cockpit instrument scanning, and an approach and landing task. Kennedy, Taylor, Reade and Yesavage (2010) studied older and younger novice and expert pilot groups and found that older pilots had a greater likelihood of making unsafe landing decisions (due to weather); performed less well on flight control tasks than their younger cohorts; and, expertise did not reduce the effect of age, except in the case of banking performance in a holding pattern. Morrow et al. (1994) observed benefits of expertise for older pilots when reading back visually presented material, but no significant benefit was afforded by expertise for auditory material.

Federal Aviation Administration commissioned studies examining pilot age and accident rates were summarized by Broach (2004) and in cases where pilots over the age of 60 were included in the analysis there were increases in pilot accident rates associated with older age. Converging evidence is reported by Li, Baker, Qiang, Crabowski and McCarthy (2005) who found significant increased relative risk of aviation crashes for older, male, inexperienced pilots. Eyraud and Borowsky (1985) studied naval pilots and found that older pilots tended to display more procedural type errors than younger pilots: this pattern was considered a factor of over-confidence rather than cognitive aging effects (in this study older pilots were less than 60 years of age). In a study that included some pilots over the age of 60, Rebok, Qiang, Baker and Li (2005) found no discriminating pattern of crash-related errors between older and younger air taxi pilots.

The search for accident error pattern differences between younger and older pilot groups has not yielded consistent results to date. Taking a different approach, we looked for patterns of competency and safety concerns for older and younger pilot groups as perceived by flight instructors and pilot examiners. Flight instructors, in particular, might have the opportunity to develop a long-term professional relationship with their clientele and might fly with the same pilot over a number of years. This longitudinal perspective, along with the subject matter expertise gained from promoting and evaluating the competency of pilots of various ages, was considered a potentially rich source of data which might inform the issue of age-based patterns of pilot error.

## Method

A national online survey of flight instructors and pilot examiners was launched in February 2011. The following results are based on 20 days of online data collection. The survey was disseminated to flight instructors and pilot examiners in the general aviation domain.

### Participants

Survey dissemination methods targeted flight instructors and pilot examiners working in Canada. After disqualified responses were removed from the dataset, 61 complete responses were obtained. A *Human Resource Study of Commercial Pilots in Canada* (Air Transport Association of Canada, 2001) reported that there were approximately 500 general aviation flight instructors in Canada. This provided us with a conservative response rate of 12.2%. The median respondent was male (87%), between the age of 25 and 39 years (36.4%) and reported a mix of younger and older general aviation and commercial clientele (50%). Almost half the respondents had worked as a flight instructor or pilot examiner for ten years or more.

### Procedure

Flight instructors and pilot examiners working in the general aviation domain were targeted using a national email campaign. The survey used a well-known internet-based platform and was accessible only via a hypertext link in the recruitment email. The survey recruitment email was successfully delivered to approximately 120 addresses (those not returned as undeliverable). To maximize recruitment of eligible respondents, the recruitment email encouraged qualified respondents to forward the survey invitation email to their flight instructor and pilot examiner colleagues.

### Survey

The online survey consisted of 11 (for flight instructors) or 16 (for pilot examiners) questions. The questions and the response options were designed in collaboration with subject matter experts comprised of pilot examiners and flight instructors with more than 80 years flying experience and 10,000 hours of instruction time combined. Respondents were asked to reflect upon key times during flight training when they most seriously weighed the safety and competency concerns of their clients and to consider what concerns were frequently associated with younger and older pilot groups. Respondents were asked to select as many of the suggested areas of safety and competency, which they associated most with younger and then with older client groups, as they deemed appropriate. Pilot examiners were asked four additional questions which pertained to reasons why clients might fail a portion of their flight test, or reasons why clients might not be recommended for licensing after a flight test. Response options pertained to procedural and general aviation knowledge, physical ability to operate an aircraft, cognitive factors such as situation awareness, problem-solving, error recognition and decision-making, as well as confidence, our psychosocial factor. Two questions pertaining to currency review also included the response options of total flight and recent flight hours. Respondents were also asked if they agreed with the statement that they rarely or never saw competency differences between younger and older pilots: either generally (flight instructors and pilot examiners) or when completing a flight test (pilot examiners only).

## Results

### Flight Instructors and Pilot Examiners Perceptions of Age Group Differences in Flight Training or Flight Currency Review Responses

Sixty-nine percent of respondents indicated that they observed differences between younger and older pilot groups when considering competency and safety issues related to the training or currency aspects of flight instruction. Sixty percent of respondents indicated that they observed differences between younger and older pilot groups when considering competency and safety issues related to the pilot examination aspects of flight instruction.

