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Individual Differences in Aviator Performance and Psychophysiological Indices during Early Morning Simulated Flight

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14. ABSTRACT
Differences in circadian rhythms, known as chronotype, have been shown to influence performance in a variety of cognitive processes. To evaluate whether these differences also affect performance during helicopter flight, as well as influence the aviator's psychophysiological state (electroencephalogram, respiration rate, heart rate, and heart rate variability), 32 rated Army aviators completed 2 flights in a Black Hawk simulator. Participants completed a series of maneuvers under high and low workload conditions. To assess effects of chronotype, the flights were completed at 0400 hours, with participants required to maintain at minimum six hours of sleep each of the three nights prior to the study, thus not directly manipulating fatigue. Flight performance and psychophysiological variables were recorded, and results suggest workload and experience frequently predicted flight performance measures, whereas individually based predictors, to include daytime sleepiness, previous nights' sleep quality, and chronotype, predicted several psychophysiological measures.

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Circadian Rhythm, Circadian Chronotype, Workload, Individual Difference, Aviation

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However, both flight performance and psychophysiological measures were predicted by several of the individual factors, suggesting these play a role in the outcomes of both and necessitate inclusion in future research endeavors.

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Introduction

The impact of individual differences in performance variability has gained attention in recent years. In attempts to understand the underlying causes of variability within cognitive functioning, including executive functions, task-related patterns of brain activity, sustained attention/vigilance, etc., the impact of differences between individuals has been studied. Such studies have yielded findings including the contribution of genetic components (e.g., Friedman et al., 2008; Friedman & Miyake, 2017 [executive functions]), cognitive style and strategies (e.g., Miller et al., 2012), personality attributes, and stress coping styles (e.g., Shaw et al., 2010) as several of the factors at play in creating these differences. The results of many of these studies has been a push towards the development of personalized approaches to improving performance, somewhat mirroring the movement for personalized medicine approaches (Hamburg & Collins, 2010). Concerning the military, methods of improving or maintaining a Warfighter's performance, are often sought. Aviators in particular have frequently been the subject of such research given the demands of even the most mundane flights. Rotary-wing aviators, who make up the majority of Army aviators, often face performance-related challenges that differ from their fixed-wing counterparts. These include the necessity to fly at high speeds at a low altitude, as well as land in austere locations, such as mountaintops or dusty locations. Such tasks and conditions are known to place increased demands on their cognitive processing.

While previous researchers have identified the possible role of the following as influencing aviator performance: individual differences related to personality (e.g., Rose et al., 2014), cognitive abilities (e.g., Carretta et al., 2014), and multitasking abilities (e.g., Barron & Rose, 2017), the impact of individual differences related to circadian rhythms has not been extensively studied within this population. Given that aviators are frequently required to rotate shifts or fly at a moment's notice, a deeper understanding of factors influencing their attentional processes is needed to allow interventions to be recommended and/or developed to offset effects on performance. Differences related to circadian rhythm have been identified within the literature, with individuals demonstrating differences in time of day preferences, known as chronotype. A person's chronotype drives their preferred sleep and wake times, as well as their alertness levels throughout the day and night (Natale & Cicogna, 2002; Taillard, Philip, & Bioulac, 1999). Chronotype is of interest as its influence on alertness can likely be manipulated through countermeasures as simple as adjusting scheduling, or through specifically timed and dosed countermeasures, such as medication or newer techniques such as non-invasive brain stimulation. Further consideration to be taken is that as aviation operations continue to progress technologically, with the introduction of new automation features and aircrafts, the demands resulting from changes in workload experienced will likely also affect cognitive performance. Suggested methods of combating detrimental performance impacts have included the incorporation of real-time monitoring (e.g., physiological monitoring of the individual) coupled with the machine (e.g., Salomon & Boudreaux, 2016; Ting et al., 2010) or feedback to the command team (Taylor & Crowley, 2017; Tucker, 2017). As technology and missions continue to progress, the understanding of the impact of the individual on outcome measures, including performance and physiological changes, need to maintain pace to allow for the development of holistic solutions that can be applied on the individual level.

Circadian Rhythm and Chronotype

An individual's wakefulness and arousal levels are affected by a number of different factors, including but not limited to, ingestion of stimulants (caffeine, nicotine)(Davranche & Audiffren, 2002; Rogers et al., 2013), activities engaged in, and emotional state (e.g., Alexandre, Andermann, & Scammell, 2013 [activities, emotions]). At the core of maintaing wakefulness and arousal, to include the opposite, sleepiness, are neurobiological systems that promote either wakefulness or sleep (Alexandre et al., 2013), and can be considered the sleep-wake cycle. Circadian rhythm, also referred to as the circadian timing process, is noted as the body's natural clock, and is one of the processes by which the sleep-wake cycle is regulated, to include the timing of various physiological and neurobiological processes (e.g., Dijk & Lockley, 2002; Schmidt, Collette, Cajochen, & Peigneux 2007). In addition to the circadian timing process, the sleep-wake cycle is also influenced by the homeostatic process, which is the body's response to amount of time spent awake. These systems work together to promote sleep and work in opposition to keep an individual awake (Schmidt et al., 2007).

The circadian timing process is most influenced by the light-dark cycle, which causes fluctuations in cognitive functioning and alertness to occur in synchrony with changes in lighting throughout the day (Rogers, Dorrian, & Dinges, 2003). The circadian timing process is controlled primarily through the suprachiasmatic nuclei (SCN) within the hypothalamus, which is controlled mainly by external cues, the most predominant cue being that of light (Dibner, Schibler, & Albrecht, 2010; Moore, 1999). The SCN subsequently controls the circadian timing process via signals sent to other physiological processes that regulate processes such as bodily temperature fluctuations, as well as feeding and fasting rhythms (Dibner et al., 2010). The circadian process promotes wakefulness and arousal during daylight hours, while promoting sleep during dark hours, through increased production of melatonin, amongst other factors (Cajochen, Kräuchi, & Wirz-Justice, 2003). Consequently, the timing process can be summed up as a mainly biological process driven also by external environmental cues, which subsequently impact fluctuations in alertness patterns throughout the day (Duguay & Cermakian, 2009; Jasper et al., 2010).

Conversely, the homeostatic process is influenced by the time spent awake, where longer periods awake correspond with an increase in pressure, or need, for sleep, accompanied by a decrease in alertness (Maire, Reichert, & Schmidt, 2013). Furthermore, it has been shown that an increase in adenosine occurs alongside the increase in sleep pressure, and may assist in inducing sleep (Basheer et al., 2004). Throughout the day, an individual's alertness will be influenced by both processes, with the circadian timing process working to keep the individual awake during daylight hours, and the homeostatic process working to increase sleepiness as time awake increases (Schmidt et al., 2007). As daylight hours diminish, both processes work together to promote sleep.

The effects of circadian timing and homeostatic processes on arousal/wakefulness and alertness are further affected by an individual's chronotype. Chronotype refers to a person's sleep and wake preference, such that those considered evening-types (E-types) prefer later waking and sleeping hours, while morning-types (M-types) prefer earlier hours for each. Some of these differences have been exibited in tolerance to sleep pressure. For example, E-types have been found to tolerate the build-up of sleep pressure in the evening better than M-types, exhibited in their ability to maintain alertness later into the day (Schneider & Randler, 2009).

Whereas M-types more quickly build-up sleep pressure during the daytime, thus reaching their peak alertness levels earlier in waking day (Taillard et al., 2003), but are able to dissipate the sleep pressure more quickly during sleep (Mongrain, Carrier, & Dumont, 2006). The differences in dissipation of sleep pressure may also carryover to the differences found in quality of sleep reported by these two groups, with E-types typically reporting worse quality of sleep, paritcularly when their sleep schedules are restricted to align with social norms (Vitale et al., 2014). Differences in sleep pressure dissipation and quality subsequently affect levels of daytime sleepiness resulting in E-types typically reporting higher levels of daytime sleepiness than M-types (Schneider & Randler, 2009).

Taken together, the observed differences in levels of daytime sleepiness between the two groups are likely the result of poorer sleep quality when individuals are required to follow a schedule incongruent with their specific chronotype. The combination of the experience of daytime sleepiness, and differences in the tolerance to, build up of, and dissipation of sleep pressure lead to the differences seen in sleep-wake times and alertness fluctuations between the chronotypes which in turn can cause changes in cognitive performance.

Cognitive Performance

Arousal and attention levels affect performance on cognitive tasks, as evident in studies such as those examining the effects of sleep deprivation (e.g., Durmer & Dinges, 2005) and stimulant consumption (e.g., nicotine as in Davranche & Audiffren, 2002; caffeine as in Rogers et al., 2013). However, several studies have also found the variability in arousal and attentional levels related to chronotype to impact performance on cognitive tasks. The effects of chronotype on cognition have been most apparent when comparing performance of individuals tested during a time that was congruent or incongruent with their chronotype. These studies have typically found that individuals are prone to making more errors or perform worse when tested during incongruent times than when tested during congruent times (Schmidt et al., 2007; West, Murphy, Armilio, Craik, & Stuss, 2002). This has most frequently been noted in tasks assessing memory (Petros & Beckwith, 1990 [prose memory], Schmidt et al., 2015 [working memory]), sustained attention (Correa, Molina, & Sanabria, 2014), and cognitive inhibition (Schmidt et al., 2012). However, the effects of chronotype on cognitive processes have not always been clear. In Schmidt and colleagues' (2012) study, they had participants who were categorized as either extreme M- or E-type complete the Stroop Test, a measure of cognitive inhibition, during times of day both congruent and incongruent with individual chronotype (e.g., M-types tested in the evening). They found that E-types were able to maintain or increase performance when tested from morning to evening, but that M-types' performance decreased from morning to evening. This indicates a difference in cognitive inhibition and in attentional control between the two chronotypes as a function of time of day, but suggests also that E-types may be more resistant to these effects. Further complicating this difference is a recent study by Barclay and Myachykov (2017) where participants maintained wakefulness for 18 hours and then completed attentional tasks with chronotype assessed as a continuous variable, using total score. They found those with a tendency towards E-type performed worse following the 18 hours of wakefulness, whereas those tending towards M-type showed the opposite and improved performance as compared to baseline performance. This was an unanticipated finding, as it suggests asynchrony, and does not line up with the Schmidt et al. study where E-types appeared more resistant to effects of incongruent testing. However, Barclay et al. postulated that the differences may have been due to E-types having to wake earlier than usual in order to complete the baseline task at 0800, suggesting a variety of factors can contribute to these types of different findings.

While there have been several studies indicating a difference in performance related to chronotype, several studies, though finding effects of chronotype, have been less clear regarding the exact role chronotype plays in altering performance (e.g., Barclay & Myachykov, 2017; Schmidt et al., 2012). Moreover, fewer studies have examined how chronotype may impact job-related task performance, particularly those that require shiftwork. The majority of the previous studies have examined the effects of chronotype using simple, well-controlled, laboratory-based tasks, assessing a singular construct, rather than examining the effects when more complex tasks requiring a variety of cognitive processes are completed. Further, of the studies that have examined chronotype in shiftworkers, each study has generally focused on effects of chronotype in number of hours slept or sleep quality in relation to schedules (e.g., Juda, Vetter, & Roenneberg, 2013; van de Ven et al., 2016), and less so in terms of on-the-job performance outcomes.

Given that military aviators are frequently subjected to changing schedules, with many operations occurring during the nighttime or early morning hours (Rabinowitz et al., 2009), typically not coinciding with their chronotype and natural circadian rhythm, the impact of chronotype on their performance is of interest. Several previous studies have demonstrated schedules not coinciding with an individual's chronotype and circadian rhythm can result in increased rates of fatigue and the likelihood of committing errors (Caldwell, 2001, 2004). Aviators face additional risks to performance that result from the types of conditions in which they work, as well as the type of tasks they must perform, producing differing levels of workload that can further impact performance.

Workload

Workload, within the context of aviation, is most frequently defined as "the combination of task demands, or load factors, and the operator's response" (Mouloua, Gilson, Kring, & Hancock, 2001, p. 162). The cognitive task demands placed on aviators throughout a given flight can and often do, result in varying degrees of workload experienced within a single flight. For instance, aviators will most often experience a high workload level during the take-off and landing phases, and a low workload level during the cruise or en route phase (Di Nocera, Camilli, & Terenzi, 2007). Other instances of workload experienced are sometimes less predictable, such as weather or environmental conditions that may change throughout a flight. For example, when skies are clear the pilot is able to rely on visual cues outside of the aircraft to assist in maintaining the flight, whereas cloudy skies and low visibility requires the pilot to rely on instruments within the cockpit. Flying with instruments and few or no external visual cues require a higher amount of cognitive processing, resulting in a higher workload (Veltman, Oving, & Bronkhorst, 2009). Additionally, the availability of automated systems during flight will alter the workload experienced. Typically, when automated systems are available workload levels often lower but can increase when there is a malfunction and the system is unavailable (Olson, 2001), although this is not always the case.

The experience of fatigue may also have differential effects on workload performance among pilots, but is less understood and documented within the literature. Pilots who are fatigued have been shown to demonstrate poor performance and increased errors during the cruise phase, when workload is lower (Cabon, Coblentz, Mollard, & Fouillot, 1993), contradictory to the results seen in many studies where subjects who are not fatigued maintain stable performance during low workload conditions while performance in high workload conditions tend to suffer. This finding was noted in a recent review by Wickens and colleagues (2015) who found in a number of studies that complex, or high workload, task performance was less negatively affected by fatigue as compared to simple, or low workload, task performance. However, the reviewed studies did not account for individual differences in regard to fatigue susceptibility based on neither chronotype nor time of day, both of which may impact overall performance. Additionally, objective measures, specifically psychophysiological indices, will advance our understanding performance changes in response to workload and will contribute to the development of algorithms intended to identify operator state in real time.

Psychophysiological Indices

Various physiological measures are frequently used to objectively measure workload and fatigue, including heart rate, heart rate variability, respiration rate, and electroencephalogram (EEG). These measures have generally been chosen as they have been shown to be sensitive indicators of arousal (e.g., Mehler, Reimer, Coughlin, & Dusek, 2009; Sara & Bouret, 2012). Heart rate variability (HRV) has been demonstrated to be sensitive to changes in workload, as it reflects changes in the autonomic nervous system (ANS) in response to increased task demand (Luque-Casado, Perales, Cardenas, & Sanabria, 2016). Heart rate variability reveals changes in the ANS through changes that occur in the sympathetic and parasympathetic nervous systems. Previous studies have found the low frequency (LF) variability of heart rate (HR) to be associated with blood pressure control, which is indicative of sympathetic activity, and high frequency (HF) variability of HR to be associated with variations in respiratory sinus arrhythmia, indicative of parasympathetic activity (Durantin, Gagnon, Tremblay, & Dehais, 2014). It is based on these findings that the LF/HF ratio of HRV is used to indicate workload changes, where the LF/HF ratio typically decreases as levels of workload increase (Durantin et al., 2014; Hsu, Wang, & Chen, 2015). Inclusion of these metrics is important for future development of real-time operator monitoring tools as differences in chronotype can affect responses to stress. For instance, Roeser and colleagues (2012) previously demonstrated differences in cardiovascular response between E- and M-types through HR and HRV measures at rest and under stress induced from task loading.

Regarding changes in stress response, respiration rate (RR) has also been demonstrated to be sensitive to aviators' responses to workload manipulations in laboratory, simulation, and flight environments (Wilson, Fullenkamp, & Davis, 1994). Others have shown similar changes in more recent work, and identified that as cognitive workload increases, RR tends to increase as well; however, the effects may be less apparent in experienced individuals compared to less experienced individuals (Yao et al., 2008). Mehler and colleagues (2009) demonstrated an increase in RR to correspond with increased workload during a driving task, however their findings need to be interpreted with caution as the task involved some auditory responses. To date, no known work has been completed examining RR in terms of chronotype, but doing so will also add to the understanding of the predictability of these measures in different settings by accounting for the variability that individual differences such as chronotype might have.

Electroencephalogram measures have been shown to be valid and sensitive to workload changes through several studies (see Berka et al., 2007; Vidulich & Tsang, 2012; Wilson & Eggemeier, 1991). It has been noted that changes in beta, theta, and alpha rhythms of brain activity correlate with alertness and task engagement (Kamzanova et al., 2011), suggesting that monitoring of these rhythmic changes may provide an indication of operator state relevant to task demands (Freeman, Mikulka, Scerbo, Prinzel, & Clouatre, 2000). Electroencephalogram measures have also been demonstrated to be sensitive to the experience of fatigue. Objective measures of fatigue are useful, given that many individuals who experience chronic sleep deprivation become accustomed to the fatigued state, and as a result underreport the actual level of fatigue experienced (Balkin, Rupp, Picchioni, & Wesensten, 2008; Dinges, 2004). One study reported subjects who experienced chronic sleep deprivation, lasting a period of 14 days, demonstrated poorer performance on a psychomotor vigilance task as days of sleep deprivation accumulated, but reported low levels of fatigue during this time (Van Dongen, Maislin, Mullington, & Dinges, 2003). This finding suggests many individuals remain unaware of actual fatigue states and are unaware of its influence on performance. Few studies have examined changes in EEG activity based on chronotype, although differences in cerebral activity measured through fMRI due to chronotype has been shown (e.g., Schmidt et al., 2012). Given that EEG has been studied by several others as a potential candidate for real-time operator state monitoring (e.g., Ting et al., 2010), examining what, if any, effects chronotype has on EEG activity will aid in an overall understanding of its use in future operations. Combining the examination of the effects of chronotype and workload on both performance outcomes and psychophysiological outcomes will provide not only objective measures of changes in response to workload and induced by chronotype, but also point to potential countermeasure options by understanding the physiological basis of some of the performance changes.

The main objective of the present study was to determine whether chronotype significantly influences performance and physiological response metrics during simulated flights occurring during early morning hours (0400hrs), and whether the presence and degree of influence is constrained by workload. It was hypothesized that workload and chronotype will predict changes in the outcome metrics of performance (cognitive tasks; flight metrics), subjective workload, and psychophysiological indices such that those tending towards M-types would exhibit less performance variability, lower subjective workload ratings, and less physiological response (e.g., less change from baseline HRV to task HRV). Additionally, worse performance, higher subjective ratings, and greater physiological response would be exhibited under high compared to low workload conditions. A secondary objective was to assess the influence of sleep–related metrics (daytime sleepiness measures and previous nights' sleep quality) in predicting the outcome metrics, when combined with chronotype and workload. It was hypothesized that the addition of these measures would aid in accounting for more of the variability found within the outcome metrics, such that higher levels of daytime sleepiness and worse sleep quality would predict worsened performance, higher subjective workload ratings, and greater physiological responses.

