

STUDY OF PHYSIOLOGICAL
AND
PSYCHOLOGICAL AGING

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SPECIFIC AIMS

The primary research aim is to study rates of physiological aging in individuals representing a profession which demands high standards of bodily and mental health — commercial, military and experimental test pilots. We feel these subjects who fly high performance aircraft must have been, in a sense, "biologically selected" and proven to be usually free of degenerative diseases of the cardiovascular, pulmonary, and central nervous system. Based on this premise, the group offers an unusually fine opportunity to study the physiological potential for adult males in all decades in our society. Results from study by our group of 100 pilots would suggest that the test performances of these subjects are superior. It is believed that 400 more such subjects (100 in each age decade from the twenties to the sixties) will give us a top range of normal values which may then become a standard reference point for the study of other population groups in our society.

Our general approach can best be put in the form of two questions: Given the chronological age of a highly trained individual, can his physiological age be estimated from clinical and laboratory studies? Is it possible to evaluate the degree of his resistance to what is classically regarded as "disintegrating conditions," and to draw the fine line which sometimes separates diminished function from gross pathology?

The answer to the above questions can be, at best, only a heavily qualified "yes." Nevertheless, with this small promise in sight, it does not seem unreasonable to expect that this research program should succeed in developing a reliable technique with which to predict tolerance limits and the range of constancy of the relevant functions and skills (Szafran, 1965b).

It might, at first sight, be thought that the best approach to the investigation of the effects of aging in this professional group would be to study their actual performance as pilots. It should be borne in mind, however, that the use of a multimillion dollar flight simulator would require further evaluation. The study of aircrew performance in flight cannot be said to be easy, because it is not usually possible to standardize conditions at critical points, e. g., takeoff and landing. Nor is the study of aging easy, whether by cross-sectional or longitudinal methods. There is a wide variation between individuals, and the likelihood is that progressive

selection in the course of years in any occupational group renders the older members less representative than the younger (Welford, 1957).

It may be argued that since our primary intent is not to assess pilot performance, the study of physiological aging of this professional group in the laboratory is more advantageous. It gives us the dual opportunity of (1) carefully focusing down upon a given physiologic system and (2) comparing simultaneous function of totally different systems. For example, in the field of psychology, three aspects which could influence performance would appear to be of particular importance: the slowing of decision, the limited resolving power of sensory detectors, and the reduction in the capacity for short-term memory. Although a great deal of work has been devoted to the elucidation of these processes, their cerebral basis is not completely clear. However, whatever the mechanism, it must be envisaged as having sufficient plasticity to permit some degree of variation in the details of executive responses in high-grade skills (Szafran, 1965c). Moreover, is this mechanism underlying the psychologically determined change related primarily to the deterioration of the cardiovascular system? Do changes in the ballistocardiogram or endogenous creatinine clearance presage or occur concomitantly with changes in skilled performance? We hope that the use of this highly skilled and functionally competent group will make it easier to begin to answer these questions.

METHOD OF PROCEDURE

Data Acquisition

One-hundred pilots in each age decade from the twenties to the sixties will be studied carefully in 4 fundamental areas (see Table 1):

1. Anthropometric and Physical Competence
2. Pulmonary Function
3. Cardiovascular-Renal
4. Psychological (including special senses)

These studies will be repeated every 5 years. If evidence of clinical pathology develops during the course of this longitudinal study, the subject will no longer be carried in the "normal" group. Careful re-examination of his data will be made in the light of the morbid condition diagnosed, and all efforts will be made to determine whether such morbidity could have been anticipated from these data. In this context, all tests used in this study have been critically examined in terms of their potential predictive capacity.

The studies outlined in Table 1 have been chosen primarily because other reliable observers have noted age-related changes in these systems. The reports of these changes are recorded in our bibliography. The method used to make these measurements is outlined in Table 1 or is included in the discussion. The rationale for our choice of approximately 100-odd