### Competency and Safety Concerns during Flight Training and Currency Review

As shown in Figure 1, there was a clear difference in how frequently respondents chose decision-making and judgement as a concern for each pilot group: with 63.5% of respondents selecting this response for younger pilots and only 27.7% of respondents selecting this option for older pilots. As will be shown, this pattern was consistent throughout the survey. Problem solving was also perceived as a greater issue for younger pilots (34.6%) than older pilots (14.9%). Many more respondents selected physical ability to operate the aircraft as a concern for older pilots (51.1%) than for younger pilots (9.6%). Error recognition was also cited more often for older pilots (38.3%) than younger (26.9%). During the flight training phase, procedural knowledge concerns (but

not crystallized intelligence such as knowledge of the aircraft parameters or general aviation domain specific facts) was cited more often for older (46.8%) than younger pilots (28.8%).

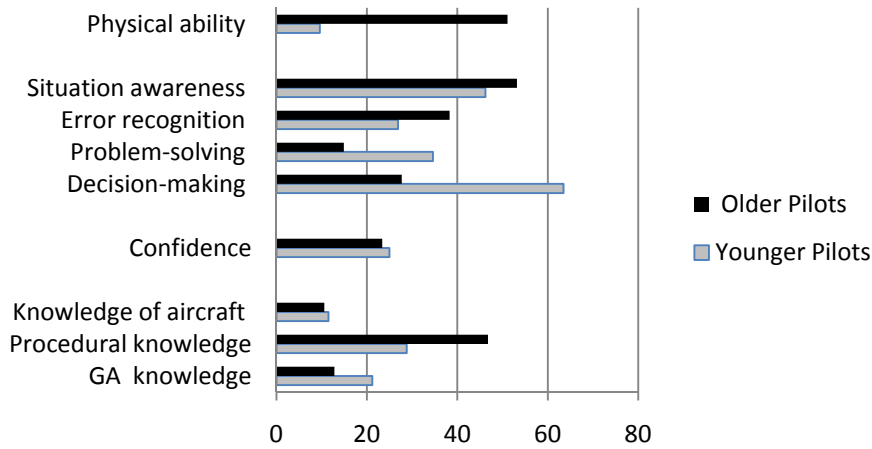


Figure 1. Competency and safety concerns during flight training for younger and older pilot groups.

### Competency and Safety Concerns for Younger and Older Pilot Groups during Currency Reviews

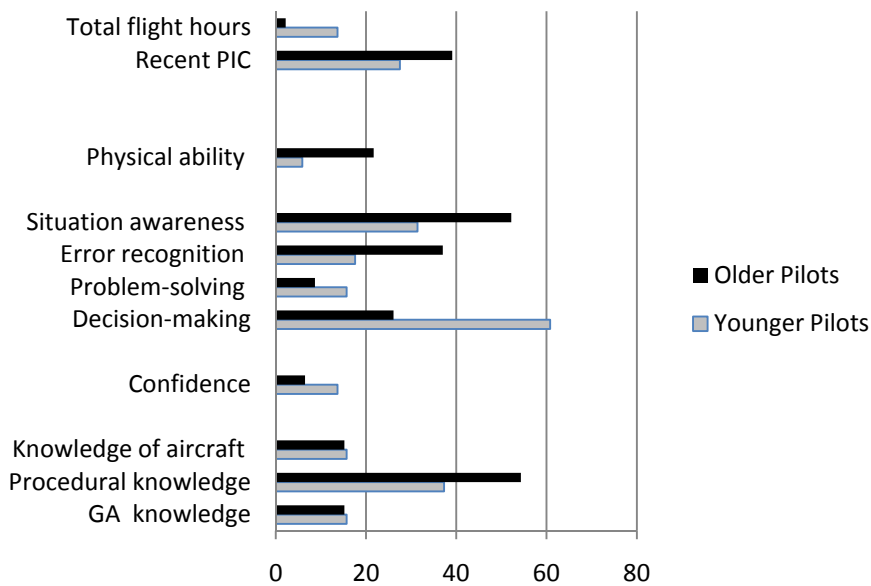


Figure 2. Competency and safety concerns for younger and older pilot groups during currency reviews

As shown in Figure 2, when considering currency reviews a similar pattern of flight training competency issues was found. Situation awareness and error recognition were greater concerns for older versus younger pilots: 52.2% and 31.4%, respectively for situation awareness; and 37.0% and 17.6% respectively for error recognition. As was also seen in Figure 1, respondents tended to identify problem solving and decision-making more often for the younger pilots than the older pilots. Decision-making and judgment was more than twice as likely to be a concern for younger (60.8%) than for older pilots (26.1%). As expected, total flight hours was not a concern for older pilots, however, recent flight time was more of a concern for older (39.1%) than younger (27.5%) pilots. As was found for flight training concerns, procedural knowledge was more often perceived as a concern for older (53.4%) rather than younger pilots (37.3%).