Methods

Participants

Thirty-two rated Army aviators (29 males, 3 females) participated in the study[*]. A sample

[*] The study was to initially include a prescreening to create three groups based on chronotype (morning-type, intermediate, evening-type). However, due to difficulties in recruiting participants who met the qualification based on MEQ scores, the study was amended to use MEQ as a continuous score.

size of 30 participants was determined a priori using the statistical software R and the package "pwr" for a multiple linear regression model for a sufficiently powered model (power = 0.8, effect size = 0.35). Participants were recruited locally from Fort Rucker, AL through flyers, word-of-mouth, and recruitment briefings. Recruitment briefings occurred without the presence of supervisors and those present were informed they may leave at any time. Potential participants were informed they would be compensated up to $200 in monetary gift cards upon completion of both visits for the study; those who completed only the first visit (n = 2) received $100.

Sample Characteristics. Participants were predominantly Caucasian and ranged in age from 22 to 47 years old (M = 31.31, SD = 6.82). The participants were a mixture of Officers (5 Lieutenants, 13 Captains), Warrant Officers (n = 13), and one Department of the Army Civilian. All participants self-reported a current level of health of average to excellent, with none reporting below average, in comparison to others of the same age. Participants' average Body Mass Index was 26.96 (SD = 3.87), which is considered overweight by the National Heart, Lung and Blood Institute (U.S. Department of Health & Human Services); however, many of the individuals who participated were physically fit, with the higher value likely due to muscle mass. One participant reported regular tobacco use. All of the participants self-reported uncorrected (n = 26) or corrected-to-normal (n = 6) 20/20 vision. Participants were primarily right-handed (n = 24), with six who reported left-handedness and two ambidextrous. Participants all met the following inclusion criteria: (1) absence of diagnoses affecting attention (e.g., attention deficit hyperactivity disorder, narcolepsy, depression); (2) absence of sleep-related disorders; (3) absence of cardiovascular disorders; (4) not currently on a schedule including early mornings (0500 or earlier) or late night (2200 or later) shifts; and (5) not currently taking medications or supplements that induce drowsiness (e.g., narcotics for pain, antihistamines) or enhance alertness (e.g., modafinil, gingko biloba). Eligibility was assessed through self-report during the first visit.

Devices and Materials

The study used several psychophysiological devices to objectively measure response to workload, an actigraphy watch to measure compliance with sleep instructions, cognitive tests to assess basic cognitive functioning, several questionnaires to gain demographic information, sleep-related factors, and intelligence, and a full-motion Black Hawk simulator to assess flight performance. The devices and materials used in the study are outlined below.

Psychophysiological Devices.

Physiological changes in response to flight tasks and workload were assessed using EEG, electrocardiogram (ECG), and a respiration monitor. An actigraphy watch was worn throughout the study to measure sleep.

Electroencephalogram. Electroencephalogram data were collected using the Advanced Brain Monitoring (ABM) B-Alert X-24® wireless wet electrode system with 20 channels corresponding to scalp locations according to the International 10-20 system (frontal channels: Fp1, Fp2, F7, F3, Fz, F4, F8; central channels: C3, Cz, C4; temporal channels: T3, T4, T5, T6; parietal and occipital channels: P3, PO, POz, Pz, P4, O1, O2). Reference electrodes were placed on each mastoid. The B-Alert system is equipped with pre-measured electrode strips in sizes extra-small, small, and medium. To determine electrode strip size, participants' scalps were measured for the distance between the nasium and the inion, the head circumference, and the crest of the helix from ear to ear. Foam sensors were placed onto each EEG site on the electrode strip, with a conducive gel applied to each sensor before placing onto the participants' scalp. The mastoid sensors were a set of Ag/AgCl sensors, with conducive gel applied to each prior to affixing to the participant. EEG signals were filtered online with high pass 0.1 Hz and low pass 100 Hz filters. Impedance values less than 40 kΩ were accepted, following the device's recommendations. Signal decontamination was done online using ABM's validated artifact identification and decontamination algorithms, which identified and removed five artifact types: electromyography (EMG), electrooculography (EOG), excursions, saturations, and spikes (Berka et al., 2004).

Power spectral density (PSD) values were computed using ABM's software and patented algorithms. The PSD values were computed by performing a Fast Fourier Transform (FFT) and then calculating the amplitudes of the sinusoidal components for designated frequency bins. The frequency domain variables were based on the PSD derived after application of a 50% overlapping window and a FFT with a Kaiser window. The software then provided PSD values from 1 to 40 Hz for each EEG channel that were logged to obtain a Gaussian distribution. Selected 1 Hz bins were averaged that then were logged to create conventional EEG bands (theta 3 to 7 Hz, alpha 8 to 13 Hz, beta 13 to 29 Hz). A 50% overlapping window, which averages the PSD value across three by one-second overlays, was applied to smooth the data. The overlays 0, 1, and 2 are averaged with each overlay containing 256 data points with 128 data points shared for each overlay to provide the PSD values for each epoch. A Kaiser window was applied to each overlay to accentuate the contribution of power from the signal in the middle third of the overlay and minimize the impact of signal near each edge of the overlay in order to reduce edge-effects.

The ABM software also provides cognitive state classification algorithms that have been validated in previous studies (Berka et al., 2007; Johnson et al., 2011). For the present study, participants' workload classification was examined. The workload classification used was developed with data collected using the forward digit span task, and has been found to fit approximately 85% of the population. This classification provides a raw workload probability (value ranging 0 to 1), with a higher probability reflecting higher workload. The workload classification was derived using a linear discriminant function analysis (DFA) with two classes, high and low workload. EEG data from differential channels C3C4, CzPOz, F3Cz, F3C4, FzC3, and FzPOz are used to calculate the classification (Berka et al., 2007). The workload classification provides an indication of working memory load and processing. The ABM software also provides additional cognitive state classifications that are derived using participants' data following completion of three computer-based baseline tasks, however, these cognitive state classifications were not analyzed here. In addition to the ABM workload metric, an index of engagement was evaluated using the ratio of beta to theta+alpha (Freeman et al., 2000). To calculate this ratio, the raw PSD values at the frontal sites (F3, F4, F7, and F8) were used.

Electrocardiogram. The electrocardiogram (ECG) data was collected using the BioNodamix electrocardiogram amplifier module (ECG100). The ECG100 is a single channel, high gain, differential input, biopotential amplifier designed specifically for monitoring the heart's electrical activity. Single-lead Ag-AgCl electrodes were placed on each of the subject's clavicles and one below the left pectoral area (see Appendix A), and sampled at a rate of 1,000 Hz. Post-processing of data was done using Biopac's AcqKnowledge software. Data were first filtered using an analog band pass filter at 1 to 35 Hz. Following filtering of the data, the data were visually inspected for artifacts by two members of the research team, and corrected for using linear interpolation or waveform math. Next, AcqKnowledge's automated R-wave detector function and heart rate variability algorithms were used to provide the dependent variables for analyses. Specifically, the R-wave detector provided an output signal of smooth positive peaks every time the R-wave is detected. This data was then used to calculate beats per minute, to provide HR.

Heartrate variability in the frequency domain was extracted using Acq*Knowledge*'s HRV algorithm. Their HRV algorithm conforms to the frequency domain algorithm guidelines published by the European Heart Journal (Task Force, 1996). Acq*Knowledge* processed HRV in three stages: (1) RR intervals were extracted using a modified Pan-Tompkins QRS detector; (2) RR intervals were re-sampled to a continuous sampling rate to extract frequency information using cubic-spline interpolation; and (3) frequency information was extracted from RR intervals and used to produce ratios and power sums, with a Welch periodogram used to generate the PSD values. After running the algorithm to extract HRV, tachograms were also visually inspected to identify any outliers or possible missed beats not previously identified. The LF/HF ratio was the primary variable from the HRV data. Prior to analyses, data were baseline-corrected using data obtained from a five-minute resting baseline.

Respiration. Respiration data were collected using the BioNomadix respiration pneumogram amplifier module (RSP100C), which is a single channel, differential amplifier designed specifically for recording respiration effort. Respiration was collected through a transducer strap placed on the chest or abdomen of the participant, pending his or her breathing patterns, sampled at a rate of 50 Hz. After data collection the respiration data was filtered using a high-band pass filter of 0.05 Hz, and then visually inspected for artifacts, which were corrected for using linear interpolation. All data were processed using AcqKnowledge software and respiration rate was extracted as breaths per minute. Data were baseline-corrected prior to analyses using the same method as ECG data.

Actiwatch®. The Actiwatch® is a small, lightweight, limb-worn device that uses an accelerometer to monitor the occurrence and degree of motion. The sensor integrates the degree and speed of motion and produces an electrical current that varies in proportional magnitude at a sampling rate of up to 32 Hz. Data were wirelessly downloaded to a reader connected to a personal computer, and the Actiwatch® software was used for the manipulation, analysis, and presentation of the output data. The following output data were provided: assumed sleep (the amount of time between the point at which it appears that the onset of the sleep period and the time that they finally arose from sleep), actual wake time (reflects the number of minutes of time within the assumed sleep period that were spent awake), sleep efficiency (indicates the percent of time that the wearer is assumed to be "in bed" or attempting to sleep), number of sleep bouts (reflects the number of independent bouts of sleep identified during the assumed sleep period), immobile minutes (reflects the number of minutes within the assumed sleep period that were scored as immobile), and fragmentation index (reflects the amount of movement or disrupted sleep). For the purpose of this study, sleep efficiency, was used to determine compliance with sleep instructions.

Performance Measures.

Measures of performance for the study included flight performance data collected in the simulator during two flights, the Psychomotor Vigilance Task (a measure of sustained of attention), and the Stroop Test (a measure of cognitive inhibition).

Black Hawk Flight Simulator. A full-motion Black Hawk simulator was used to create two simulated flights designed to induce high and low workload conditions. The simulator consists of a simulator compartment containing a cockpit, instructor/operator station, observer station, and a six-degree-of-freedom motion system. A Dell Precision laptop received information concerning changes in the aircraft/simulator state parameters at a 60 Hz capture rate. Settings in the simulator were manipulated to create the experience of a high or low workload by manipulating the time of year to alter the appearance of daylight, the level of the clouds, the visibility, and flight system functionality; Table 1 outlines these differences. The flight scenarios were designed so that participants performed 14 maneuvers during each flight, with specified headings, altitudes, rates of climb/descent, and airspeed to maintain. These were included to provide performance measures that assessed deviations from desired parameters. The maneuvers, instructed parameters, approximate duration, and associated outcome metrics are listed in Table 2. Maneuvers and instructions were the same for each condition.

Table 1. Simulator Settings for Workload Conditions

Workload Manipulation	Time of Day	Time of Year	Cloud Height	Weather	Visibility	Flight Systems
Low	0500	11 July	No ceiling	Clear day	10 sq.mi.	All operational
High	0500	11 January	700’ Ceiling	Overcast	2 sq.mi.	FPS inoperable

Note. FPS = flight path stabilization

Table 2. Flight Tasks Descriptions

Maneuver Description	Heading (degrees)	Altitude (feet)	Rate of Climb/Descent (feet per min)	Air Speed (knots indicated)	Approximate Duration (mins)	Outcome Metrics
1. Stationary Hover Power Check	180	10 AGL	0	0	2	Heading, Altitude
2. Takeoff	187	10 AGL to 2000 AGL	+500	0 to 80	3	Heading, Climb rate, Trim
3. Straight & Level Acceleration	187	2000 AGL	0	80 to 120	6	Heading, Altitude, Trim
4. Right Standard Rate Turn	187 to 253	2000 MSL	0	120	0.5	Altitude, Airspeed, Turn rate, Trim

5. Straight and Level	253	2000 MSL	0	120	10	Heading, Altitude, Airspeed, Trim
6. Right Standard Rate Turn	From 253, two 360 degree turns for spacing	2000 MSL	0	120	4	Altitude, Airspeed, Turn rate, Trim
7. Straight and Level	253	2000 MSL	0	120	5	Heading, Altitude, Airspeed, Trim
8. Straight Climb	253	2000 MSL to 3000 MSL	+500	120	2	Heading, Climb rate, Airspeed, Trim
9. Straight and Level	253	3000 MSL	0	120	8.5	Heading, Altitude, Airspeed, Trim
10. Left 433 degree Descending Standard Rate Turn	253 to 180	3000 MSL to 2000 MSL	-500	120	3	Airspeed, Turn rate, Trim
11. Straight and Level	180	2000 MSL	0	120	6	Heading, Altitude, Airspeed, Trim
12. Straight Descent	180	2000 MSL to 500 MSL	-500	120	3	Heading, Airspeed, Trim, Descent Rate
13. Straight and Level Deceleration	180	500 MSL	0	120 to 80	3.5	Altitude, Airspeed, Turn rate, Trim
14. VMC Approach and Landing	170	500 MSL to Runway 17	As desired	80 to 0	2	Heading

Psychomotor Vigilance Task. The Psychomotor Vigilance Task (PVT) (Dinges & Powell, 1985) assesses sustained attention by requiring participants to respond to a visual stimulus. The PVT provides the participant's reaction time responding to the stimulus. The PVT was administered on a laptop computer using a standard mouse for responses. The version of the PVT used was developed by Khitrov and colleagues (2014), and has been demonstrated to be valid and comparable to the original handheld version of the PVT. The PVT trial time was set for 10 minutes. The outcome measures assessed included mean reaction time, accuracy measured as number of valid responses, and number of false starts.

Stroop Test. The Stroop Test was used to assess inhibitory response. The test was displayed on a laptop computer using the computerized neurocognitive test battery, called CNS Vital Signs (CNSVS). CNSVS is a reliable and validated battery of several neuropsychological tests (Gualtieri & Johnson, 2006). The Stroop Test was presented in three parts. In the first part, the words "red", "yellow", "blue", and "green" appeared in black font at random on the screen. A simple reaction time score was generated from participants pressing the spacebar when the word appeared. In the second part, the same words appeared on the screen in colored font. A complex reaction time was generated from participants pressing the spacebar when the word was in a font color that matched the word (e.g., "red" printed in red font). In the third part the same words appeared on the screen printed in font. A complex reaction time was generated when participants correctly pressed the spacebar when the color of the font did not match the written word (e.g., "red" printed in blue font). The outcome measures assessed included simple reaction time, complex reaction time, Stroop reaction time when letters are incongruent, and number of errors of commission.

Questionnaires.

Seven questionnaires were used to assess the participants' chronotype, demographic information (e.g., age, flight hours, time in military career, health), general intelligence, subjective workload, quality of sleep, daytime sleepiness, and previous night's sleep.

Morningness-Eveningness Questionnaire. The Morningness- Eveningness questionnaire (MEQ) (Horne & Östeberg, 1976) is a 19-item self-report questionnaire that asked participants to rate statements regarding preferred sleep and wake times. The questionnaire produced a score ranging from 16 to 86, with lower scores indicating preference towards evening and higher scores indicating preference towards morning, the outcome variable examined was total score used to indicate chronotype.

Demographic Questionnaire. The demographic questionnaire consists of 29 items that asked basic demographic questions, such as age, rank, time in military career, education level, and health.

Shipley Institute of Living Scale. The Shipley Institute of Living Scale (SILS) (Shipley & Burlingame, 1941) is a measure of general intellectual functioning. The SILS takes a maximum of 20 minutes to complete, and yields three major summary scores: Vocabulary, Abstraction, and combined Total scores. The Vocabulary sub-scale consists of 40 multiple choice verbal reasoning questions, and primarily taps crystallized intelligence. The Abstraction subscale includes 20 series completion items of inductive reasoning that tap fluid ability.

Convergent validity of both the Vocabulary and Abstraction measures with crystallized and fluid intelligence (respectively) has been assessed and confirmed in a general population (Matthews, Orzech, & Lassiter, 2011). The Abstraction Quotient score, which compares the ratio of crystallized intelligence with fluid intelligence, was the primary measure of interest from the SILS in the present study.

NASA Task Load Index. The NASA Task Load Index (NASA-TLX) (Hart & Staveland, 1988), is a well-validated and reliable measure of subjective workload. Workload was rated using a 100-point scale for the following subscales: mental demand, physical demand, temporal demand, performance, effort, and frustration. The subscales were subsequently weighted by presenting the participant with pairs of the subscales and asking which contributed more to their workload. The outcome measures assessed included a weighted total workload score and individual scores for the six subscales.

Pittsburgh Sleep Quality Index. The Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) consists of 10 items where participants rate sleep quality over the past month. The PSQI generated seven component scores, with subscale scores ranging from zero to three: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. These component scores were combined to give the outcome measure of a global score of subjective sleep quality, ranging from 0 to 21, with higher scores representing poorer sleep quality. The PSQI was administered on a laptop computer using the CNSVS software.

Epworth Sleepiness Scale. The Epworth Sleepiness Scale (ESS) (Johns, 1991) assessed daytime sleepiness and consists of eight questions in which participants rate their chance of dozing off during a particular activity using a 4-point scale. The outcome measure was a total score, with higher scores indicating greater daytime sleepiness. The ESS was administered through a laptop computer using the CNSVS software.

Sleep-Wake Questionnaire. This survey was developed in house to document time woken the day of the study, whether any naps were taken since waking and duration, time of going to bed the night prior, quality of sleep rated on a five-point scale (1, very good; 5, very poor), current level of sleepiness rated on a five-point scale (1, not at all sleepy; 5, very sleepy), and approximate number of hours slept in the previous three nights.

Procedure

The study consisted of two visits that were separated by 3 to 14 days. For the first visit, participants were scheduled to report to the laboratory at a time of their convenience. The main purpose of the first visit was to ensure participants were able to adequately perform the flight maneuvers required in the study, as well as gain comfort with wearing the physiological recording devices in the simulator, and receive their Actiwatch®. Prior to coming to the laboratory, participants were instructed to obtain 8 hours of sleep the night prior, avoid consumption of caffeine 16 hours, nicotine 2 hours prior, and alcohol 24 hours prior to their appointment. These were requested to obtain clean physiological recordings (e.g., Gilbert, Dibb, Plath, & Hiyane, 2000 [caffeine, nicotine]; Kähkönen, Wilenius, Nikulin, Ollikainen, & Ilmoniemi, 2003 [alcohol]). During visit one, participants provided written consent to participate in the study, received their Actiwatch® and instructions for participation, were scheduled for visit two, and completed the MEQ and SILS. Participants were fitted with the physiological recording devices, baseline measures were obtained, and then entered the simulator to complete a minimum of three flights with the research pilot to ensure the participant could adequately perform the maneuvers required during the second visit. The research pilot observed the flight maneuvers and rated whether or not the participant met the standards using pass/fail. All participants were able to meet the standards.

