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Aerospace Medical Association

Position Paper

The Age 60 Rule

INTRODUCTION

The Standard established by the International Civil Aviation Organization (ICAO) limits the age of a pilot-in-command to 60 years (Annex 1 to The Convention on International Civil Aviation, paragraph 2.1.10.1), and a co-pilot to 60 years (Annex 1, paragraph 2.1.10.2). As of 1998, twenty-four Contracting States have notified ICAO of differences with the Standard; some have raised the age limit, others have lowered it, and some have done away with it altogether [80].

The Requirements of the Joint Aviation Authorities (JAA) also prohibit a pilot who has attained the age of 60 from engaging in commercial air transport operations, with the exception of multi-pilot crew operations where the pilot is the only one who has attained 60 years of age, but has not yet reached the age of 65. (JAR-FCL 3 Subpart A, JAR-FCL 3.060 paragraphs a(1), a(2), b).

The Age 60 Rule, implemented by the Federal Aviation Administration (FAA) in 1959, does not allow persons engaged in operations conducted under Part 121 of the Federal Aviation Regulations (FAR) to serve as a pilot or co-pilot upon reaching their 60th birthday (Title 14 CFR Chapter I Part 121.383(c)). Considerable controversy has surrounded the Age 60 Rule since its inception. During the last two decades, various studies have been carried out to assess the relationship between age, experience, and pilot performance. Results have differed significantly from study to study, making a clear understanding of the relationship between age, pilot performance, and safety difficult.

OBJECTIVE

The objective of this paper is to review and interpret the recent scientific literature dealing with pilot age and performance for consideration by the Council of the Aerospace Medical Association.

AGING

Age-related changes in memory, attention, and cognitive skills can affect the in-flight performance of a pilot. Age-related physiological and psychological changes are normally progressive and continuous [1], and theories on aging have suggested a general decline in central processing speed and a reduction in working memory capacity [2, 3]. Physiological studies consistently show age-related declines in hearing, vision, and perceptual motor skills, etc. [4-11]; however, results in other areas are not as clear.

Pilot cognitive performance has been shown to generally decline with age [12-16] with the possible exception of time-sharing tasks [17-21]. While pilot performance on most memory tasks has shown age-related declines [22, 23], aviation expertise has been shown to reduce age differences on more aviation-related memory tasks [24, 25]. Some studies document age-related declines in attention [17-19, 26], while others show that the performance of older subjects equals that of younger subjects [21, 27]. Simulator studies [28-33] and studies of actual flight performance [34-39] have yielded equally mixed results. One review [4] concluded that there was only weak evidence that age-related differences in cognition influence pilot performance. However, a more recent simulator study of age and pilot performance found that increased age was significantly associated with decreased aviator performance [29].

Overall, the scientific record has not resulted in a clear specification of the relationship between age, cognitive function, and pilot performance. Nor have any theoretical models linking age, cognitive abilities, and specific aspects of pilot performance emerged from the research as the basis for understanding the relationships or making predictions about the effects of age.

PILOT INCAPACITATION

Airline pilot in-flight medical incapacitation was a primary concern at the time the Age 60 Rule was adopted [40], and continues to be an important topic [41-47]. A recent FAA study of U.S. airline pilots [48] found that in-flight incapacitations increased significantly with age. While sudden incapacitation is often cited as a major concern in efforts to amend the Age 60 Rule, its frequency and impact on flight safety suggests that, in contrast to many human factors causes of airline accidents (i.e. judgment, decision making, and communication), pilot incapacitation does not pose a significant risk [41, 42, 44, 47-50]. In part, this is due to the fact that flight safety, in the event of pilot incapacitation, is typically assured by the presence of two qualified pilots – captain and first officer – either of whom can take over operation of the aircraft should the other become incapacitated.

PHYSIOLOGY AND PERCEPTUAL MOTOR SKILLS

Many physiological changes that accompany aging may influence performance, including changes in perceptual motor skills, vision, hearing, and sleep patterns. A recent overview of the perceptual-motor skills literature reported that age-related changes in perceptual-motor skills were evident in the pilots tested [4].

With age, ocular muscles and lens elasticity may be affected, resulting in visual decline [5]. A recent FAA report noted that the percentage of civil airmen older than 40 years of age increased from 36% of aviators in 1971 to more than 48% in 1991. This may explain, in part, a 12% increase in presbyopic aviators requiring near vision restrictions from 1981 to 1991 [6]. Near vision can be a problem for the aging pilot in the cockpit because of the complexity and uniqueness of visual tasks [7]. Some studies have found that during ideal conditions, older subjects can accommodate nearly as quickly as younger subjects; however, during degraded visual conditions, the accommodation time for older subjects can increase by as much as ten-fold [8]. Senior pilots are often reluctant to admit defective visual acuity; in one study, 90% of pilots tested demonstrated less than 20/20 visual acuity, although 46% stated that the instrument panel could be seen clearly without accommodative lenses [9].

