Appendix B: Written proposal

Project details

Name of the Student: Ilya Bychkov

Email Address: [redacted]

Name of person interacting with the student in the lab:

Email address:

Name of the Supervisor: Ross Pollock

Email Address [redacted]

Title of Project:
Understanding the work of breathing associated with ejection seat angle and clothing

Background (max 100 words):
Include key references
With the increase in the length of flights performed by military jets and rapid development of new aircraft, physiological issues have been identified affecting the work of breathing of pilots. These have been named "physiological episodes" and had a wide-spread effects on the fleets of new F-22 and F-35 aircraft, leading to standing down of entire fleets. A potential explanation for this change in the work of breathing for fighter pilots is the angle of the ejection seat back and the weight of the equipment often carried by the crews in the flight jacket pockets placed on the chest. The changes in the cockpit conditions and clothing are a likely culprit in the increase in the work of breathing as was described by Barnas et al 1993. The requirement for understanding of work of breathing is further increased by the recent changes in the design philosophy in of ejection seats, with understanding that the cockpit of an aircraft should be treated as a working office environment of a pilot, rather than just a means to an end.

Aim of the investigation (max 100 words):
Specify hypotheses to be tested
The investigation has three main aims. The first is to investigate the effect of different clothing and harness setups on the work of breathing of a subject in an ejection seat. The second aim is to investigate the effect of different seat back angles on the work of breathing. The final aim of the study is to investigate the effect of interaction between the clothing and seat back angles on the work of breathing. The hypothesis of the study is that the work of breathing will increase with the increase of seat back angle and increase in the weight of clothing on the subject's chest.

Proposed plan of work (max 200 words):
Please include research methods
To investigate the effects of different clothing and seatback angles on the work of breathing, 10 subjects will be invited to a lab in the Chest Unit of Kings College Hospital for testing. Prior to participating in the study, the participants will be given the information sheet outlining the method and informed consent will be gained. The subjects will then have to take a rapid COVID test, with only COVID negative subjects allowed to participate. ECG and EMG electrodes will be placed to record the ECG and EMG. A gastric/oesophageal pressure transducer will then be passed into the subject's stomach through the nose following administration of a local anaesthetic spray. The subject will then be fitted with a facemask connected to a spirometry pod. For the normal clothes/no harness, the subject will be seated in a deactivated F-35 ejection sit (provided by Martin-Baker) in their normal clothes with the harness undone. The EMG, ECG, expired O2 and CO2, respiratory flow, O2 saturations will be measured for 5 minutes at each angle. The angles used for testing will be 20, 40, and 60 degrees. The other "clothing" conditions used will be: normal cloth with done up harness, flight jacket with 5kg of buckshot in chest pockets with harness undone and done up. The data will be recorded using the LabChart software.