When participants returned for visit two at 0400 hours, compliance with caffeine, nicotine, and alcohol consumption instructions were verified through self-report, while compliance with sleep instructions were verified using the Actiwatch®. One participant's Actiwatch® failed at this time, although data were later recovered, and self-report was used to confirm sleep. Following verification of sleep requirements, participants completed the sleep/wake questionnaire, the PVT, the Stroop test, the ESS, and the PSQI. Next, the physiological recording devices were placed on the participant. Baseline recordings were taken for the ECG and respiration. Participants then moved to the simulator to complete the two test flights, with condition order counterbalanced amongst participants. At the end of each flight the NASA-TLX was completed. Once both flights were finished, the physiological devices were removed and the participant was released.

Statistical Analysis and Quality Control

Questionnaire responses were manually entered by research team members and data entry accuracy was assessed using a 10% sample. Respiration and ECG data were examined by two research team members, with one team member responsible for correcting artifacts and extracting the outcome variables (HR, HRV, respiration rate) to minimize variability in methods of correction. EEG data were processed using ABM's software. Statistical analyses were performed using the statistical software package SPSS release 23.0.0. Descriptive statistics including frequencies, percentages, means, and standard deviations are reported for all questionnaire items where appropriate. Manipulation of workload was verified through paired sample *t*-tests using flight performance measures and TLX scores.

To assess the hypotheses, outcome variables including performance measures (flight performance and cognitive tests), subjective workload, and psychophysiological measures (EEG, HR/HRV, and respiration) were analyzed using a series of hierarchical multiple linear regressions. Predictor variables were entered into the model in five steps, defined in Table 3 below.

Table 3. Regression Model Descriptions

Model Entry	Variables	Description of Variable
Step 1	Participant Number	Each had 2 entries into model; control variable
Step 1	Workload	Binary: low (1), high (2)
Step 2	Chronotype	Continuous: total score, higher values = tendency toward morningness, lower values = tendency toward eveningness
Step 3	Sleep Quality	Continuous: not at all sleepy (1) to very sleep (5), based on previous night
Step 4	Daytime Sleepiness	Continuous: lower daytime sleepiness (1) to higher daytime sleepiness (12)
Step 5	Experience	Continuous: higher values = higher flight hours, lower values = lower flight hours

The cognitive tests were assessed also using a hierarchical multiple regressions, with just three predictor variables included: *chronotype* (step one), *sleep quality* (step two), and *daytime sleepiness* (step three). Workload was not manipulated in the cognitive tests and flight experience was not anticipated to have an effect on the outcome measures of these tests, and therefore were excluded.

Prior to completing the regressions, data were inspected for outliers, identified as greater than three standard deviations (*SD*s) from the mean, and are reported below. Data were also assessed to determine whether they met the assumptions for parametric testing. After the regression models were run, results were examined to determine whether the assumptions of multiple regression were met. Several of the flight performance metrics indicated issues with homoscedasticity, and should be interpreted with caution; these are identified within the results tables in the Appendix. Finally, given that the assumption of independence of observations was violated with each participant contributing two sets of data points for each of the outcome measures (outcome measures for high and low workload), these models should be interpreted with caution.

Results

Examination of Morningness-Eveningness Questionnaire (MEQ) found an average score of 59.91 (SD = 9.96), which falls within the moderate morningness range (scores of 59 to 69). None of the participants fell within the definite eveningness range (scores of 16 to 30), although some fell within the moderate evening range (scores of 31 to 41). The range for scores in this sample were 40 to 79. The sample had relatively high intelligence, with an average Shipley Institute of Living Score of 108.69 (SD = 6.23), with scores ranging from 92 to 120. This is in line with previous work that has found Army aviators typically have average to above average IQ scores (Kratz, Poppen, & Burroughs, 2007). Participants overall reported relatively good sleep quality with an average PSQI global score of 4.47 (SD = 1.96) and moderate daytime sleepiness, with an average ESS score of 7.44 (SD = 3.58). It should be noted that PSQI scores greater than five are an indication of poor sleep, and the average PSQI score here was close to five (4.47), suggesting the group overall may be trending towards poorer sleep quality.

Descriptive statistics of flight experience are in Table 4, which includes total flight experience categorized by total flight hours, recency of experience during the last year, last 90 days, and last 30 days, and total hours as pilot in command.

Table 4. Flight experience reported

	Mean	**Std. Dev.**	**Minimum**	**Maximum**
Total hours	1229.40	1266.64	50.00	4350.00
Hours last year	139.86	110.24	0	400.00
Hours last 90 days	33.01	32.86	0	120.00
Hours last 30 days	13.64	18.42	0	60.00
Total hours pilot in command	727.34	1118.26	0	3800.00

Note. Those who reported 0 hours last year (n = 2) had high total hours.

Participants also reported up to five aircrafts and approximate hours flown in each. Table 5 below provides frequency values and total hours for each type. Black Hawks were the most frequently reported aircraft flown, as expected, as it is the Army's main airframe. All participants reported at least one aircraft type.

Table 5. Aircraft Types and Hours

	AC Type 1		AC Type 2		AC Type 3		AC Type 4		AC Type 5	
Aircraft Type	***N***	***Hrs***	***N***	***Hrs***	***N***	***Hrs***	***N***	***Hrs***	***N***	***Hrs***
Training	11	66.36	4	85	2	90	3	120	--	--
Black Hawk	10	720.97	7	1671.43	6	445	3	190	2	318
Fixed Wing	3	509.33	3	132	2	128.50	2	75.40	1	750
Apache	1	700	1	100	2	155	--	--	--	--
Lakota	2	92.5	1	100	1	300	--	--	--	--
Other*	5	326	10	391.50	4	1032.50	--	--	--	--

Note. *Other includes: Kiowa and Huey; AC = aircraft

The majority of participants rated the previous night's quality of sleep as good (n = 17, 53 %), a third of participants rated it as neutral (n = 11, 34 %), and only four (12 percent) rated previous night's sleep quality as poor or very poor. Actigraphy data were examined for compliance and sleep patterns. Table 6 includes total sleep time (TST), which indicates the hours of assumed sleep, and total time in bed (TIB), which indicates the hours of sleep efficiency. Each were averaged across the three nights prior to returning for the study, as well as the average for the night prior to the study.

Table 6. Actigraphy Results

Variable	Mean	MDN	STD	MIN	MAX
TST Night Prior	6.52	6.20	1.35	4.97	12.12
TST 3 Nights	7.08	6.85	0.82	6.02	9.63
TIB Night Prior	7.51	7.60	1.44	5.67	13.58
TIB 3 Nights	8.30	8.09	0.94	6.79	10.91

Cognitive Tests

Descriptive statistics for the PVT and Stroop Test are reported in Table 7. None of the regression models were significant for the PVT nor Stroop Test outcome measures (see Appendix C for full regression results).

Table 7. Cognitive Metrics Descriptive Statistics

	Mean	MDN	STD	MIN	MAX
Psychomotor Vigilance Task					
Reaction Time	277.25	261.48	47.69	228.44	424.87
Accuracy	93.67	93	3.82	85	101
False Starts	2.70	2	2.47	0	9
Stroop Test					
Simple RT	275.80	269.5	65.95	204	542
Complex RT	598.83	566.5	127.91	455	971
Stroop RT	695.37	659	126.69	501	1024
Commission Errors	1.2	1	1.10	0	4

Note. Reaction times are in milliseconds.

Flight Performance

The performance outcome metrics for each flight maneuver were extracted, Table 8 indicates how each outcome metric for each maneuver was calculated to indicate performance. Two subjects' data were removed based on outlier criteria and low total flights hours (50 hours reported). Descriptive statistics for each maneuver and associated outcome metrics can be found in Appendix C.

Table 8. Flight Performance Metrics

Maneuver	Heading	Altitude	Airspeed	Climb/Descent	Turn	Trim
1. Hover Power Check	Δ180°	Δ 10 AGL	--	--	--	--
2. Takeoff	Δ187°	--	--	Ft. per min	--	
3. Straight & Level Accel.	Δ187°	Δ2000 AGL	--	--	--	Pos. Slip Ball
4. Right Turn	--	Δ2000 AGL	Δ120 knts	--	°per sec	[indication of
5. Straight & Level	Δ253°	Δ2000 AGL	Δ120 knts	--	--	how far out
6. Right Turn	--	Δ2000 AGL	Δ120 knts	--	°per sec	of trim
7. Straight & Level	Δ253°	Δ2000 AGL	Δ120 knts	--	--	aircraft is,
8. Straight Climb	Δ253°	--	Δ120 knts	Ft. per min	--	with higher
9. Straight & Level	Δ253°	Δ3000 AGL	Δ120 knts	--	--	values
10. Left Descend. Turn	--	--	Δ120 knts	--	°per sec	indicating
11. Straight & Level	Δ180°	Δ2000 AGL	Δ120 knts	--	--	further out of
12. Straight Descent	Δ180°	--	Δ120 knts	Ft. per min	--	trim]
13. Straight & Level Decel.	--	Δ500 AGL	--	--	--	
14. Approach & Landing	Δ170°	--	--	--	--	--

Although data were collected during each of the fourteen flights maneuvers, results of six maneuvers are reported within the text. The six maneuvers include: *takeoff* (maneuver two), the *first standard rate right turn* (maneuver four), the *second right standard rate turn* (maneuver six), the *left descending standard rate turn* (maneuver 10), the *straight and level deceleration* (maneuver 13), and the *approach and landing* (maneuver 14). These were selected for the main focus within the text as they are most pertinent to a successful flight within the flight profile used and are most susceptible to performance degradation due to the design of the flights. Determination of which maneuvers to examine was made with input from research pilots within the laboratory. Regression analyses of all of the maneuvers and associated outcome metrics can be found in Appendix C, along with coefficient tables for the maneuvers reported here.

The flight metrics examined with the *takeoff*, heading and climb rate, were not significantly predicted. This may likely be due to participants' training resulting in them being less affected by any workload or time of day manipulations with this maneuver, such that they have been trained to carefully execute this maneuver regardless of extraneous factors that may affect performance.

Altitude deviations, airspeed deviations, rate of turn, and trim were examined as metrics of performance for the *first standard rate right turn* (maneuver four). The final models for altitude and airspeed deviations containing all predictor variables were non-significant. However, the rates of turn during this maneuver were predicted, with a marginally significant final model,

$F = 2.30$, $p = 0.50$. The addition of *daytime sleepiness scores* into the model in step four significantly contributed to the regression model, accounting for an additional 14% of variation. The addition of *experience* in the final model, while not significantly changing the R^2, contributed an additional 1% in explaining the variability in rates of turn, with a final model predicting 23% of the variability. Changes in trim during the maneuver were also predicted, with a significant final model, $F = 13.61$, $p < .001$. The first step of the model, with *participant entries* and *workload,* was significant, accounting for 56% of the variability in changes to trim. The addition of *experience* in the final step, significantly contributed to the model, adding 6% of variability explained, with a final model accounting for 65% of the variability.

The same metrics were examined for the *second standard rate right turn* (maneuver six) as the first; however, it should be noted that the second turn required two 360-degree turns, and thus was slightly more difficult to execute. Although deviations in altitude were not predicted during the first right turn, they were predicted during the second, with a significant final model, $F = 3.92$, $p = 0.003$. *Participant entries* and *workload* in the initial step accounted for 28% of the variability, with the addition of the remaining predictors minimally contributing and not resulting in a significant change to R^2, with the final model accounting for 32% of the variation. Airspeed deviations and rates of turn were not significantly predicted during this maneuver. Changes to trim were significantly predicted, with a significant final model, $F = 7.54$, $p < .001$. The initial step in the model, with *participant entries* and *workload*, significantly contributed the variation in the model, accounting for 47% of the variability. The additions of the remaining predictors did not significantly contribute to the model, but did result in 50% of variability accounted for in the final model.

Metrics examined during the *left descending standard rate turn* (maneuver ten) included airspeed deviations, rate of turn, and trim. Airspeed deviations and adjustments to trim were not predicted during this maneuver. The final model for rate of turn was significant, F (6, 45) = 2.80, $p = 0.02$. Upon examining the additions of predictors to the model, *sleep quality* added in the third step significantly contributed to the model, adding 16% to variability explained. The additions of *daytime sleepiness scores* and *experience* in the fourth and fifth steps did not significantly contribute to the variability explained, but did increase the final model to explaining 27% of the variability.

Metrics of interest for performance during the *straight and level deceleration* (maneuver 13) included altitude deviations and trim adjustments. For this maneuver, only changes in trim adjustments were predicted, with a significant final model, F (6, 45) = 5.66, $p < .001$. The initial step, with *participant entries* and *workload*, significantly contributed to the model, predicting 40% of the variability. While the addition of the remaining predictors to the model did not significantly contribute, they did add 3% of variability , with the final model accounting for 43% percent. Finally, the only metric of interest in performance during the approach to landing was heading deviations. The final model was significant in predicting heading deviations, F (6, 45) = 3.37, $p = 0.008$. The addition of *experience* in step five most significantly contributed to the variability explained, with the final model accounting for 31% of variability within the data.

Psychophysiological Metrics

Electroencephalogram (EEG) data, ECG data, and respiration data were analyzed using the same series of multiple hierarchical regressions as performance data. Each of the psychophysiological metrics were examined separately, *ABM index, β ratio values, HRV, HR, and RR*. The outliers identified from the flight performance data were also removed so that their low experience would not impact analyses of the psychophysiological data. Further, several additional participants' data were excluded due to poor data quality in both *HR* and *HRV* analyses ($n = 1$, low workload) or as significant outliers, greater than 3 *SDs* from the mean ($n = 2$, low workload; $n = 1$, high workload). Further, *HR* and *HRV* data were examined for each maneuver, which resulted in the removal of several participants' data for specific maneuvers, due to either poor data quality within the maneuver or the participant was an outlier. See Appendix D for descriptive statistics. Respiration rate (RR) was also examined for outliers, which resulted in the removal of two participants' data.

Several of the psychophysiological metrics were predicted during the *takeoff*. Changes to *HRV* were predicted, with a significant final model, F (6, 44) = 5.96, $p < .001$. The initial step with *participant entries* and *workload* entered into the model significantly contributed to the model, which accounted for 22% of variability. The addition of *chronotype* in the second step also significantly contributed to the model, increasing variability accounted for up to 31%. Finally, the addition of *experience* in the final step significantly contributed to the model, with the final model accounting for 49% of the variability. Changes to *RR* were the only other psychophysiological metric predicted during this maneuver, with a significant final model, F (6, 41) = 3.46, $p = 0.007$. The addition of *sleep quality* to the model significantly contributed to the variability accounted for, increasing it from 3 to 14 %. The addition of *experience* in the final step also significantly contributed to the model, increasing the variability accounted for by 15%, with a final model accounting for 34% of the variability in the model.

Psychophysiological metrics that were predicted during the *first standard rate right turn* (maneuver four) included the changes to *HRV*, F (6, 38) = 5.96, $p < .001$. However, the final model of the *EEG β ratio values* approached significance, F (6, 47) = 2.14, $p = 0.07$. Examination of the *HRV* model steps indicate that the addition of *daytime sleepiness* in the fourth step significantly contributed to the model, increasing variability accounted for to 35%. *Experience* added to the model in the fourth step did not significantly change variability explained, but did increase the value to 40 %. While the final model for the *β ratio values* was not significant, examination of the steps within the model indicate the addition of *daytime sleepiness* to the model in step four significantly contributed to the amount of variability accounted for by adding 14% explained. The final model, with *experience* added, resulted in 21% of the variability explained.

Regression results of the *second standard rate right turn* (maneuver six), indicated that changes to *HRV values* were also predicted during this maneuver, although none of the other metrics were predicted. The final model predicting changes in *HRV* was significant, F (6, 40) = 4.10, $p = 0.003$. The initial step in the model, with *participant entries* and *workload*, significantly contributed to the variability, accounting for 18 %. The addition of the remaining variables to the model in steps two through four did not significantly contribute to the model, although did increase the total variability explained in step four to 24 %. The addition of *experience* in the final step significantly increased the amount of variation accounted for by 14%, with the final model predicting 38% of the variability.

During the *left descending standard rate turn* (maneuver 10), only changes in *HRV* and *RR* were predicted. The final model for *HRV* was significant, F (6, 35) = 3.14, $p = 0.01$. The addition of *daytime sleepiness* in the fourth step of the model significantly contributed to the model, adding 15% to the variability accounted for. Within the final step, *experience* also significantly contributed to the model, increasing the variability accounted for by 13%, yielding a final model that accounted for 35% of the variability. The final model for *RR* was significant, F (6, 42) = 3.06, p = 0.01. The addition of *sleep quality* to the model in step three significantly contributed to the variation accounted for, adding 15% explanation. The addition of *experience* in step five contributed 9% to variation explained, with the final model accounting for 30% of the variability.

Changes to *HRV* during the *straight and level deceleration* (maneuver 13) were significantly predicted, with a significant final model, F (6, 39) = 4.95, p = 0.001. The addition of *participant entries* and *workload* in the initial model significantly contributed to the model, accounting for 26% of the variability. The addition of *experience* in the fifth model significantly contributed to the variability, adding 11% to variability explained, with the final model accounting for 35 %.

The final maneuver, approach to landing, resulted in several of the psychophysiological metrics predicted. The *ABM workload* metric was predicted, with a significant final model, F (6, 46) = 3.03, p = 0.01. The initial step in the model, *participant entries* and *workload*, contributed significantly to the variability, increasing to 16 %. The addition of *daytime sleepiness* in the fourth step added 9% to variability explained, and increasing the R^2 value to 28%. While the final model was significant, *experience* did not significantly contribute to the variability with no change to the R^2 value. The *EEG β ratio values* were also predicted during this maneuver, with a significant final model, F (6, 47) = 3.34, p = 0.008. The addition of *sleep quality* in step three significantly contributed to variability accounted for increasing to 19%. The addition of *experience* in the final step also significantly contributed to the variation, with the final model accounting for 30% of the variation. Changes in *HRV* were also predicted during this maneuver, final model significant, F (6, 34) = 4.57, p = 0.002. The initial step in the model, *participant entries* and *workload*, significantly contributing to the model with 23% of accounted variability. The addition of *chronotype* in step two significantly increased the variation accounted for to 30 percent. The final step of the model significantly increased the variation accounted for to 45% with the addition of *experience*. Changes in *HR* were also predicted during this maneuver, final model, F (6, 35) = 2.52, p = 0.04. The addition of *sleep quality* in step three of the model significantly contributed to the variation explained, adding accountability for18%. The final model accounted for 30% of the variability, although the addition of *daytime sleepiness* and *experience* did not significantly add to variability explained.