Pilot hearing, compromised by exposure to the noisy aviation environment, can result in age-related changes in the ability to hear high frequency sounds (presbycusis) [51]. Although, above age 60 there were no significant differences between pilots and non-pilots in hearing loss in a general aviation simulator study [10]. This study showed that some older pilots did not hear an autopilot/autotrim alarm; however there are no recent data to determine the extent to which similar changes occur in commercial pilots [10].

An interaction between age and sleep loss for pilots involved in long-haul operations showed that the amount of sleep loss generally increased with age [11]. These findings have important implications for the establishment of duty schedules and the development of fatigue countermeasures in aviation.

PILOT PERFORMANCE AND COGNITIVE SKILLS

There have been many recent studies of aging and pilot performance that show a general decline with increased age [12-16], but few involve commercial pilots. Although the exception of performance decline in the case of time-sharing tasks has been disputed by some researchers [16], it has been confirmed by others [18-21].
Hardy and Parasuraman conducted the most extensive review concluding that, with the possible exception of time-sharing, increased pilot experience does not appear to alter the typical age-related decline found in many cognitive skills [4,].

MEMORY

The effect of pilot performance on memory tasks has shown age-related changes for most tasks. While pilots and non-pilots have exhibited similar age-related declines in the recall of less domain relevant tasks [22, 23], aviation expertise has been shown to reduce age differences for tasks that are more aviation-related [24, 25].

ATTENTION

Results of age-related studies on attention are mixed. While some studies document age-related declines in performance related to attention [17-19, 26], especially when task demands are high [52], other studies show that the performance of older subjects equals that of younger subjects [21, 27].

SIMULATOR PERFORMANCE

Simulator research on age-related flight performance has produced mixed results. The primary concern is that a simulation cannot produce sufficient workload to test whether an impaired pilot could manage the necessary time-sharing tasks with adequate speed in an actual in-flight emergency. While some data show age-related declines in performance [28, 29], other data do not support age-related differences [4, 30-33] and some show ambivalent results [53].

FLIGHT PERFORMANCE

The number of accidents involved in air carrier operations is small, and does not permit effective comparisons across age. Consequently, studies of actual flight data provide conflicting evidence on the effects of age upon performance.

In a study of general aviation crashes, Baker and colleagues [82] found that the percent of crashes involving poor decisions or pilot error declined with age. A 1991 study of general aviation pilots determined that older pilots were at less risk than younger pilots for both accidents and violations [34]. Likewise, McFadden [35] found that accident rates of U.S. airline pilots declined as pilot experience (total flight hours and recent flight time) and age increased. Furthermore, Kay et al [36] found that the accident rates of older pilots with a Class II or III medical certificate evidenced a gradual decline from age 40 through the early 60s, but showed a slight increase from age 65-69. In a longitudinal study of pilots 45 and older, Li et al. [85] found that neither crash circumstances, nor the prevalence and patterns of pilot errors, changed significantly with age.

Most recently, Li and colleagues [84] followed a cohort of 3,306 commuter and air taxi pilots for 11 years, who were 45 to 54 years of age in 1987. They did not find a significant age-associated increase in crash risk, but the risk of a crash *decreased* by about half among pilots with a total flight time of more than 5,000 hours at baseline.

Conversely, information regarding age and training success of pilots transitioning to the Airbus A320 revealed a failure rate of 2 to 5% in 29-44 year old pilots, approximately 8% for 45-48 year old pilots and around 16% for those 49 and older [38]. However, the results may have been confounded by a cohort effect because different age groups could have been exposed to dissimilar life experiences. For example, younger pilots could have had a greater exposure to computers and computer games that might have given them an advantage in transitioning to the Airbus.

Li and Baker [37] found that the risk of an accident increased with age in commuter and air taxi accidents when flight time was controlled; however, univariate analyses showed a decrease with age, suggesting that their greater experience keeps older pilots from being at excess risk. Rebok et al [39] concluded that there “appear to be no significant age differences in the pilot performance factors contributing to aviation crashes.”