### Reasons for Failing Part of or All of a Flight Test: Comparisons of Younger and Older Pilot Groups.

As shown in Figure 3, the age group differences for reasons a pilot must repeat a segment of the flight test, or reasons for not recommending licensing after the final flight test are more subtle than differences found during the previously described training or currency reviews (Figures 1 and 2).

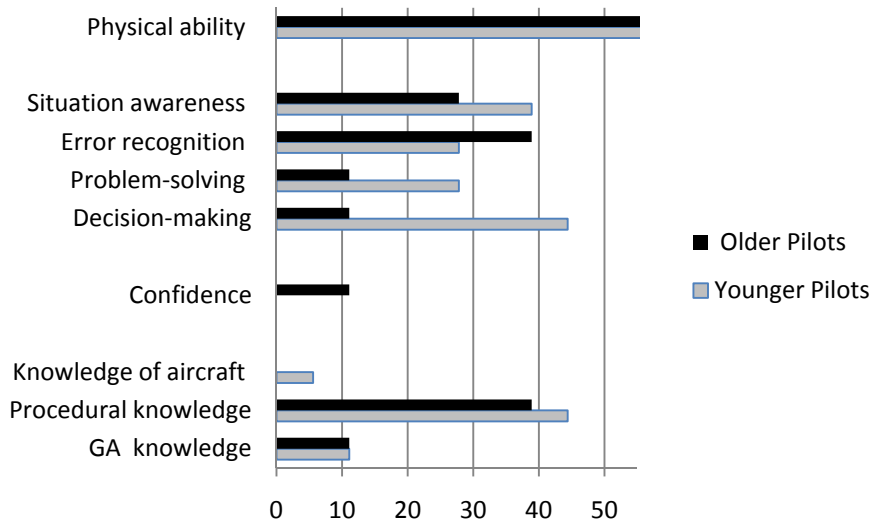


Figure 3. Reasons for failing part of a flight test: comparisons of younger and older pilot groups.

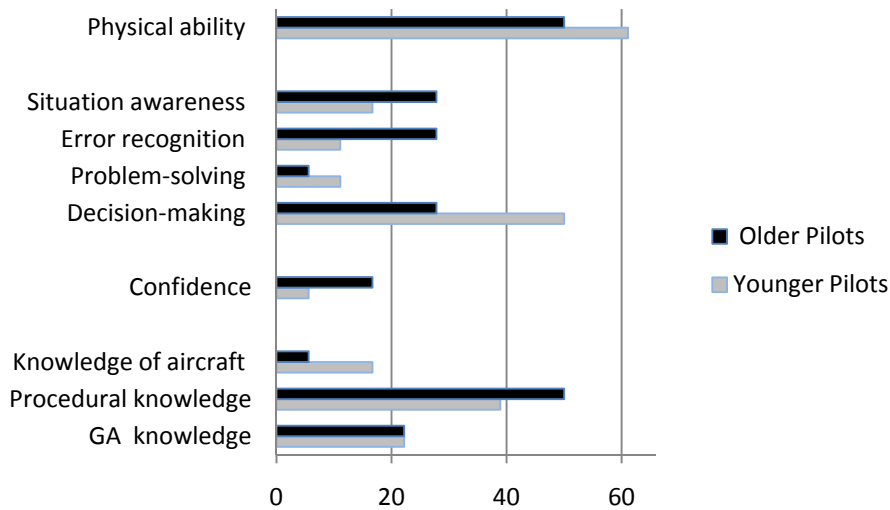


Figure 4. Reasons for failing a flight test entirely: comparisons of younger and older pilot groups.

Pilot examiners clearly highlighted decision-making and judgment as a reason for partial (44%) or full failure (50%) of a flight test for younger pilots. Situation awareness, error recognition confidence and procedural knowledge tended to be cited as reasons for failing a flight test moderately more frequently for older pilots.

### Age Group Patterns: Significant Differences between Older and Younger Pilot Group Competency Concerns

Applying single factor analysis of variance we analyzed all response options across each competency question to determine if any of the response patterns showed statistically significant differences between the younger and older pilot groups. As shown in Figure 4, we found that error recognition ( $M=35.5\%$  older,  $M=20.9\%$  younger) and procedural knowledge ( $M=47.5\%$  older,  $M=37.4\%$  younger) were significantly more likely to be

perceived as a concern for older pilots:  $F(1,6)=9.49, p<.05$  for error recognition, and  $F(1,6)=4.90, p=.068$  for procedural knowledge.