NASA TLX

Descriptive statistics for the NASA TLX scores are reported below in Table 9. Subjective ratings of workload clearly indicate a difference between the low and high workload flights, with higher workload ratings during the high workload flight. Further, a multiple hierarchical regression was also conducted for TLX scores, with the same predictor variables as the previous outcome metrics. The final model was statistically significant, F (6, 54) = 12.94, p < 0.001. The model's initial step, of *participant entries* and *workload,* significantly contributed to the variation explained, accounting for 56% of variability. The addition of *daytime sleepiness* in the fourth step of the model also significantly contributed to the variation explained, adding 6% of accounted variability. The addition of *experience* in the final model did not change the variation accounted for, with the final model accounting for 62% of variability.

Table 9. NASA TLX Descriptive Statistics

Workload Category	Minimum		Maximum		Mean		SD	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Mental	10	30	100	100	31.07	68.52	20.25	17.96
Physical	0	5	40	90	15.18	45.93	11.51	25.31
Temporal	0	0	40	85	18.21	40.74	10.20	22.77
Performance	0	15	75	100	22.68	50	17.40	22.10
Effort	10	15	100	100	30.54	68.70	21.32	21.19
Frustration	0	5	50	100	14.29	60.74	13.24	23.73
Weighted Total	0	16.67	79.33	97.67	25.46	61.48	16.90	16.19

Discussion

The present study found evidence for individual differences related to circadian rhythm and fatigue influencing the variability in flight performance and psychophysiological response while completing flights outside of the circadian norm. *Daytime sleepiness*, *sleep quality*, and to a lesser extent, *chronotype,* were found to influence some of the variability within both the flight performance and the psychophysiological metrics. However, during several maneuvers the addition of *experience* accounted for a considerable amount of the variability, and in some instances resulted in a change of significance in the individual-based variables, suggesting a possible interaction with *experience*. Perhaps most notable is the consistency in significant predictor variables across the turn maneuvers for metrics in both performance and psychophysiological outcomes.

Sleep quality predicted rate of turn during the *first standard rate right turn*, with poorer quality of sleep predicting a slower rate of turn. Further, the addition of *sleep quality* into the model had an effect on the variance *chronotype* accounted for, with *chronotype* becoming a significant predictor in the model, suggesting *sleep quality* accounts for some of the variance within the data that *chronotype* alone did not account for. Rates of turn during the *left descending turn* were predicted by both *daytime sleepiness* and *sleep quality*, where higher levels of *daytime sleepiness* and worse *sleep quality* each predicted a slower rate of turn. Similar was found in the several psychophysiological measures during these maneuvers as well. *Daytime sleepiness* and *sleep quality* each predicted changes to *HRV* during the *first right turn*, with higher levels of *daytime sleepiness* and worse *sleep quality* predicting greater changes to *HRV* during this task. Additionally, *HRV* during the *left descending turn* was influenced by *daytime sleepiness,* however, in examining the coefficients for the metric, the addition of *experience* to the model nullified the influence of *daytime sleepiness* in the final model, suggesting *experience* accounts for different aspects of the variation in *HRV* that were not accounted for with *daytime sleepiness.* The changes in *RR* were also predicted by *sleep quality* during the *left descending turn*; with worse *sleep quality* predicting a higher change in *RR.*

The overlap in *sleep quality* and *daytime sleepiness* predicting changes in psychophysiological response and rates of turn during these maneuvers suggests that the effects of fatigue that are accounted for in the measures of *sleep quality* and *daytime sleepiness* affect performance in such a way that can also be accounted for with changes in *HRV* and *RR*. However, the operational significance of these findings is not apparent in the present study, as rates of turn measured here would not equate to detrimental performance. But the findings here do provide support for further development of real-time operator state monitoring, by identifying overlap in individual-based metrics predicting both performance and physiological changes during the same task. Testing this under more extreme conditions where workload is manipulated further may provide additional insight regarding the identification and validation of performance thresholds in psychophysiological measures. Further work should examine the effects of individual-based variables on motor control, and examine whether psychophysiological metrics can be used to identify when an operator is likely to make mistakes during motor-intensive tasks. The influence of attention in regulating motor control has been recently evaluated within the literature (Lohse, Jones, Healy, & Sherwood, 2014), suggesting further probing of factors influencing attention, such as individual-based variables, may provide a more operationally-relevant perspective of factors affecting operator performance. Therefore, further evaluating factors affecting an aviators' attention in operational settings and examining motor control under strained conditions, such as completing a precise landing on the pinnacle of a mountaintop, may yield more operationally applicable findings that can translate to identification of thresholds where countermeasures are needed.

During the *approach and landing,* the addition of *experience* in the final model significantly predicted heading deviations, with more experienced individuals deviating less from the desired heading. However, *daytime sleepiness* also became a significant predictor in the final model, with higher levels of *daytime sleepiness* predicting fewer heading deviations as well. The change in significance of *daytime sleepiness* once *experience* was added to the model suggests it accounts for different aspects of the variance that *daytime sleepiness* alone did not account for, or that *experience* overrides the negative impacts associated with *daytime sleepiness*. While *daytime sleepiness* predicting fewer deviations in the final model appears counterintuitive, it may be explained with an examination of the psychophysiological metrics. The *ABM Workload Index* from the EEG data found higher levels of *daytime sleepiness* during this maneuver predicting a lower index of workload, which may suggest those who were accustom to the experience of fatigue required fewer cognitive resources to perform the task.

Alternatively, the effects of *experience* were supported by the *β ratio value* and *HRV*, where higher experienced individuals' *HRV* changed less from baseline values, suggesting they did not require as many cognitive resources to be engaged on maintaining performance during this maneuver. *Heart rate* was predicted by *chronotype* and *sleep quality*, with individuals tending towards morningness and poorer sleep quality predicted a greater change in *HR* from baseline. Taken together, the significant predictors during the *approach and landing*, suggest a role of fatigue in predicting physiological changes, although *daytime sleepiness* and *sleep quality* predicted different changes in the different psychophysiological metrics. This likely relates to the different aspects of fatigue that are evaluated in these measures, as daytime sleepiness is a measure of day-to-day fatigue whereas sleep quality specifically assesses the quality of sleep obtained the night prior. There is some evidence of this within the flight performance metrics, although *experience* accounted for the greatest amount of variability within that data. Given that approach to landing is such a crucial maneuver, it was likely overshadowed by experience levels impacting overall findings, but that these were each supported in the physiological measures is promising for identifying the psychophysiological indices needed for adequate operator state monitoring.

Finally, the subjective measure of workload, *NASA-TLX* scores, indicated that *daytime sleepiness* and *workload* manipulations were significant predictors of perceived levels of workload. The direction of the prediction differed from the findings within performance and psychophysiological measures, however. *Daytime sleepiness* predicted higher ratings of perceived workload on the *NASA-TLX*, differing from the performance and psychophysiological metrics that suggested those reporting higher levels of *daytime sleepiness* had developed a mechanism for coping with this to maintain alertness through cognitive resource recruitment. However, a similar dissociation was found in a study using simulated surgical tasks, where daytime sleepiness predicted perceptions of higher workload (Tomasko, Pauli, Kunselman, & Haluck, 2012). However, their study did not find any differences in performance related to daytime sleepiness. Our findings may be evidence of a dissociation between perceived workload and the actual effects of task loading on both performance and physiological outcomes. Further, given that the physiological metrics were predicted by *daytime sleepiness* in a similar manner as the performance metrics (i.e., greater engagement/less arousal response reflected improved performance), sole reliance on self-report of workload may be inadequate for determining true effects in terms of degraded performance. This is not to say that self-report is entirely inadequate, but rather, objective measures, such as physiological monitoring, should be included to assess the effects of tasks on the individual. The incorporation of both objective and subjective measures in assessing workload can then provide a better overall picture of task effects on workload experienced by the individual.

Limitations

The present study was limited in several ways. The psychophysiological metrics were averaged over each of the maneuvers, reducing the temporal resolution of the changes throughout the flight. Examining these data in smaller intervals may reveal clearer patterns of change in response to task demands that could be used to identify changes related to performance in more finite details, with this reexamination ongoing. Additionally, the inclusion of a more cognitively demanding and unexpected task, such as an emergency procedure, following an extended period of low workload, could provide further insight into the effects of chronotype on alertness and performance. A manipulation such as that would likely place more strain on the cognitive processing in the individuals, and further elucidate the differences in alertness patterns based on chronotype and sleepiness. Whereas the present study provided a substantial baseline of performance effects resulting from these types of manipulations.

The study was also limited by a convenience sample. There was a wide range of experience levels, which is due to the majority of available individuals who participated being either student pilots with low hours, or instructor pilots with very high hours (see Figure 1 below). The study would have benefited from having participants whose experience level was less extreme and therefore more representative of the mid-career pilot, rather than having participants who were at the extremes. Similarly, the majority of participants tended towards the morningness end of the chronotype spectrum rather than more evenly dispersed across the entire spectrum (see Figure 2 below). Recruitment from a more diversified population may yield more individuals who tend towards the eveningness end of the spectrum as well. However, it may also be that the majority of Army aviators fall within this range of circadian preference. A survey of aviators' circadian preferences would provide valued insight regarding this. Nonetheless, the data here provide a crucial piece to the ongoing work in real-time operator state monitoring, which is the need to consider individual differences, such as chronotype, as well as the impact of time of day and other environmental factors, on the ability of these monitoring metrics to adequately detect changes that may impact performance. Further, during several of the maneuvers, both flight performance and psychophysiological metrics were predicted by the same variables, which is a crucial step in furthering real-time monitoring.

Figure 1. Distribution of Experience

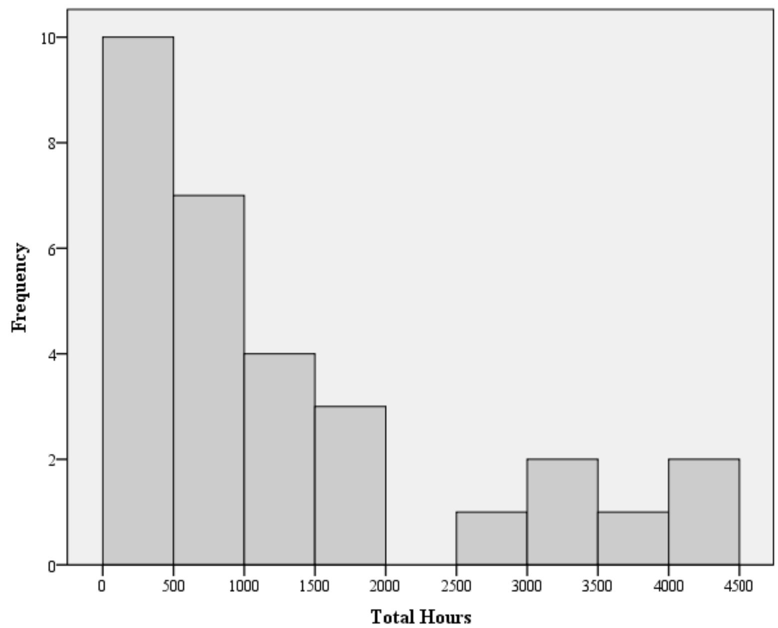
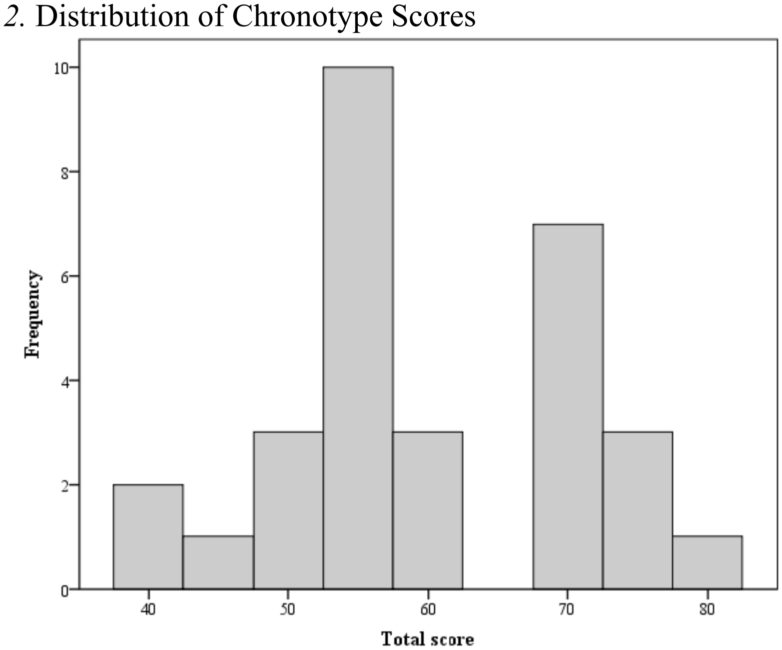


Figure 2. Distribution of Chronotype Scores



Future Research Recommendations

From the results of the present study, it is recommended that work in real-time operator state monitoring continue to examine the contribution of individual differences to changes in psychophysiological response, and that future countermeasure work consider the impact of these individual differences in performance. Future work should build on what was found here, by including more indicators of individual differences related to sleep, including *daytime sleepiness*, *sleep quality*, and *chronotype*, by assessing performance in a range of mission types (e.g., rapid response, degraded visual environment). Given that these variables were found to predict some of the performance and psychophysiological outcomes in the present study, which consisted of relatively mundane flights in terms of requiring no problem solving or time pressures, it is possible that evaluating these under flights including more cognitive strain would result in stronger outcomes. Assessing the influence of these additional factors and under a variety of circumstances should help to account for more of the variability within the data that could be built into a model for predicting performance outcomes during flight, based on both individual differences and physiological metrics, that could then occur in real-time. Next steps include further examination of the data collected within this study, to include multilevel modeling to account for the structure of the data, which may provide clearer indications of the relationships amongst the predictor variables and their influence on the performance and psychophysiological measures.

Conclusions

Flight performance is affected by a variety of factors, including the conditions under which the flight occurs and the experience levels of the pilot. Here we found evidence for individual differences related to fatigue and to some extent, chronotype, in predicting not only performance changes, but also psychophysiological measures. Present results suggest further work to evaluate these factors in affecting performance and examining influences when under extreme conditions so that countermeasures or interventions can be developed using knowledge gained from real-time operator state monitoring in these circumstances.

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Appendix A. Study Devices

Figure A1. B-Alert X-24 EEG system. This is a wireless, wet electrode system with 20 channels corresponding to scalp locations according to the International 10-20 system. The EEG system provides cognitive state classification algorithms (engagement, distraction, and workload) to be used for data analysis.

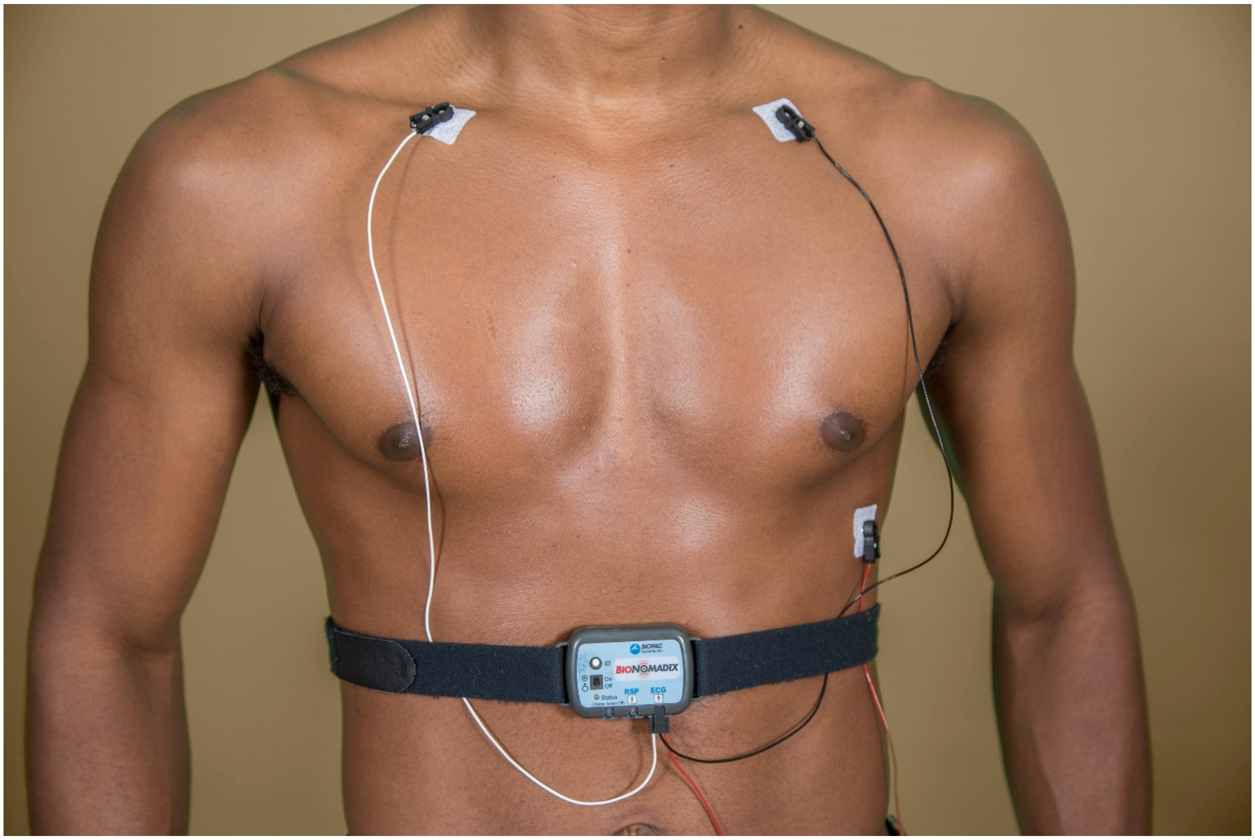


Figure A2. The ECG-100 is a single channel, high gain, differential input, biopotential amplifier. Single-lead electrodes were placed on the participant’s clavicles and one on a left rib.