Recently, Broach, Joseph, and Schroeder investigated the relationship between age and accident rates [54]. They found a “U” shaped relationship between the age and accident rates of professional pilots holding Class I medical certificates and ATP certificates operating under 14 CFR § 121 and § 135. However, the range of mean differences across age groups was very small and not statistically significant when comparing adjacent age groups on either side of the current rule. In a subsequent study, Broach et al [73] again found an overall “U” shaped relationship between age and accident rates for professional pilots holding Class I or II medical and ATP or Commercial certificates, for accidents occurring under 14 CFR § 121 and § 135. Moreover, they reported that the accident rate for pilots age 60-63 was statistically greater than the rate for pilots age 55-59. That finding has been criticized as an artifact of the design [72] and may have reflected the historically higher risks associated with operations under Part 135 rather than the risk associated with pilot age *per se*.

Japan, in a study of its over-60 pilots, found that none had been involved in an accident during the three-year study period [83] and subsequently raised its age limit from 63 to 65. Standards in 45 countries have been amended to include exceptions that indicate specific circumstances under which pilots over the age of 60 may continue to fly commercial air transport aircraft [78]. While many countries have adopted regulations that require additional operational restrictions, proficiency checks and medical surveillance of older pilots, the regulations are not uniform from country to country. [81]. Regulations of the Joint Aviation Authorities, applicable to 37 member countries, allow a pilot age 60-64 to operate a multi-crew aircraft provided that no other pilot is 60 years or older [86, 88]. Australia, Canada, and New Zealand, have no maximum age restrictions for pilots, and many other countries have raised their age limits [81, 87]. Multi-national research evaluating the experience of pilots over age 60 would be valuable.

EXPERTISE

The benefits of pilot expertise on age-related pilot performance are often debated. The common belief is that experience will reduce the effects of age-related performance deficits; however, the results of recent scientific studies are mixed. After reviewing a number of studies, Salthouse concluded that age-related declines in performance were evident in measures of occupationally relevant activities [3]. After additional review, however, Salthouse concluded that the accumulation of occupation-specific knowledge might explain how older employees maintain job performance [55]. Hardy and Parasuraman suggest that “crystallized intelligence,” the store of information or knowledge an individual builds up through experience, may be less susceptible to aging than is “fluid intelligence” [4]. Other researchers have found similar evidence suggesting that the experience gained by pilots reduces, but does not eliminate, the expected age-related decline in performance [19, 20, 24, 56, 57, 84].

ALTERNATIVES TO CHRONOLOGICAL AGE

Many researchers believe that criteria other than chronological age should be used to assess a pilot’s ability to continue to fly [58-65]. For example, *functional* age has been suggested as an alternative to chronological age to determine a pilot's ability to remain in flight status without a mandatory retirement age [58-65]. Others believe that cognitive performance [4] or the risk of sudden medical incapacitation [66] cannot be adequately predicted by traditional testing methods; therefore, the use of functional age would be impractical. However, computerized neuropsychological test batteries have been developed that have been shown to accurately evaluate age-related changes in performance that could make functional age a workable concept in evaluating a pilot's ability to perform flight duties safely [67-69].

Kay [70] recently used CogScreen-AE to demonstrate that the magnitude of age effects on aviation-related cognitive performance negatively impacted aviation performance; however, Kay emphasized that these were group data, and that conclusions based on the aggregate do not necessarily apply to individual pilots. Some older pilots performed better than some younger pilots, and it appeared that some airline pilots who continued to fly past age 60 did not show the predicted level of cognitive deterioration. Considerable investment would be required to implement the non-age-based criteria [71] and additional associated medical screening would be required [50]. In addition, reliability and validity would have to be rigorously established in order to withstand the legal challenges that inevitably would be raised over their use, since the tests could potentially involve retirement decisions.

DISCUSSION

Changes in pilot performance with age are not completely understood and therefore cannot be easily explained. The changes discussed in this paper are summarized in Table I. The numbers in the table refer to studies in the reference list.

		Effect of Age on Pilot Performance				
		Worse with Age	No Change with Age	Less Than Expected Change with Age	Improvement with Age	Other
Pilot Performance	Medical Incapacitation	[40-48]				
	General Physiological & Perceptual Motor	[1, 4]				
	Vision	[5-9]	[8][1]			
	Hearing	[10, 51]				
	Cognitive Skills	[2, 3] [12-17]	[17][2]			
	Memory	[2, 3] [22, 23]		[24, 25][3]		
	Attention	[17-19] [26, 52]	[21] [27]			
	Simulator Performance	[28, 29]	[4] [30-33]			[53][4]
	Flight Performance	[37, 38, 42, 48]	[39] [83,84,85]		[34-36], [82]	[54,73][5]
	Effects of Expertise	[2] [16, 17]		[4], [17-21][2], [24, 25][3], [55-57]		

[1] Ideal visual conditions only.