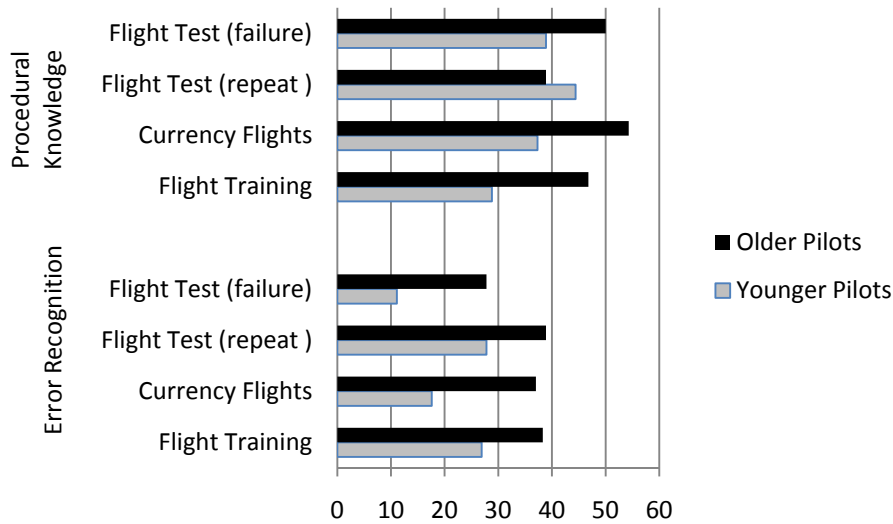


Figure 5. Procedural knowledge and error recognition selection patterns.

As shown in Figure 5, we found that respondents were very clear in their pattern of responses regarding decision-making and judgment: younger pilots were selected 54.7% of the time and older pilots 23.1%,  $F(1,6)=27.11, p<.01$ .

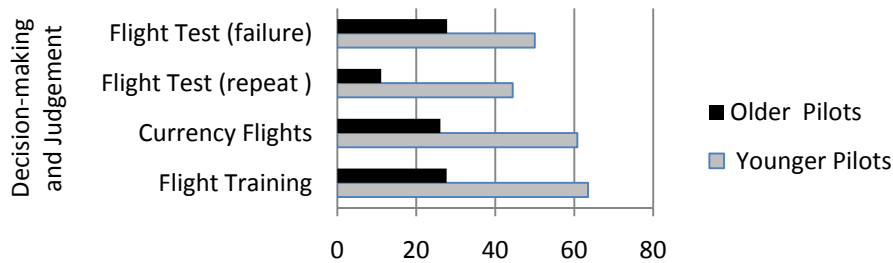


Figure 6. Pattern of decision-making and judgment selections for younger and older pilots.

### Discussion

This study examined patterns in flight instructors' and pilot examiners' perceptions of competency and safety issues for younger and older general aviation pilots. Stakeholders developing strategies to improve safety for pilots across the adult life span can utilize these findings and target pilot groups with content tailored to their particular needs. The majority of flight instructors and pilot examiners indicated that they observed differences in competency and safety concerns for younger and older pilot groups. More specifically, the following patterns arose from the survey responses: for flight training, flight currency and pilot examination situations decision-making and judgement skills were significantly more likely to be identified as a concern for younger pilots; in contrast, respondents were more likely to identify procedural knowledge and error recognition as key concerns for older pilots. This differs from the results of Kennedy et al. (2010) who found more decision-making and judgement errors for older rather than younger pilots (this difference may arise from our very distinct pilot age groups: pilots under age 25 and pilots over age 60). Other dominant patterns identify physical ability to operate the aircraft and situation awareness skills as more of a concern for older pilot group during training and currency flights. These results are supported by Morrow et al. (1992; 1994), Coffey et al. (2007) and Taylor et al. (2007) who report age effects for errors in the procedural and situation awareness domains.

During pilot examination the majority of pilot examiners selected physical ability to operate the aircraft as a reason why a pilot might fail a portion of the flight examination for both younger and older pilots.

Confidence appeared as a concern more often for older pilots in pilot examination situations but not during training or currency review flights. We suggest that a strategic approach, incorporating age-related patterns of concern, to flight training and aviation skill maintenance will not only address safety from a pragmatic and efficient stance, but might also serve to reduce the anxiety and stress that can accompany flight currency and pilot examination processes, in particularly for older pilots.

### **Acknowledgements**

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