Figure A3. The BioNomadix respiration pneumogram amplifier module was utilized for the collection of respiration data. The transducer strap was placed on the chest or abdomen of the subject and sampled at a rate of 50 Hz.

Figure A4. Complete hookup of B-Alert X-24 EEG, BioNomdix ECG electrodes and BioNomadix pneumogram respiration belt.

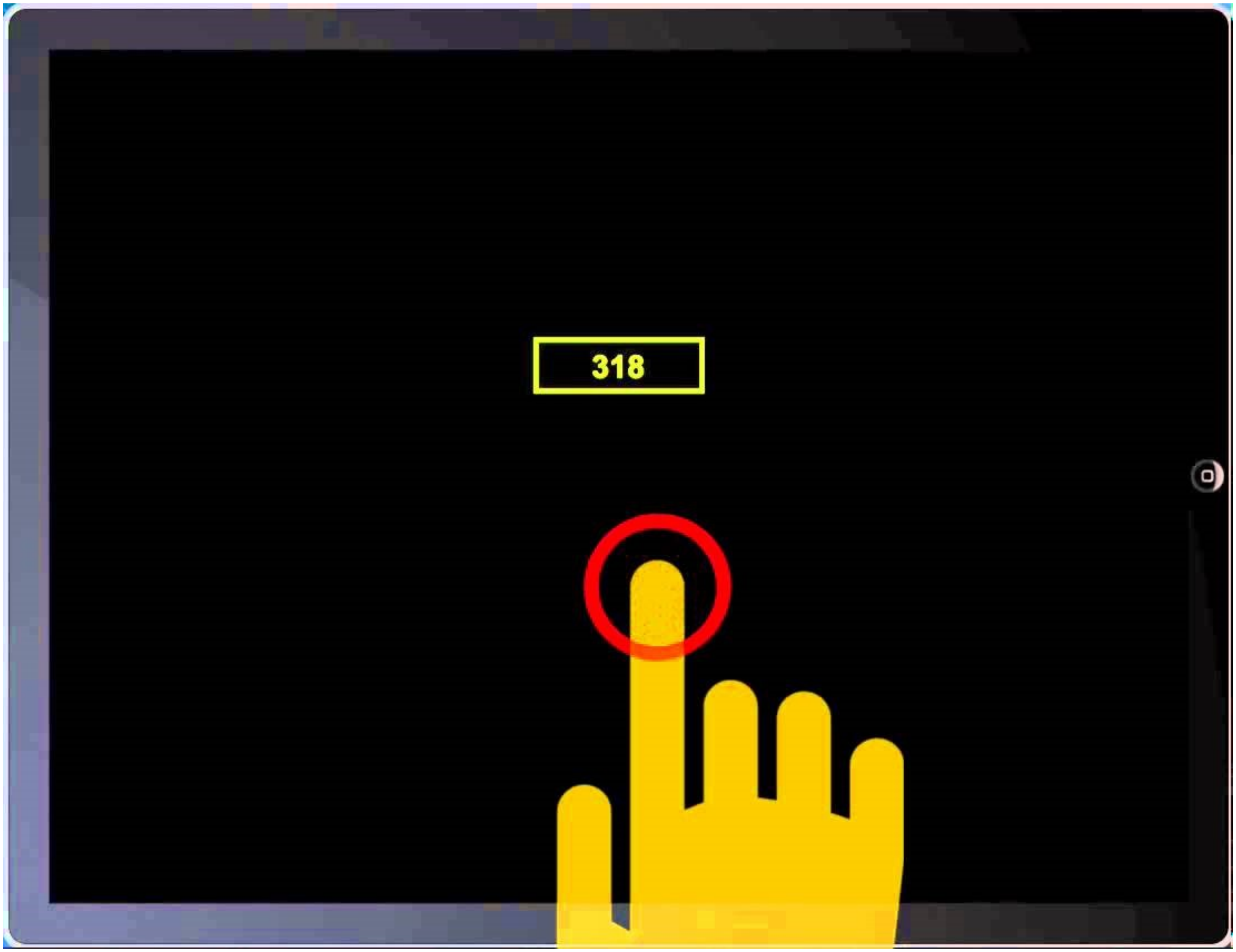
Figure A5. Actiwatch® activity monitoring system. Subjects were required to wear an Actiwatch® for the duration of the study in order to ensure he/she was meeting the sleep requirements.

Figure A6. Black Hawk flight simulator consisting of a cockpit, operator station, observer station, and a six-degree-of-freedom-motion system.

Figure A7. In cockpit view of the low workload settings during testing.

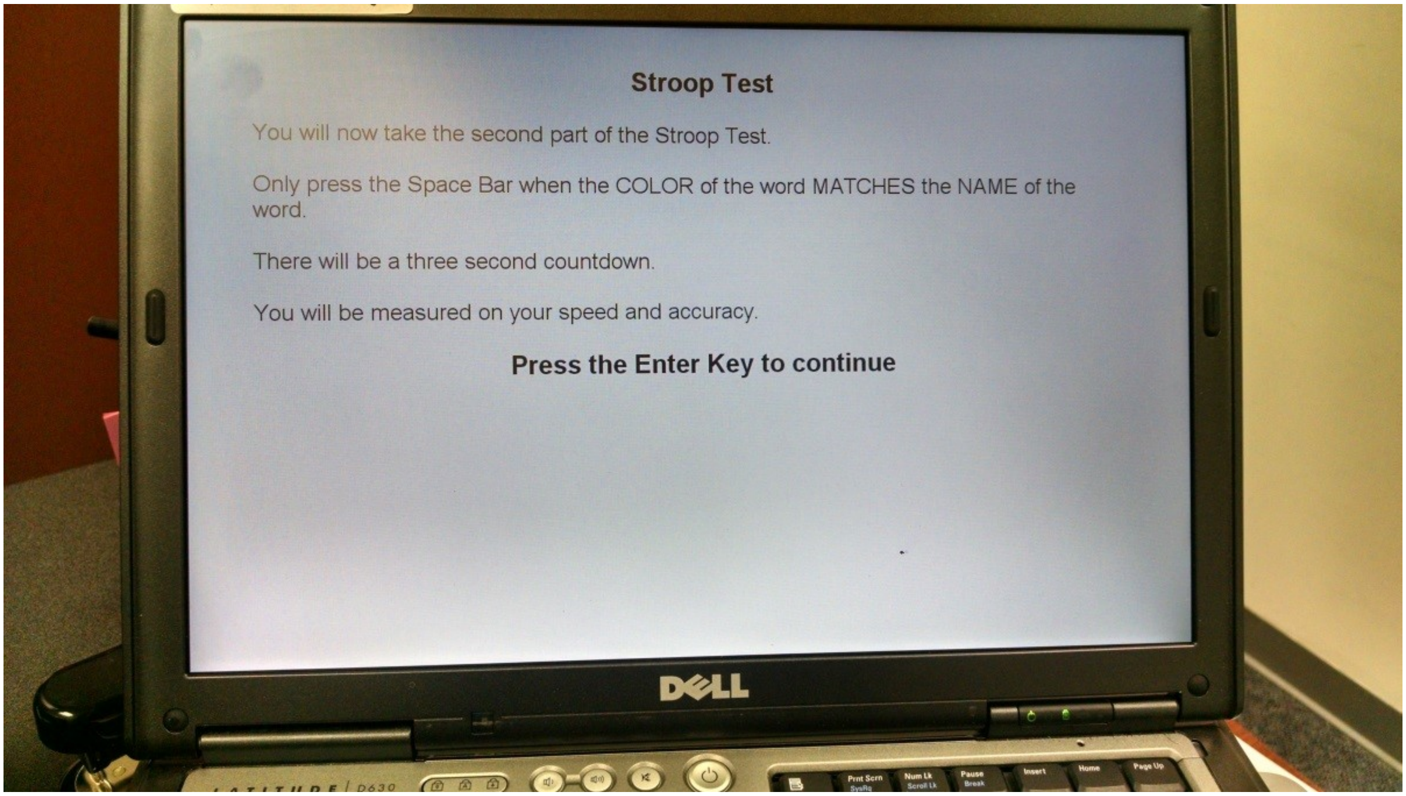
Figure A8. In cockpit view of the high workload settings during testing. The FPS was also inoperable during the flight, which required the pilots to employ more hands-on flying in order to meet performance parameters.

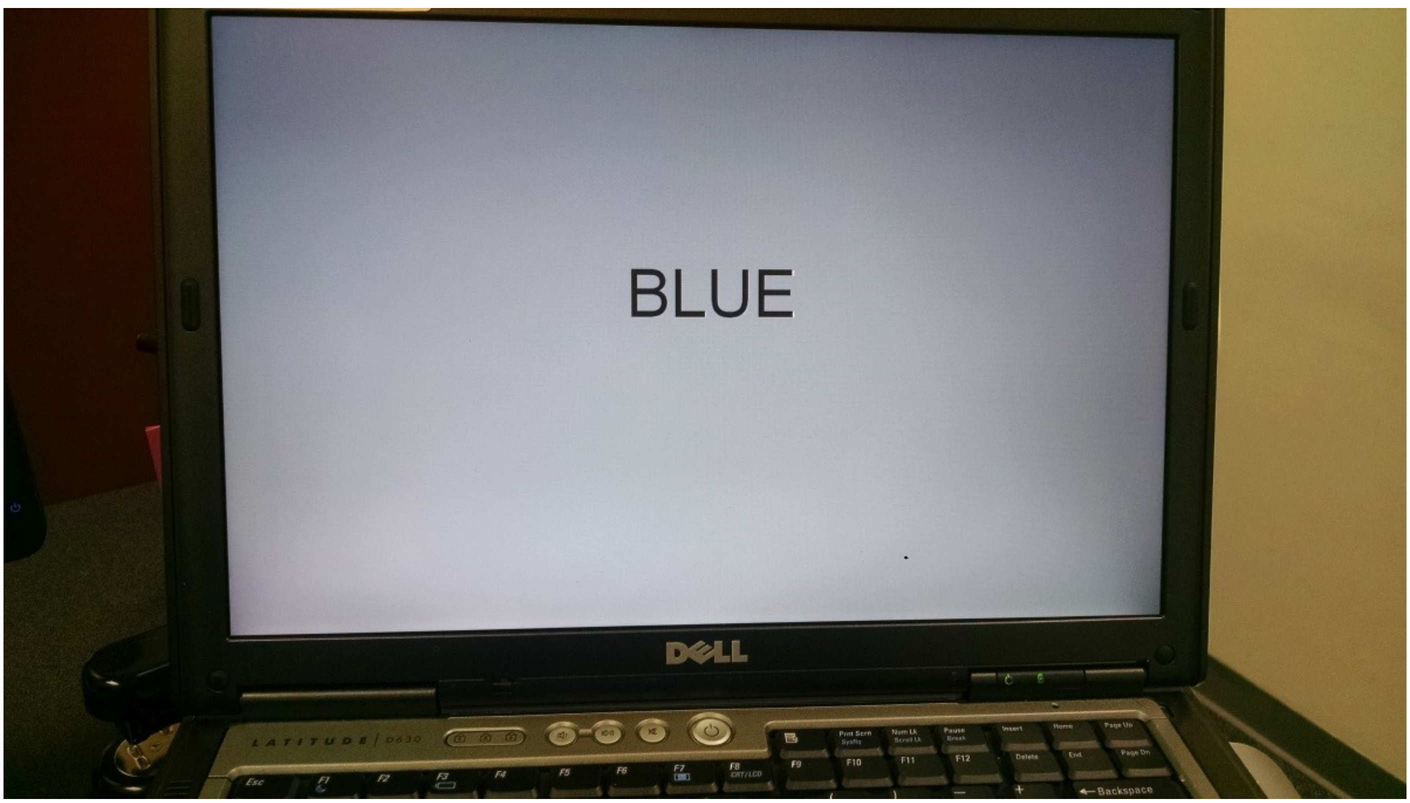
Appendix B. Assessments



Psychomotor Vigilance Task

Stroop Test





Morningness-Eveningness Questionnaire

Instructions:

Please read each question carefully before answering. Answer ALL questions. Answer questions in numerical order. Each question should be answered independently of others. Do NOT go back and check your answers. All questions have a selection of answers. For each question place a cross (X) alongside ONE answer only. Some questions have a scale instead of a selection of answers. Place an X at the appropriate point along the scale. Please answer each question as honestly as possible. Both your answers and the results will be kept in strict confidence.

1. Considering only your own "feeling best" rhythm, at what time would you get up if you were entirely free to plan your day?

AM **5** I I I **6** I I I **7** I I I **8** I I I **9** I I I **10** I I I **11** I I I **12** PM

2. Considering only your own "feeling best" rhythm, at what time would you go to bed if you were entirely free to plan your evening?

PM **8** I I I **9** I I I **10** I I I **11** I I I **12**AM I I I **1** I I I **2** I I I **3** AM

3. If there is a specific time at which you have to get up in the morning, to what extent are you dependent on being woken up by an alarm clock?

Not at all dependent ____
Slightly dependent ____
Fairly dependent ____
Very dependent ____

4. Assuming adequate environmental conditions, how easy do you find getting up in the morning?

Not at all easy ____
Not very easy ____
Fairly easy ____
Very easy ____

5. How alert do you feel during the first half-hour after having woken up in the morning?

Not at all alert ____
Slightly alert ____
Fairly alert ____
Very alert ____

6. How is your appetite during the first half-hour after having woken up in the morning?

Very poor ____
Fairly poor ____
Fairly good ____
Very good ____

7. During the first half-hour after waking up in the morning, how tired do you feel?

Very tired ____
Fairly tired ____
Fairly refreshed ____
Very refreshed ____

8. When you have no commitments the next day, at what time do you go to bed compared to your usual bedtime?

Seldom or never late ____
Less than 1 hour later ____
1-2 hours later ____
More than 2 hours later ____

9. You have decided to engage in some physical exercise. A friend suggests that you do this 1 hour twice a week and the best time for him is between 7:00 and 8:00 AM. Bearing in mind nothing else but your own "feeling best" rhythm, how do you think you would perform?

Would be on good form ____
Would be on reasonable form____
Would find it difficult ____
Would find it very difficult ____

10. At what time in the evening do you feel tired and as a result in need of sleep?

PM **8** I I I **9** I I I **10** I I I **11** I I I **12**AM I I I **1** I I I **2** I I I **3** AM

11. You wish to be at your peak performance for a test which you know is going to be mentally exhausting and lasting for 2 hours. You are entirely free to plan your day and considering only you own “feeling best” rhythm, which ONE of the four testing times would you choose?

8:00-10:00 AM ____
11:00 AM-1:00 PM ____
3:00-5:00 PM ____
7:00-9:00 PM ____

12. If you went to bed at 11:00 PM, at what level of tiredness would you be?

Not at all tired ____
A little tired ____
Fairly tired ____
Very tired ____

13. For some reason you have gone to bed several hours later than usual, but there is no need to get up at any particular time the next morning. Which ONE of the following events are you most likely to experience?

Will wake up at usual time and will NOT fall asleep____
Will wake up at usual time and will doze thereafter ____
Will wake up at usual time and will fall asleep again____
Will NOT wake up until later than usual ____

14. One night you have to remain awake between 4:00-6:00 AM in order to carry out a night watch. You have no commitments the next day. Which ONE of the following alternatives will suit you best?

Would NOT go to bed until the watch was over ____
Would take a nap before and sleep after ____
Would take a good sleep before and nap after ____
Would take ALL sleep before watch ____

15. You have to do 2 hours of hard, physical work. You are entirely free to plan your day and considering only your own “feeling best” rhythm, which ONE of the following times would you choose?

8:00-10:00 AM ____
11:00AM-1:00 PM ____

3:00-5:00 PM ____
7:00-9:00 PM ____

16. You have decided to engage in some physical exercise. A friend suggests that you do this 1 hour twice a week and the best time for him or her is between 10:00-11:00 PM. Bearing in mind nothing else but only your own "feeling best" rhythm, how do you think you would perform?

Would be on good form ____
Would be on reasonable form ____
Would find it difficult ____
Would find it very difficult ____

17. Suppose that you can choose your own work hours. Assume that you worked a FIVE hour day (including breaks) and that your job was interesting and paid by results. Which FIVE CONSECUTIVE HOURS would you select?

12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
Midnight Noon

18. At what time of the day do you think that you reach your "feeling best" peak?

12 1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
Midnight Noon

19. One hears about "morning" and "evening" types of people. Which ONE of these types do you consider yourself to be?

Definitely a "morning" type ____
Rather more a "morning" than an "evening" type ____
Rather more an "evening" than a "morning" type ____
Definitely an "evening" type ____

Demographics

Please respond to the following questions as truthfully and accurately as you can. Thank you for your time.

1. Sex: _____ Male _______ Female
2. Age: ______________________
3. Height:____________________ Weight:____________________
4. Ethnicity:

   _____ African-American (non-Hispanic) _____ Asian/Pacific Islander

   _____ Caucasian (non-Hispanic) _____ Latino or Hispanic

   _____ Native American _____ Other: ________________________

Please respond to the following questions regarding your flight training and experience.

1. Please list the type(s) of aircraft you have flown and the approximate hours in each type:

Type	Hours	Period of Operation
1.		
2.		
3.		
4.		
5.		

2. Approximate total hours of flight time: ___________________
3. What was the approximate flight time you received in the:

   Last year: ______________________________

   Last 90 days: ___________________________

   Last 30 days: ___________________________

4. Total hours as pilot in command: _________________________

a. How long ago was your most recent flight as pilot in command: ________________________

5. Total hours of instrument flight (actual and simulated) and how long ago was your last instrument flight:

   A = _____________________ # of months or weeks: ____________________

   S = _____________________ # of months or weeks: ____________________

5. Education History:

   A. High School Graduate Year: ___________________ Degree: _________________

   B. College Graduation Year: _____________________ Degree: _________________

   If currently in college, circle class: FR SO JR SR

6. Please respond to the following:

   What is your current rank in the military: _________________

   How many years have you been serving in the military: _____________________

7. Do you regularly smoke cigarettes or use other tobacco products?

   Yes________ No___________

8. If you answered yes to question 5, approximately how many times a day do you use tobacco products? ______________________________

   a. Approximately how long have you been able to go without the use of tobacco products without experiencing withdrawal symptoms?

   ____

   ____

9. Using the following scale, please circle the number which corresponds to your current health level in comparison to others your age.