[2] Time-sharing tasks only.

[3] Aviation relevant tasks only.

[4] Ambivalent results.

[5] “U-shaped” relationship between age and accident rate.

Table I: The Effect of Age on Pilot Performance.

Table 1 provides an easily referenced summary of the studies that were reviewed for this paper, from which some general conclusions can be drawn. However, it must be emphasized that the number of papers reporting age-related changes in performance in each cell does not necessarily directly indicate the strength of scientific evidence supporting such changes, given that the papers are not all of equal quality. Some of the papers were based on better studies, were better reviewed, and published in peer-reviewed journals, while others were not. Therefore, if a number of studies were to report that performance was worse with age, and an equal number report that performance improved, as was the case with Flight Performance Studies, this may not indicate that the weight of scientific evidence is equally divided. It would depend on the quality of the individual studies in each cell.

Table I does imply that, while the scientific literature does not unanimously support age-related declines in all aspects of pilot performance, the majority of studies reveal that performance in all areas show declines with age. In fact, all studies in the areas of in-flight medical incapacitation, and general physiological and perceptual motor (vision and hearing), have shown age-related declines in performance. Cognitive skills show age-related declines with the possible exception of time-sharing tasks, and memory skills show declines with age with the possible exception of aviation relevant tasks.

Age-related performance declines in other areas of pilot performance are less clear. The effects of expertise, while associated with fewer performance declines than expected with age in many studies, showed clear declines in several other studies. Flight simulator studies and studies of the relationship of flight experience on pilot performance, have led to somewhat conflicting results. Flight simulator studies have yielded results including declining performance no changes in performance, and ambiguous results with age. Similarly, flight performance studies have yielded mixed results that included declining performance, no performance changes, and improved performance with age.

RECENT CHALLENGES TO THE AGE 60 RULE

In December 1995, the FAA acted upon issues raised concerning the Age 60 Rule, responding to requested public comments to a 1993 comprehensive review of the Rule; The Age 60 Project, Consolidated Database Experiments, Final Report, 1993 (the Hilton Study) [36]. The FAA also responded to issues raised by pilots seeking exemptions from the Age 60 Rule and a petition by the Professional Pilots Federation (PPF) to remove the Rule. The FAA cited that there were insufficient facts and analyses to support that raising the age 60 limit would assure that the current level of safety would be maintained or improved, and acknowledged that the medical and scientific literature indicates the lack of a single "obviously right answer." On that basis, the FAA determined not to initiate rulemaking to change the Age 60 Rule at that time and decided not to grant any of the pending petitions for exemption or rulemaking [74].

On February 15, 2001, *S. 361, A Bill to Establish Age Limitations for Airmen* was introduced by Senator Frank Murkowski, [AK]. Citing a critical shortage of airline pilots, the purpose of the Bill was to change the mandatory retirement age of airline pilots from 60 years of age to 65 years. The Bill was read and referred to the Senate Committee on Commerce, Science, and Transportation, which held hearings on March 13, 2001. Proponents of the change also cite economic and safety issues, advances in life expectancy, and advances in medicine that support raising the age limit. Additional views submitted by Committee members support the authority of the FAA to maintain safety standards, and support the Administration's decision-making based upon previous exhaustive examination of the Age 60 Rule. Issues for consideration prior to further action on the Bill were noted: 1) whether the new legislation would make age 63 a mandatory retirement age, and 2) whether there is an effective means to appraise pilots to identify individuals who would pose a hazard. On May 22, 2002, the Bill was amended, setting the air carrier pilot age limit to 63, providing that the FAA retains its authority to take measures to uphold air transport safety. The bill is still in Committee [75].

In June 2002, another Petition for Exemption was filed with the FAA, this time requesting exemptions for 10 members of the Professional Pilots Federation. As of April 2003, the FAA has not responded [76].

On March 4, 2003, *H.R. 1063* was introduced to the House of Representatives by James A. Gibbons, (R-NV), under the title: *To limit the age restrictions imposed by the Administrator of the Federal Aviation Administration for issuance or renewal of certain airman certificates, and for other purposes.* The purpose of the Bill is to amend Section 44703 of title 49 United States Code to limit age restrictions on part 121 pilots who are age 65 or younger, and is to apply only to those persons who have not reached the age of 60 as of the date of enactment of the subsection. The bill was referred to the House Subcommittee on Transportation and Infrastructure, and then referred to the Subcommittee on Aviation [77].