1	2	3	4	5
Excellent	Above Average	Average	Below Average	Poor

10. If you are currently taking any medication(s) or supplements (including vitamins and workout supplements), would you please describe the type(s) and quantity(s) below.

____

____

____

____

11. Have you been diagnosed with attention-deficit hyper-activity disorder (ADHD), narcolepsy, depression, or received a traumatic brain injury?

Yes________ No_________

12. If you answered yes to question 9, what is your diagnosis?

____

13. Are you currently diagnosed with a sleep-related disorder, such as insomnia, sleep apnea, etc.?

_________ Yes ________ No

14. If you answered yes to question 11, what is your diagnosis?

____

15. Are you currently diagnosed with a cardiovascular disorder, such as hypertension, etc.?

_________ Yes ________ No

16. If you answered yes to question 13, what is your diagnosis?

____

17. How would you classify your handedness?

_________ Right ________ Left __________ Ambidextrous

18. Do you have 20/20 uncorrected vision? __________Yes ____________No

19. If you answered NO to number 16, do you wear:

_______Glasses _______Contacts _______Both _______Neither

20. Do you have any other visual impairments, such as color blindness?

________Yes ________No

If Yes was selected for question 18, please state the impairment(s) below:

____

____

NASA-TLX

Instructions: After performing each flight you will be given a sheet of rating scales. You will evaluate the flight by putting an “X” on each of the six scales at the point which matches your experience. Each line has two endpoint descriptors that describe the scale. Note that “own performance” goes from “good” on the left to “bad” on the right. Consider each scale individually. Your ratings will play an important role in the evaluation being conducted, thus your active participation is essential to the success of this experiment and is greatly appreciated. Below are the definitions for each scale:

Mental Demand: how much mental and perceptual activity was required (e.g., thinking, deciding, calculating, remembering, looking, searching, etc.)? Was the task easy or demanding, simple or complex, exacting or forgiving? This you will rate from low to high on the scale.

Physical Demand: how much physical activity was required (e.g., pushing, pulling, turning, controlling, activating, etc.)? Was the task easy or demanding, slow or brisk, slack or strenuous, restful or laborious? This you will rate from low to high on the scale.

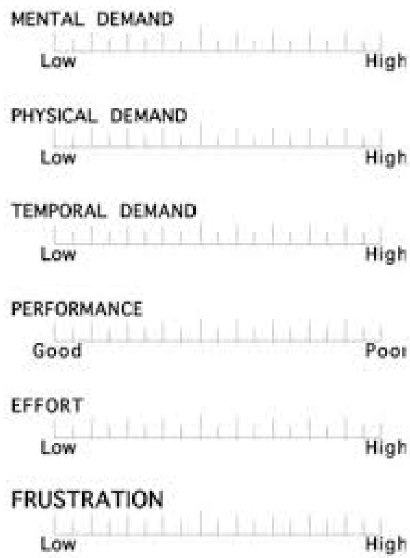
Temporal Demand: how much time pressure did you feel due to the rate or pace at which the tasks occurred? Was the pace slow and leisurely or rapid and frantic? This you will rate from low to high on the scale.

Performance: how successful do you think you were in accomplishing the goals of the task set by the experimenter (or yourself)? How satisfied were you with your performance in accomplishing these goals? This you will rate from good to poor on the scale.

Effort: how hard did you have to work (mentally and physically) to accomplish your level of performance? This you will rate from low to high.

Frustration Level: how insecure, discouraged, irritated, stressed, and annoyed versus secure, gratified, content, relaxed, and complacent did you feel during the task? This you will rate from low to high.

Rating Scales



Now we ask that you to assess the relative importance of six factors in determining how much workload you experienced. We ask you to do this as everyone experiences workload differently and we want to know you specifically experienced the workload.

The evaluation you are about to perform is a technique that has been developed by NASA to assess the relative importance of the six rating scale titles (mental demand, physical demand, temporal demand, performance, effort, frustration level) in the amount of workload you experienced. The procedure is simple: you will be presented with a series of pairs of the titles (for example, Effort vs. Mental Demand) and asked to choose which of the items was more important to your experience of workload during the flight. Each pair of titles will appear on a separate card.

Subjects will then be presented the following pairs and asked to determine which was more important in their experience of workload. The pairs will be presented individually, and in a random order by drawing the cards out of a storage container.

Effort or Performance

Temporal Demand or Effort

Performance or Frustration

Physical Demand or Performance

Frustration or Effort

Performance or Temporal Demand

Mental Demand or Physical Demand

Frustration or Mental Demand

Temporal Demand or Frustration

Physical Demand or Frustration

Physical Demand or Temporal Demand

Temporal Demand or Mental Demand

Performance or Mental Demand

Mental Demand or Effort

Effort or Physical Demand

Subject #__________
Date: _____________

Workload: _____ High _____ Low

Mental Demand

Low High

Physical Demand

Low High

Temporal Demand

Low High

Performance

Good Poor

Effort

Low High

Frustration

Low High

Circle each choice that the subject makes on the flash cards on this page.

Effort or Performance

Temporal Demand or Effort

Performance or Frustration

Physical Demand or Performance

Frustration or Effort

Performance or Temporal Demand

Mental Demand or Physical Demand

Frustration or Mental Demand

Temporal Demand or Frustration

Physical Demand or Frustration

Physical Demand or Temporal Demand

Temporal Demand or Mental Demand

Performance or Mental Demand

Mental Demand or Effort

Effort or Physical Demand

Pittsburgh Sleep Quality Index

Note: The Pittsburgh Sleep Quality Index was presented to the subject through the CNSVS computer program. The same questions were asked, but subjects answered on the computer.

1. During the past month, what time have you usually gone to bed at night?

BED TIME _____________

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?

NUMBER OF MINUTES___________

3. During the past month, what time have you usually gotten up in the morning?

GETTING UP TIME _____________

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed).

HOURS OF SLEEP PER NIGHT ____________

For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you . . .

a) Cannot get to sleep within 30 minutes

Not during the past month_______	Less than once a week______	Once or twice a week_________	Three or more times a week_________

b) Wake up in the middle of the night or early morning

Not during the past month_______	Less than once a week______	Once or twice a week_________	Three or more times a week_________

c) Have to get up to use the bathroom

Not during the past month_______	Less than once a week______	Once or twice a week_________	Three or more times a week_________

d) Cannot breathe comfortably

Not during the   Less than   Once or twice   Three or more past month_______ once a week______ a week_________ times a week_________

e) Cough or snore loudly

Not during the past month_______ Less than once a week______ Once or twice a week_________ Three or more times a week_________

f) Feel too cold

Not during the past month_______ Less than once a week______ Once or twice a week_________ Three or more times a week_________

g) Feel too hot

Not during the past month_______ Less than once a week______ Once or twice a week_________ Three or more times a week_________

h) Had bad dreams

Not during the past month_______ Less than once a week______ Once or twice a week_________ Three or more times a week_________

i) Have pain

Not during the past month_______ Less than once a week______ Once or twice a week_________ Three or more times a week_________

j) Other reason(s), please describe ____
____

How often during the past month have you had trouble sleeping because of this?

Not during the past month_______ Less than once a week______ Once or twice a week_________ Three or more times a week_________

6) During the past month, how would you rate your sleep quality overall?

Very good __________________
Fairly good_____________________
Fairly bad______________________
Very bad ______________________

7) During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?

Not during the past month_______	Less than once a week______	Once or twice a week_________	Three or more times a week_________

8) During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month_______	Less than once a week______	Once or twice a week_________	Three or more times a week_________

9) During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

No problem at all ___________
Only a very slight problem ___________
Somewhat of a problem ____________
A very big problem _____________

10) Do you have a bed partner or roommate?

No bed partner or roommate ___________
Partner/roommate in other room ___________
Partner in same room, but not same bed ___________
Partner in same bed ___________

If you have a roommate or bed partner, how often has he/she said in the past month you have had …

a) Loud snoring

Not during the past month_______	Less than once a week______	Once or twice a week_________	Three or more times a week_________

b) Long pauses between breaths while asleep

Not during the past month_______	Less than once a week______	Once or twice a week_________	Three or more times a week_________

c) Legs twitching or jerking while you sleep

Not during the	Less than	Once or twice	Three or more

past month_______	once a week______	a week_________	times a week_________

d) Episodes of disorientation or confusion during sleep

Not during the past month_______	Less than once a week______	Once or twice a week_________	Three or more times a week_________

e) Other restlessness while you sleep; please describe ___________________________________

____

Not during the past month_______	Less than once a week______	Once or twice a week_________	Three or more times a week_________

Epworth Sleepiness Scale

Note: The Epworth Sleepiness Scale was presented to the subject through the CNSVS computer program. The same questions were asked, but subjects answered on the computer.

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times. Even if you haven't done some these things recently try to work out how they would have affected you.

Use the following scale to choose the **most appropriate number** for each situation:

0 = would **never** doze
1 = **slight chance** of dozing
2 = **moderate chance** of dozing
3 = **high chance** of dozing

It is important that you answer each question as best you can.

Situation	**Chance of Dozing (0-3)**
Sitting and reading	________________
Watching TV	_________________
Sitting, inactive in a public place (e.g., a theater or a meeting)	_________________
As a passenger in car for an hour without a break	_________________
Lying down to rest in the afternoon when circumstances permit	_________________
Sitting and talking to someone	_________________
Sitting quietly after a lunch without alcohol	_________________
In a car, while stopped for a few minutes in the traffic	_________________

Sleep/Wake Questionnaire

Please answer the following:

1. At what time did you wake up today? ________________________________
2. Have you taken any naps since initially waking? ______________________
3. If yes, what was your total napping time? _____________________________
4. At what time did you go to sleep last night?__________________________
5. Please rate the quality of sleep obtained last night (*circle one)*:

   Very good Good Neutral Poor Very Poor

6. Please rate your current level of sleepiness (*circle one*):

   Not at all sleepy Somewhat sleepy Neutral Sleepy Very sleepy

7. Please indicate approximately how many hours of sleep you have received in each of the previous 3 nights:

Last night:______________________________ (date: ____*)*

One night ago:___________________________ (date: ____*)*

Two nights ago:_________________________ (date: ____*)*

Appendix C. Flight Performance Tables.

Table C1. Heading Descriptive Statistics

Maneuver	Minimum		Maximum		Mean		Std. Error		Std. Deviation	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
1 Hover Power Check	0.03	0.16	9.50	10.24	2.60	2.48	0.50	0.42	2.55	2.19
2 Takeoff	0.62	0.94	9.24	14.81	5.06	5.78	0.40	0.60	2.04	3.12
3 Straight & Level Accel.	0.99	0.28	7.46	29.84	4.26	6.28	0.35	0.98	1.78	5.09
5 Straight & Level	0.05	0.29	7.57	9.81	2.16	3.15	0.37	0.45	1.90	2.34
7 Straight & Level	0.06	0.04	5.31	8.85	2.01	2.73	0.29	0.41	1.47	2.15
8 Straight climb	0.37	0.09	5.25	10.55	1.96	3.10	0.24	0.51	1.21	2.67
9 Straight & Level	0.40	0.49	10.93	18.46	3.31	4.15	0.56	0.80	2.84	4.15
11 Straight & Level	0.68	0.36	5.80	6.07	2.50	2.76	0.24	0.33	1.24	1.73
12 Straight Descent	0.18	0.18	8.27	11.53	1.88	2.41	0.35	0.46	1.77	2.38
14 Approach & Landing	0.00	1.01	16.37	37.24	6.87	8.18	0.94	1.43	4.79	7.45

Table C2. Heading Regressions Stationary Hover Power Check

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	1.67	--	2.06	--	2.71	--	-1.14	--	-1.42	--
Subject	0.03	0.24	0.03	0.24	0.03	0.23	0.02	0.20	0.02	0.19
Workload	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.00	0.00
MEQ	--	--	-0.01	-0.03	-0.01	-0.04	0.02	0.07	0.02	0.07
Sleep Qual.	--	--	--	--	-0.19	-0.06	0.01	0.00	-0.10	-0.03
ESS	--	--	--	--	--	--	0.24	0.31^*	0.28	0.36^*
Experience	--	--	--	--	--	--	--	--	0.00	0.11
R^2	0.06		0.06		0.06		0.14		0.15	
F	1.45		0.96		0.76		1.53		1.35	
ΔR^2	0.06		0.00		0.00		0.08		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C3. Heading Regressions Takeoff

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	4.47	--	2.74	--	3.29	--	2.72	--	3.09	--
Subject	0.00	-0.03	-0.01	-0.04	-0.01	-0.04	-0.01	-0.04	0.00	-0.03
Workload	0.72	0.14	0.71	0.14	0.72	0.14	0.73	0.14	0.77	0.15
MEQ	--	--	0.03	0.12	0.03	0.11	0.03	0.12	0.03	0.12
Sleep Qual.	--	--	--	--	-0.17	-0.05	-0.14	-0.04	0.07	0.02
ESS	--	--	--	--	--	--	0.03	0.04	-0.03	-0.04
Experience	--	--	--	--	--	--	--	--	0.00	-0.19
R^2	0.02		0.03		0.04		0.04		0.06	
F	0.51		0.56		0.45		0.36		0.49	
ΔR^2	0.02		0.01		0.00		0.00		0.02	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C4. Heading Regressions Straight & Level Acceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.50	--	-1.20	--	-3.76	--	-3.76	--	-3.92	--
Subject	-0.01	-0.04	-0.01	-0.04	-0.01	-0.03	-0.01	-0.03	-0.01	-0.04
Workload	2.04	0.26	2.04	0.26	2.05	0.26	2.05	0.26	2.04	0.26
MEQ	--	--	0.06	0.16	0.07	0.19	0.07	0.19	0.07	0.19
Sleep Qual.	--	--	--	--	0.73	0.15	0.73	0.15	0.67	0.13
ESS	--	--	--	--	--	--	0.00	0.00	0.02	0.02
Experience	--	--	--	--	--	--	--	--	0.00	0.04
R^2	0.07		0.09		0.11		0.11		0.12	
F	1.78		1.66		1.52		1.19		0.98	
ΔR^2	0.07		0.03		0.02		0.00		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C5. Heading Regressions Straight and Level (Maneuver Five)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.39	--	2.90	--	4.32	--	3.04	--	3.51	--
Subject	-0.03	-0.30	-0.03	-0.30	-0.03	-0.31	-0.03	-0.32	-0.03	-0.31
Workload	0.89	0.21	0.89	0.21	0.89	0.21	0.89	0.21	0.92	0.22
MEQ	--	--	-0.01	-0.04	-0.01	-0.07	-0.01	-0.03	-0.01	-0.03
Sleep Qual.	--	--	--	--	-0.41	-0.15	-0.34	-0.13	-0.15	-0.05
ESS	--	--	--	--	--	--	0.08	0.12	0.02	0.02
Experience	--	--	--	--	--	--	--	--	0.00	0.23
R^2	0.14		0.14		0.16		0.18		0.21	
F	4.00^*		2.65		2.30		1.96		2.02	
ΔR^2	0.07		0.03		0.02		0.00		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C6. Heading Regressions Straight and Level (Maneuver Seven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	1.57	--	2.09	--	2.62	--	1.79	--	2.06	--
Subject	-0.01	-0.07	-0.01	-0.07	-0.01	-0.07	-0.01	-0.08	-0.01	-0.07
Workload	0.67	0.19	0.67	0.19	0.67	0.19	0.68	0.19	0.70	0.19
MEQ	--	--	-0.01	-0.05	-0.01	-0.06	-0.01	-0.03	-0.01	-0.03
Sleep Qual.	--	--	--	--	-0.15	-0.07	-0.11	-0.05	0.00	0.00
ESS	--	--	--	--	--	--	0.05	0.09	0.02	0.03
Experience	--	--	--	--	--	--	--	--	0.00	-0.15
R^2	0.04		0.04		0.05		0.05		0.07	
F	1.03		0.72		0.58		0.52		0.57	
ΔR^2	0.04		0.00		0.00		0.01		0.02	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C7. Heading Regressions Straight Climb

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	1.04	--	-0.45	--	-1.85	--	-3.01	--	-2.72	--
Subject	-0.01	-0.08	-0.01	-0.09	-0.01	-0.08	-0.01	-0.09	-0.01	-0.08
Workload	1.21	0.28	1.21	0.28	1.21	0.28	1.21	0.28	1.23	0.28^*
MEQ	--	--	0.03	0.12	0.03	0.14	0.04	0.18	0.04	0.18
Sleep Qual.	--	--	--	--	0.40	0.14	0.46	0.17	0.58	0.21
ESS	--	--	--	--	--	--	0.07	0.10	0.03	0.05
Experience	--	--	--	--	--	--	--	--	0.00	-0.14
R^2	0.08		0.10		0.12		0.13		0.14	
F	2.23		1.73		1.56		1.33		1.22	
ΔR^2	0.08		0.01		0.02		0.01		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C8. Heading Regressions Straight and Level (Maneuver Nine)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	4.22	--	6.45	--	8.68	--	11.09	--	11.02	--
Subject	-0.04	-0.25	-0.04	-0.25	-0.04	-0.26	-0.04	-0.24	-0.04	-0.25
Workload	0.48	0.07	0.48	0.07	0.48	0.07	0.47	0.07	0.46	0.07
MEQ	--	--	-0.04	-0.12	-0.05	-0.15	-0.06	-0.20	-0.06	-0.20
Sleep Qual.	--	--	--	--	-0.64	-0.15	-0.76	-0.18	-0.79	-0.19
ESS	--	--	--	--	--	--	-0.15	-0.14	-0.14	-0.14
Experience	--	--	--	--	--	--	--	--	0.00	0.02
R^2	0.07		0.9		0.11		0.13		0.13	
F	1.87		1.49		1.42		1.32		1.08	
ΔR^2	0.07		0.01		0.02		0.02		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C9. Heading Regressions Straight and Level (Maneuver Eleven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.76	--	2.95	--	3.72	--	3.63	--	4.09	--
Subject	-0.02	-0.27	-0.02	-0.27	-0.02	-0.28	-0.02	-0.28	-0.02	-0.26
Workload	0.35	0.12	0.35	0.12	0.35	0.12	0.35	0.12	0.38	0.13
MEQ	--	--	0.00	-0.02	-0.01	-0.04	-0.01	-0.04	-0.01	-0.05
Sleep Qual.	--	--	--	--	-0.22	-0.12	-0.22	-0.12	-0.03	-0.02
ESS	--	--	--	--	--	--	0.01	0.01	-0.06	-0.12
Experience	--	--	--	--	--	--	--	--	0.00	-0.32
R^2	0.09		0.09		0.10		0.11		0.18	
F	2.44		1.60		1.37		1.07		1.59	
ΔR^2	0.09		0.00		0.01		0.00		0.07	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C10. Heading Regressions Straight Descent