On March 12, 2003, Paul Emens, Vice Chairman of Air Line Pilots Against Age Discrimination (ALPAAD), testified before the House Aviation Subcommittee of the Committee on Transportation & Infrastructure. His support of *H.R. 1063* to amend the Age 60 Rule to "at least the age of 65" was based on the belief that the Rule is age discrimination, and has an unfair economic effect upon airline pilots. Arguing that the Rule is not a safety issue, he cited a number of agency and expert opinions, the FAA's practice of granting exemptions to pilots with various medical problems after passing cognitive tests, and that airline pilots in 45 other nations continue to fly past age 60 [78].

At the time of this writing, *S. 959* presents the most recent challenge to the Age 60 Rule*; A bill to limit the age restrictions imposed by the Administrator of the Federal Aviation Administration for the issuance or renewal of certain airman certificates, and for other purposes*. The Bill was introduced on April 30, 2003 as a measure to end age discrimination among airline pilots by Senator Jim Inhofe (OK), who declared that he is the Senate's only commercially licensed pilot. The Bill proposes to raise of the "retirement age to 63 immediately, and then incrementally increases the age limit to 65," and would apply to those who did not yet reach the age of 64 as of the date of its enactment. Supporting arguments included the lack of medical and scientific evidence to support a specific age limit [79].

SUMMARY

A transition to a criterion-based process for determining a pilot's fitness to fly beyond age 60 would require extensive additional research. The economic burden on the FAA and corporations to develop a non-age safety basis for denying pilots continued employment could be significant.

It would require the identification and validation of medical and neuropsychological tests that predict which medical or psychological conditions pose a significant risk for continued flying. Considerable resources would be required to develop and validate these procedures and to administer them periodically to all pilots. This could mean that some pilots under the age of 60 would be removed from their positions if they did not perform at an acceptable level.

There are flight performance criteria currently in existence. Most major airlines, on an annual basis, have their pilots undergo rigorous flight performance (proficiency) checks, two of which are conducted in a digital simulator. Aircrew must meet the minimum standards described in a long list of objective performance criteria before being operationally certified. Some of these check–rides can last for several hours.

There are three conclusions that can be reached based on the available published data. First, performance on measures of most, (not all) cognitive functions decline with advancing age. Second, the group of average effects may not predict the performance of any specific individual. Third, there are limited data demonstrating that the observed "declines" in test performance are predictive of any changes in performance in the cockpit [68].

It is important to remember that the decision to use 60 years of age as an upper limit for commercial air transport operations was arbitrary. Currently, there is equal lack of justification for setting the age limit at 55 years or at 65 years.

Finally, the current medical certification process implicitly, but not explicitly, assumes that meeting current medical standards places the aviator at an acceptably low level of risk for developing a medical incapacitation during the time prior to the next medical exam. The current discussion around the cognitive/performance aspects of the Age 60 Rule seem to require that any change in the rule, and any change in the certification process, would explicitly predict that the airman's performance would not deteriorate below an acceptable level prior to the next medical exam.

OPTIONS

It is the recommendation of the Civil Aviation Safety Subcommittee that if the Association wishes to take a position on the Age 60 Rule, it should consider recommending one of the following options:

1. *Abandon the Age 60 Rule.* Based upon the small number of accidents involving pilot incapacitation, current medical and performance testing of pilots at 6-month intervals appears to be successful in weeding out high-risk pilots.
2. *Change the Age 60 Rule.* Increase the age limit to age 65, applicable to all pilots who have not reached the age of 60 at the time of the change. This recommendation is comparable to one made by a major FAA-sponsored study (the Hilton Study) that proposed raising the limit to age 63 while studying the results of the change [36].
3. *Consider replacing the age cutoff in the future with other tests that would screen out pilots likely to have a crash without unfairly affecting other pilots.* This paper does not demonstrate the feasibility of developing such tests. During the years that will be required for development and testing of a predictive decision rule with high sensitivity and specificity, consideration should be given to Number 2 above.
4. *State that there are no obvious medical or safety issues.*

CONCLUSION

Age discrimination and a shortage of air transport pilots are but two arguments that have been presented in support of raising the air transport pilot age limit to age 65. Given the current global economic climate, and its effect upon the aviation industry, the impetus for amending the Age 60 Rule may be slowed for now. The aviation medicine community is in a position to continue research and discussion that may provide additional evidence for policy-makers in the administrative and legislative arenas when the next challenge presents. Those addressing the future of the Age 60 Rule may benefit from understanding the nature and limitations of these studies, whether their outcomes are conclusive or not. Hopefully, some measure of guidance may be achieved as they address pilot age limits and related safety, economic and operational issues of the aviation industry.

Upon review of the existing evidence, the Aerospace Medical Association concludes there is insufficient medical evidence to support restriction of pilot certification based upon age alone.

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