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	1.42	--	0.84	--	0.73	--	-0.16	--	0.23	--
Subject	0.00	-0.04	0.00	-0.04	0.00	-0.04	-0.01	-0.05	0.00	-0.04
Workload	0.53	0.13	0.53	0.13	0.53	0.13	0.54	0.13	0.57	0.14
MEQ	--	--	0.01	0.05	0.01	0.05	0.02	0.08	0.02	0.08
Sleep Qual.	--	--	--	--	0.03	0.01	0.08	0.03	0.24	0.09
ESS	--	--	--	--	--	--	0.06	0.08	0.00	0.01
Experience	--	--	--	--	--	--	--	--	0.00	-0.20
R^2	0.02		0.02		0.02		0.03		0.05	
F	0.47		0.34		0.25		0.26		0.43	
ΔR^2	0.02		0.00		0.00		0.01		0.03	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C11. Heading Regressions VMC Approach and Landing

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	8.44	--	7.46	--	8.07	--	14.37	--	17.43	--
Subject	-0.09	-0.30	-0.09	-0.30	-0.09	-0.30	-0.09	-0.28	-0.08	-0.25
Workload	1.48	0.12	1.48	0.12	1.48	0.12	1.46	0.12	1.68	0.13
MEQ	--	--	0.02	0.03	0.01	0.02	-0.03	-0.05	-0.04	-0.06
Sleep Qual.	--	--	--	--	-0.17	-0.02	-0.50	-0.06	0.76	0.10
ESS	--	--	--	--	--	--	-0.40	-0.19	-0.82	-0.39^*
Experience	--	--	--	--	--	--	--	--	0.00	$-0.50^\dagger$
R^2	0.11		0.11		0.11		0.14		0.31	
F	2.91		1.91		1.41		1.48		$3.37^\dagger$	
ΔR^2	0.11		0.00		0.00		0.03		0.17	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C12. Altitude Descriptive Statistics

Maneuver	Minimum		Maximum		Mean		Std. Error		Std. Deviation	
	Low	High	Low	High	Low	High	Low	High	Low	High
1 Hover Power Check	0.05	0.10	4.16	4.41	1.24	1.24	0.20	0.22	1.00	1.14
3 Straight & Level Accel.	158.60	131.65	338.48	523.34	227.85	230.07	6.93	13.48	35.33	70.06
4 Right Turn	128.47	7.51	327.07	324.29	231.81	189.09	9.76	15.79	49.79	82.03
5 Straight & Level	104.10	83.85	187.36	225.34	145.13	141.01	3.49	6.26	17.81	32.50
6 Right Turn	166.44	110.39	281.06	362.53	217.26	199.23	5.21	12.16	26.56	63.17
7 Straight & Level	221.51	136.58	302.18	268.97	250.66	226.32	3.31	6.28	16.87	32.64
9 Straight & Level	156.48	98.19	218.35	379.59	187.81	192.82	2.92	9.26	14.90	48.11
11 Straight & Level	7.64	56.32	183.78	181.02	146.41	144.54	6.68	4.97	34.08	25.82
13 Straight & Level Decel.	1.70	24.26	242.40	323.35	83.89	100.87	12.61	12.45	64.29	64.71

Table C13. Altitude Regressions Stationary Hover Power Check

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	1.41	--	1.95	--	3.37	--	1.91	--	1.94	--
Subject	0.00	-0.04	0.00	-0.04	0.00	-0.06	-0.01	-0.09	-0.01	-0.09
Workload	-0.03	-0.02	-0.03	-0.02	-0.04	-0.02	-0.03	-0.01	-0.03	-0.01
MEQ	--	--	-0.01	-0.09	-0.02	-0.14	-0.01	-0.05	-0.01	-0.05
Sleep Qual.	--	--	--	--	-0.41	-0.29*	-0.33	-0.24	-0.32	-0.23
ESS	--	--	--	--	--	--	0.09	0.26	0.09	0.25
Experience	--	--	--	--	--	--	--	--	0.00	-0.02
R^2	0.00		0.01		0.09		0.15		0.15	
F	0.05		0.16		1.20		1.62		1.33	
ΔR^2	0.00		0.01		0.08		0.06		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C14. Altitude Regressions Straight & Level Acceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	248.50	--	158.31	--	125.93	--	81.92	--	91.31	--
Subject	-0.48	-0.17	-0.52	-0.19	-0.49	-0.18	-0.53	-0.19	-0.50	-0.18
Workload	-2.57	-0.02	-2.51	-0.02	-2.46	-0.02	-2.29	-0.02	-1.60	-0.01
MEQ	--	--	1.54	0.28*	1.66	0.30*	1.96	0.36*	1.94	0.35*
Sleep Qual.	--	--	--	--	9.24	0.13	11.49	0.16	15.35	0.22
ESS	--	--	--	--	--	--	2.78	0.15	1.50	0.08
Experience	--	--	--	--	--	--	--	--	-0.01	-0.17
R^2	0.03		0.11		0.12		0.14		0.17	
F	0.76		1.94		1.67		1.55		1.48	
ΔR^2	0.03		0.08		0.02		0.02		0.02	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C15. Altitude Regressions Right Standard Rate Turn (Maneuver Four)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	267.14	--	304.23	--	298.19	--	336.55	--	343.01	--
Subject	0.27	0.08	0.29	0.08	0.29	0.08	0.33	0.09	0.35	0.10
Workload	-43.75	-0.31^{*}	-43.77	-0.31^{*}	-43.76	-0.31^{*}	-43.91	-0.31^{*}	-43.44	-0.30^{*}
MEQ	--	--	-0.63	-0.09	-0.61	-0.09	-0.86	-0.12	-0.88	-0.13
Sleep Qual.	--	--	--	--	1.72	0.02	-0.24	0.00	2.41	0.03
ESS	--	--	--	--	--	--	-2.43	-0.10	-3.31	-0.14
Experience	--	--	--	--	--	--	--	--	-0.01	-0.09
R^2	0.10		0.11		0.11		0.12		0.13	
F	2.78		1.98		1.46		1.25		1.08	
ΔR^2	0.10		0.01		0.00		0.01		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C16. Altitude Regressions Straight and Level (Maneuver Five)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	167.23	--	128.10	--	144.68	--	151.48	--	150.90	--
Subject	-0.56	$-0.44^{\dagger}$	-0.58	$-0.45^{\dagger}$	-0.59	$-0.46^{\dagger}$	-0.59	$-0.46^{\dagger}$	-0.59	$-0.46^{\dagger}$
Workload	-4.81	-0.09	-4.78	-0.09	-4.81	-0.09	-4.84	-0.09	-4.88	-0.09
MEQ	--	--	0.67	0.26^{*}	0.60	0.23	0.56	0.22	0.56	0.22
Sleep Qual.	--	--	--	--	-4.73	-0.14	-5.08	-0.15	-5.31	-0.16
ESS	--	--	--	--	--	--	-0.43	-0.05	-0.35	-0.04
Experience	--	--	--	--	--	--	--	--	0.00	0.02
R^2	0.20		0.26		0.28		0.29		0.29	
F	$5.96^{\dagger}$		$5.71^{\dagger}$		$4.63^{\dagger}$		$3.67^{\dagger}$		2.99^{*}	
ΔR^2	0.20		0.07		0.02		0.00		0.00	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C17. Altitude Regressions Right Standard Rate Turn (Maneuver Six)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	278.76	--	234.68	--	255.47	--	280.22	--	280.82	--
Subject	-1.24	-0.52‡	-1.26	-0.53	-1.27	-0.53	-1.25	-0.52	-1.25	-0.52
Workload	-19.98	-0.21	-19.95	-0.21	-19.99	-0.21	-20.08	-0.21	-20.04	-0.21
MEQ	--	--	0.75	0.16	0.67	0.14	0.50	0.11	0.50	0.11
Sleep Qual.	--	--	--	--	-5.93	-0.10	-7.20	-0.12	-6.95	-0.11
ESS	--	--	--	--	--	--	-1.57	-0.10	-1.65	-0.10
Experience	--	--	--	--	--	--	--	--	0.00	-0.10
R^2	0.28		0.31		0.31		0.32		0.32	
F	10.56‡		7.74‡		5.92 †		4.81 †		3.92 †	
ΔR^2	0.28		0.03		0.01		0.00		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table C18. Altitude Regressions Straight and Level (Maneuver Seven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	290.91	--	264.91	--	256.21	--	263.69	--	261.71	--
Subject	-0.44	-0.32	-0.45	-0.33	-0.44	-0.32	-0.44	-0.32	-0.44	-0.32
Workload	-24.46	-0.44‡	-24.44	-0.44‡	-24.43	-0.44‡	-24.45	-0.44‡	-24.60	-0.44‡
MEQ	--	--	0.44	0.16	0.48	0.17	0.43	0.16	0.43	0.16
Sleep Qual.	--	--	--	--	2.48	0.07	2.10	0.06	1.29	0.04
ESS	--	--	--	--	--	--	-0.47	-0.05	-0.20	-0.02
Experience	--	--	--	--	--	--	--	--	0.00	0.07
R^2	0.28		0.31		0.31		0.32		0.32	
F	9.60‡		7.11‡		5.34‡		4.23 †		3.50 †	
ΔR^2	0.28		0.03		0.01		0.00		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table C19. Altitude Regressions Straight and Level (Maneuver Nine)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	278.76	--	234.68	--	255.47	--	280.22	--	280.82	--
Subject	-1.24	-0.52	-1.26	-0.53	-1.27	-0.53	-1.25	-0.52	-1.25	-0.52
Workload	-19.98	-0.21	-19.95	-0.21	-19.99	-0.21	-20.08	-0.21	-20.04	-0.21
MEQ	--	--	0.75	0.16	0.67	0.14	0.50	0.11	0.50	0.11
Sleep Qual.	--	--	--	--	-5.93	-0.10	-7.20	-0.12	-6.95	-0.11
ESS	--	--	--	--	--	--	-1.57	-0.10	-1.65	-0.10
Experience	--	--	--	--	--	--	--	--	0.00	-0.01
R^2	0.28		0.31		0.31		0.32		0.32	
F	10.56‡		7.74‡		5.92‡		4.81‡		3.92†	
ΔR^2	0.28		0.03		0.01		0.00		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table C20. Altitude Regressions Straight and Level (Maneuver Eleven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	153.20	--	144.90	--	129.94	--	140.02	--	134.12	--
Subject	-0.07	-0.05	-0.08	-0.06	-0.06	-0.05	-0.05	-0.04	-0.07	-0.06
Workload	-2.94	-0.05	-2.93	-0.05	-2.91	-0.05	-2.94	-0.05	-3.38	-0.06
MEQ	--	--	0.14	0.05	0.20	0.08	0.13	0.05	0.15	0.06
Sleep Qual.	--	--	--	--	4.27	0.13	3.75	0.11	1.33	0.04
ESS	--	--	--	--	--	--	-0.64	-0.07	0.17	0.02
Experience	--	--	--	--	--	--	--	--	0.01	0.22
R^2	0.01		0.01		0.02		0.03		0.06	
F	0.14		0.14		0.28		0.26		0.50	
ΔR^2	0.01		0.00		0.02		0.00		0.04	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table C21. Altitude Regressions Straight and Level Deceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	49.26	--	29.59	--	68.84	--	12.82	--	17.05	--
Subject	0.51	0.17	0.50	0.16	0.47	0.15	0.42	0.14	0.43	0.14
Workload	15.91	0.13	15.91	0.13	15.84	0.13	16.06	0.13	16.37	0.13
MEQ	--	--	0.34	0.06	0.18	0.03	0.55	0.09	0.54	0.09
Sleep Qual.	--	--	--	--	-11.20	-0.14	-8.33	-0.11	-6.59	-0.08
ESS	--	--	--	--	--	--	3.54	0.17	2.96	0.15
Experience	--	--	--	--	--	--	--	--	0.00	-0.07
R^2	0.04		0.05		0.06		0.09		0.09	
F	1.07		0.75		0.81		0.90		0.77	
ΔR^2	0.04		0.00		0.02		0.03		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table C22. Airspeed Descriptive Statistics

Maneuver	Minimum		Maximum		Mean		Std. Error		Std. Deviation	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
4 Right Turn	0.16	0.07	9.27	14.68	2.20	4.79	0.44	0.85	2.27	4.40
5 Straight & Level	0.00	0.04	4.96	8.77	1.14	1.78	0.24	0.37	1.21	1.93
6 Right Turn	0.03	0.04	5.78	11.10	1.89	2.79	0.31	0.53	1.60	2.76
7 Straight & Level	0.02	0.03	5.10	30.60	1.38	3.38	0.24	1.18	1.24	6.11
8 Straight Climb	0.09	0.71	4.40	14.20	1.88	5.14	0.26	0.61	1.31	3.18
9 Straight & Level	0.03	0.05	3.33	5.63	0.95	1.88	0.20	0.30	1.02	1.55
10 Left Descend. Turn	0.02	0.04	10.56	13.87	2.52	4.51	0.45	0.80	2.27	4.16
11 Straight & Level	0.06	0.08	3.24	7.21	0.94	1.78	0.19	0.35	0.95	1.81
12 Straight Descent	0.12	0.29	20.32	48.85	2.86	6.20	0.80	1.94	4.07	10.10

Table C23. Airspeed Regressions Right Standard Rate Turn (Maneuver Four)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.28	--	-2.58	--	-0.76	--	-0.91	--	-0.79	--
Subject	-0.01	-0.04	-0.01	-0.05	-0.01	-0.06	-0.01	-0.06	-0.01	-0.05
Workload	2.74	$0.37^{\dagger}$	2.74	$0.37^{\dagger}$	2.74	$0.37^{\dagger}$	2.74	$0.37^{\dagger}$	2.75	$0.37^{\dagger}$
MEQ	--	--	0.04	0.11	0.03	0.09	0.03	0.09	0.03	0.09
Sleep Qual.	--	--	--	--	-0.52	-0.11	-0.51	-0.11	-0.46	-0.10
ESS	--	--	--	--	--	--	0.01	0.01	-0.01	-0.01
Experience	--	--	--	--	--	--	--	--	0.00	-0.03
R^2	0.14		0.15		0.17		0.17		0.17	
F	4.02^{*}		2.88^{*}		2.32		1.81		1.49	
ΔR^2	0.14		0.01		0.01		0.00		0.00	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C24. Airspeed Regressions Straight and Level (Maneuver Five)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.32	--	.52	--	1.05	--	0.57	--	0.98	--
Subject	0.01	0.09	0.01	0.09	0.01	0.08	0.01	0.08	0.01	0.19
Workload	0.55	0.18	0.55	0.18	0.55	0.18	0.55	0.18	0.58	0.19
MEQ	--	--	0.00	-0.02	-0.01	-0.04	0.00	-0.02	0.00	-0.02
Sleep Qual.	--	--	--	--	-0.15	-0.08	-0.13	-0.07	0.04	0.02
ESS	--	--	--	--	--	--	0.03	0.06	-0.03	-0.05
Experience	--	--	--	--	--	--	--	--	0.00	-0.28
R^2	0.04		0.04		0.05		0.05		0.10	
F	1.00		0.66		0.56		0.47		0.87	
ΔR^2	0.04		0.00		0.01		0.00		0.06	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C25. Airspeed Regressions Right Standard Rate Turn (Maneuver Six)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.40	--	-0.72	--	1.05	--	-2.44	--	-2.07	--
Subject	0.02	0.15	0.02	0.15	0.01	0.14	0.01	0.10	0.01	0.12
Workload	0.96	0.22	0.96	0.22	0.96	0.22	0.97	0.23	1.00	0.23
MEQ	--	--	0.02	0.09	0.01	0.06	0.04	0.17	0.03	0.16
Sleep Qual.	--	--	--	--	-0.51	-0.19	-0.33	-0.12	-0.17	-0.06
ESS	--	--	--	--	--	--	0.22	0.31^{*}	0.17	0.24
Experience	--	--	--	--	--	--	--	--	0.00	-0.18
R^2	0.07		0.08		0.11		0.20		0.22	
F	1.85		1.36		1.47		2.23		2.08	
ΔR^2	0.07		0.01		0.03		0.08		0.02	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C26. Airspeed Regressions Straight and Level (Maneuver Seven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-2.14	--	-0.19	--	3.37	--	1.65	--	2.16	--
Subject	0.04	0.19	0.04	0.20	0.04	0.18	0.04	0.17	0.04	0.18
Workload	2.10	0.24	2.10	0.24	2.10	0.24	2.10	0.24	2.14	0.24
MEQ	--	--	-0.03	-0.08	-0.05	-0.11	-0.04	-0.08	-0.04	-0.09
Sleep Qual.	--	--	--	--	-1.01	-0.18	-0.93	-0.17	-0.72	-0.12
ESS	--	--	--	--	--	--	0.11	0.08	0.04	0.03
Experience	--	--	--	--	--	--	--	--	0.00	-0.12
R^2	0.09		0.10		0.13		0.13		0.14	
F	2.42		1.70		1.72		1.41		1.25	
ΔR^2	0.09		0.01		0.03		0.01		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C27. Airspeed Regressions Straight Climb

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-2.29	--	-3.42	--	-4.01	--	-5.54	--	-4.99	--
Subject	0.02	0.16	0.02	0.16	0.02	0.16	0.02	0.15	0.02	0.17
Workload	3.39	$0.57^{\ddagger}$	3.39	$0.57^{\ddagger}$	3.39	$0.57^{\ddagger}$	3.40	$0.57^{\ddagger}$	3.44	$0.58^{\ddagger}$
MEQ	--	--	0.02	0.07	0.02	0.08	0.03	0.11	0.03	0.11
Sleep Qual.	--	--	--	--	0.17	0.05	0.25	0.07	0.47	0.13
ESS	--	--	--	--	--	--	0.10	0.10	0.02	0.02
Experience	--	--	--	--	--	--	--	--	0.00	-0.19
R^2	0.35		0.35		0.35		0.36		0.39	
F	$13.01^{\ddagger}$		$8.67^{\ddagger}$		$6.42^{\ddagger}$		$5.22^{\ddagger}$		$4.74^{\ddagger}$	
ΔR^2	0.35		0.00		0.00		0.01		0.03	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C28. Airspeed Regressions Straight and Level (Maneuver Nine)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.30	--	0.25	--	1.11	--	0.21	--	0.35	--
Subject	0.01	0.10	0.01	0.10	0.01	0.09	0.01	0.08	0.01	0.08
Workload	1.01	0.36†	1.01	0.36†	1.01	0.36†	1.01	0.37†	1.02	0.37†
MEQ	--	--	-0.01	-0.07	-0.01	-0.09	-0.01	-0.05	-0.01	-0.05
Sleep Qual.	--	--	--	--	-0.25	-0.14	-0.20	-0.12	-0.14	-0.08
ESS	--	--	--	--	--	--	0.06	0.13	0.04	0.08
Experience	--	--	--	--	--	--	--	--	0.00	-0.11
R^2	0.14		0.14		0.16		0.18		0.19	
F	3.96 *		2.69		2.29		1.97		1.70	
ΔR^2	0.14		0.01		0.02		0.01		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C29. Airspeed Regressions Left 433 Degree Descending Standard Rate Turn

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.87	--	-0.83	--	1.46	--	-3.43	--	-2.77	--
Subject	-0.01	-0.05	-0.01	-0.05	-0.01	-0.06	-0.02	-0.09	-0.01	-0.08
Workload	1.94	0.28*	1.95	0.28*	1.94	0.28*	1.96	0.28*	2.01	0.29*
MEQ	--	--	0.03	0.09	0.02	0.06	0.05	0.16	0.05	0.15
Sleep Qual.	--	--	--	--	-0.65	-0.15	-0.40	-0.09	-0.13	-0.03
ESS	--	--	--	--	--	--	0.31	0.27	0.22	0.19
Experience	--	--	--	--	--	--	--	--	0.00	0.00
R^2	0.08		0.09		0.11		0.18		0.20	
F	2.20		1.58		1.48		1.96		1.90	
ΔR^2	0.08		0.01		0.02		0.06		0.03	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C30. Airspeed Regressions Straight and Level (Maneuver Eleven)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.36	--	-1.19	--	0.15	--	-3.08	--	-3.14	--
Subject	0.01	0.18	0.01	0.17	0.01	0.16	0.01	0.11	0.01	0.11
Workload	0.88	0.30*	0.88	0.30*	0.87	0.30*	0.89	0.30*	0.88	0.30*
MEQ	--	--	0.01	0.10	0.01	0.06	0.03	0.21	0.03	0.21
Sleep Qual.	--	--	--	--	-0.38	-0.21	-0.22	-0.12	-0.24	-0.13
ESS	--	--	--	--	--	--	0.21	0.43†	0.21	0.44†
Experience	--	--	--	--	--	--	--	--	0.00	0.04
R^2	0.12		0.13		0.17		0.32		0.32	
F	3.20*		2.29		2.35		4.36†		3.57†	
ΔR^2										

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C31. Airspeed Regressions Straight Descent

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-2.19	--	-1.78	--	7.29	--	-2.99	--	-3.03	--
Subject	0.04	0.10	0.04	0.10	0.03	0.08	0.02	0.06	0.02	0.06
Workload	3.60	0.22	3.60	0.22	3.59	0.22	3.63	0.23	3.62	0.23
MEQ	--	--	-0.01	-0.01	-0.04	-0.06	0.03	0.03	0.03	0.03
Sleep Qual.	--	--	--	--	-2.59	-0.26	-2.06	-0.20	-2.08	-0.20
ESS	--	--	--	--	--	--	0.65	0.25	0.66	0.25
Experience	--	--	--	--	--	--	--	--	0.00	0.01
R^2	0.06		0.06		0.12		0.17		0.17	
F	1.52		0.99		1.62		1.92		1.57	
ΔR^2	0.06		0.00		0.06		0.05		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C32. Rate of Climb/Descent Descriptive Statistics

Maneuver	**Minimum**		**Maximum**		**Mean**		**Std. Error**		**Std. Deviation**	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
2 Takeoff (Climb)	358.13	302.92	765.94	809.15	566.28	542.00	21.30	22.58	108.63	117.30
8 Straight Climb	262.08	245.45	633.16	733.74	454.70	480.17	15.97	21.58	81.44	112.16
12 Straight Descent	-1181.55	-815.98	-351.16	-234.85	-503.99	-471.74	30.70	23.57	156.54	122.45

Table C33. Climb Rate Regressions Takeoff

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	637.41	--	627.54	--	454.56	--	577.59	--	530.50	--
Subject	0.32	0.03	0.32	0.03	0.47	0.04	0.58	0.05	0.41	0.04
Workload	-79.31	-0.18	-79.40	-0.18	-85.54	-0.20	-87.87	-0.20	-95.77	-0.22
MEQ	--	--	0.17	0.01	0.90	0.04	0.10	0.01	0.24	0.01
Sleep Qual.	--	--	--	--	52.00	0.19	45.92	0.17	24.82	0.09
ESS	--	--	--	--	--	--	-7.64	-0.11	-0.56	-0.01
Experience	--	--	--	--	--	--	--	--	0.05	0.25
R^2	0.03		0.03		0.07		0.08		0.12	
F	0.85		0.56		0.85		0.77		1.01	
ΔR^2	0.03		0.00		0.03		0.01		0.04	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C34. Climb Rate Regressions Straight Climb

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	391.66	--	370.34	--	307.34	--	252.54	--	290.33	--
Subject	0.96	0.20	0.95	0.20	1.01	0.21	0.95	0.20	1.10	0.23
Workload	28.35	0.15	28.14	0.14	25.90	0.13	26.94	0.14	33.28	0.17
MEQ	--	--	0.37	0.04	0.64	0.07	0.99	0.10	0.88	0.09
Sleep Qual.	--	--	--	--	18.94	0.15	21.64	0.18	38.58	0.31*
ESS	--	--	--	--	--	--	3.40	0.11	-2.28	-0.07
Experience	--	--	--	--	--	--	--	--	-0.04	-0.44 †
R^2	0.06		0.06		0.09		0.10		0.23	
F	1.60		1.07		1.09		0.96		2.24	
ΔR^2	0.06		0.00		0.02		0.01		0.14	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C35. Climb Rate Regressions Straight Descent

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-568.94	--	-537.34	--	-480.50	--	-561.10	--	-559.46	--
Subject	-0.58	-0.06	-0.56	-0.06	-0.61	-0.06	-0.69	-0.07	-0.68	-0.07
Workload	84.44	0.21	84.75	0.21	86.77	0.22	88.29	0.22	88.57	0.22
MEQ	--	--	-0.55	-0.03	-0.79	-0.04	-0.26	-0.01	-0.27	-0.01
Sleep Qual.	--	--	--	--	-17.09	-0.07	-13.11	-0.05	-12.37	-0.05
ESS	--	--	--	--	--	--	5.01	0.08	4.76	0.07
Experience	--	--	--	--	--	--	--	--	0.00	-0.01
R^2	0.05		0.05		0.05		0.06		0.06	
F	1.25		0.83		0.67		0.57		0.47	
ΔR^2	0.05		0.00		0.00		0.01		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C36. Turn Rate Descriptive Statistics

Maneuver	**Minimum**		**Maximum**		**Mean**		**Std. Error**		**Std. Deviation**	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
4 Right Turn	.31	.16	3.14	2.53	1.53	1.63	0.11	0.12	0.58	0.59
6 Right Turn	2.13	1.49	4.28	3.71	2.76	2.68	0.10	0.10	0.51	0.49
10 Left Descend. Turn	1.68	1.64	4.57	3.66	2.77	2.74	0.12	0.11	0.62	0.56

Table C37. Turn Rate Regressions Right Standard Rate Turn (Maneuver Four)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	1.32	--	1.89	--	1.62	--	2.90	--	2.81	--
Subject	0.00	0.12	0.00	0.13	0.00	0.13	0.01	0.17	0.00	0.16
Workload	0.10	0.09	0.11	0.10	0.11	0.10	0.10	0.09	0.10	0.09
MEQ	--	--	-0.01	-0.18	-0.01	-0.16	-0.02	-0.31*	-0.02	-0.31*
Sleep Qual.	--	--	--	--	0.08	0.11	0.00	0.00	-0.04	-0.06
ESS	--	--	--	--	--	--	-0.08	-0.42†	-0.07	-0.35*
Experience	--	--	--	--	--	--	--	--	0.00	0.16
R^2	0.02		0.05		0.07		0.21		0.23	
F	0.57		0.96		0.87		2.58*		2.30	
ΔR^2	0.02		0.03		0.01		0.15		0.02	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C38. Turn Rate Regressions Right Standard Rate Turn (Maneuver Six)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.91	--	2.90	--	2.55	--	3.36	--	3.45	--
Subject	0.00	-0.03	0.00	-0.03	0.00	-0.02	0.00	0.01	0.00	0.02
Workload	-0.12	-0.12	-0.12	-0.12	-0.12	-0.12	-0.13	-0.13	-0.12	-0.13
MEQ	--	--	0.00	0.00	0.00	0.03	0.00	-0.08	0.00	-0.09
Sleep Qual.	--	--	--	--	0.10	0.17	0.05	0.08	0.09	0.16
ESS	--	--	--	--	--	--	-0.05	-0.31*	-0.06	-0.39*
Experience	--	--	--	--	--	--	--	--	0.00	-0.20
R^2	0.02		0.02		0.04		0.12		0.14	
F	0.41		0.27		0.54		1.30		1.32	
ΔR^2	0.02		0.00		0.03		0.08		0.03	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C39. Turn Rate Regressions Left 433 Degree Descending Standard Rate Turn (Maneuver Ten)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.69	--	2.56	--	1.60	--	2.39	--	2.54	--
Subject	0.00	0.11	0.00	0.11	0.00	0.13	0.00	0.15	0.01	0.17
Workload	-0.03	-0.03	-0.03	-0.03	-0.04	-0.04	-0.04	-0.04	-0.05	-0.04
MEQ	--	--	0.00	0.04	0.01	0.10	0.00	0.02	0.00	0.00
Sleep Qual.	--	--	--	--	0.29	$0.40^{\dagger}$	0.23	0.33^{*}	0.31	$0.44^{\dagger}$
ESS	--	--	--	--	--	--	-0.05	-0.26	-0.07	-0.36^{*}
Experience	--	--	--	--	--	--	--	--	0.00	-0.26
R^2	0.01		0.02		0.17		0.23		0.27	
F	0.34		0.25		2.48		2.75^{*}		2.80^{*}	
ΔR^2	0.01		0.00		0.16		0.06		0.04	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C40. Trim Descriptive Statistics

Maneuver	Minimum		Maximum		Mean		Std. Error		Std. Deviation	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
2 Takeoff	0.02	0.01	0.36	0.93	0.11	0.25	0.02	0.04	0.10	0.23
3 Straight & Level Accel.	0.00	0.00	0.29	0.66	0.08	0.28	0.01	0.04	0.07	0.19
4 Right Turn	0.00	0.01	0.98	1.19	0.07	0.67	0.04	0.06	0.20	0.32
5 Straight & Level	0.00	0.01	0.24	0.61	0.07	0.22	0.01	0.04	0.07	0.18
6 Right Turn	0.00	0.00	0.88	1.54	0.04	0.68	0.03	0.09	0.18	0.45
7 Straight & Level	0.00	0.00	0.20	0.99	0.06	0.17	0.01	0.04	0.05	0.22
8 Straight Climb	0.00	0.01	0.21	0.78	0.05	0.17	0.01	0.03	0.05	0.17
9 Straight & Level	0.00	0.00	0.25	0.46	0.06	0.15	0.01	0.02	0.06	0.12
10 Left Descend. Turn	0.00	0.00	0.57	1.65	0.04	0.58	0.02	0.09	0.12	0.47
11 Straight & Level	0.00	0.00	0.33	0.45	0.07	0.11	0.02	0.02	0.09	0.11
12 Straight Descent	0.00	0.01	0.36	0.80	0.10	0.22	0.02	0.04	0.10	0.20
13 Straight & Level Decel.	0.01	0.06	0.45	0.78	0.10	0.28	0.02	0.04	0.11	0.21

*trimmed mean

Table C41. Trim Regressions Takeoff

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.02	--	-0.12	--	-0.06	--	-0.20	--	-0.20	--
Subject	0.00	-0.04	0.00	-0.04	0.00	-0.05	0.00	-0.06	0.00	-0.06
Workload	0.14	0.37 †	0.14	0.36 †	0.14	0.37 †	0.15	0.38 †	0.15	0.38 †
MEQ	--	--	0.00	0.09	0.00	0.08	0.00	0.13	0.00	0.13
Sleep Qual.	--	--	--	--	-0.02	-0.08	-0.01	-0.05	-0.01	-0.05
ESS	--	--	--	--	--	--	0.01	0.14	0.01	0.14
Experience	--	--	--	--	--	--	--	--	0.00	-0.01
R^2	0.14		0.14		0.15		0.17		0.17	
F	3.85*		2.70		2.09		1.86		1.52	
ΔR^2	0.14		0.01		0.01		0.02		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C42. Trim Regressions Straight & Level Acceleration (Maneuver Three)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.18	--	-0.19	--	-0.18	--	-0.27	--	-0.31	--
Subject	0.00	0.14	0.00	0.13	0.00	0.13	0.00	0.12	0.00	0.11
Workload	0.21	0.60‡	0.21	0.60‡	0.21	0.60‡	0.21	0.60‡	0.21	0.59‡
MEQ	--	--	0.00	0.01	0.00	0.01	0.00	0.04	0.00	0.05
Sleep Qual.	--	--	--	--	0.00	-0.02	0.00	0.00	-0.02	-0.07
ESS	--	--	--	--	--	--	0.01	0.10	0.01	0.20
Experience	--	--	--	--	--	--	--	--	0.00	0.23
R^2	0.37		0.37		0.38		0.38		0.42	
F	14.66‡		9.58‡		7.04‡		5.73‡		5.45‡	
ΔR^2	0.37		0.00		0.00		0.01		0.04	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C43. Trim Regressions Right Standard Rate Turn (Maneuver Four)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.56	--	-0.20	--	-0.25	--	-0.22	--	-0.33	--
Subject	0.00	0.05	0.00	0.05	0.00	0.06	0.00	0.06	0.00	0.04
Workload	0.60	0.75‡	0.60	0.75‡	0.60	0.75‡	0.60	0.75‡	0.58	0.73‡
MEQ	--	--	-0.01	-0.16	-0.01	-0.15	-0.01	-0.16	-0.01	-0.15
Sleep Qual.	--	--	--	--	0.01	0.03	0.01	0.03	-0.03	-0.06
ESS	--	--	--	--	--	--	0.00	-0.01	0.02	0.10
Experience	--	--	--	--	--	--	--	--	0.00	0.29†
R^2	0.56		0.59		0.59		0.59		0.65	
F	31.39‡		22.68‡		16.70‡		13.09‡		13.61‡	
ΔR^2	0.56		0.03		0.00		0.00		0.06	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table C44. Trim Regressions Straight and Level (Maneuver Five)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.12	--	-0.13	--	-0.02	--	-0.14	--	-0.17	--
Subject	0.00	0.17	0.00	0.17	0.00	0.16	0.00	0.14	0.00	0.13
Workload	0.15	0.48‡	0.15	0.48‡	0.16	0.49‡	0.16	0.50‡	0.15	0.48‡
MEQ	--	--	0.00	0.01	0.00	-0.02	0.00	0.03	0.00	0.04
Sleep Qual.	--	--	--	--	-0.04	-0.17	-0.03	-0.14	-0.04	-0.21
ESS	--	--	--	--	--	--	0.01	0.14	0.01	0.23
Experience	--	--	--	--	--	--	--	--	0.00	0.22
R^2	0.26		0.26		0.28		0.30		0.34	
F	8.41 †		5.49 †		4.67 †		3.96 †		3.79 †	
ΔR^2	0.26		0.00		0.03		0.02		0.03	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table C45. Trim Regressions Right Standard Rate Turn (Maneuver Six)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.63	--	-0.51	--	-0.57	--	-.078	--	-0.85	--
Subject	0.00	0.07	0.00	0.07	0.00	0.07	0.00	0.06	0.00	0.05
Workload	0.63	$0.68^{‡}$	0.63	$0.68^{‡}$	0.63	$0.68^{‡}$	0.63	$0.69^{‡}$	0.62	$0.67^{‡}$
MEQ	--	--	0.00	-0.05	0.00	-0.04	0.00	-0.01	0.00	-0.01
Sleep Qual.	--	--	--	--	0.02	0.03	0.03	0.05	0.00	-0.01
ESS	--	--	--	--	--	--	0.01	0.08	0.02	0.16
Experience	--	--	--	--	--	--	--	--	0.00	0.18
R^2	0.47		0.47		0.47		0.48		0.50	
F	$21.67^{‡}$		$14.28^{‡}$		$10.53^{‡}$		$8.45^{‡}$		$7.54^{‡}$	
ΔR^2	0.47		0.00		0.00		0.01		0.02	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{†}p < 0.01$, $^{‡}p < 0.001$

Table C46. Trim Regressions Straight and Level (Maneuver Seven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.11	--	-0.19	--	-0.31	--	-0.32	--	-0.36	--
Subject	0.00	0.16	0.00	0.16	0.00	0.17	0.00	0.17	0.00	0.15
Workload	0.12	0.34^{*}	0.12	0.34^{*}	0.11	0.33^{*}	0.11	0.33^{*}	0.11	0.31^{*}
MEQ	--	--	0.00	0.08	0.00	0.11	0.00	0.12	0.00	0.12
Sleep Qual.	--	--	--	--	0.04	0.18	0.04	0.18	0.02	0.10
ESS	--	--	--	--	--	--	0.00	0.01	0.01	0.11
Experience	--	--	--	--	--	--	--	--	0.00	0.26
R^2	0.15		0.15		0.18		0.18		0.23	
F	4.16^{*}		2.86^{*}		2.59^{*}		2.03		2.20	
ΔR^2	0.15		0.01		0.03		0.00		0.05	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{†}p < 0.01$, $^{‡}p < 0.001$

Table C47. Trim Regressions Straight Climb

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.08	--	-0.08	--	-0.17	--	-0.17	--	-0.19	--
Subject	0.00	0.12	0.00	0.12	0.00	0.13	0.00	0.13	0.00	0.12
Workload	0.11	$0.42^{†}$	0.11	$0.42^{†}$	0.11	$0.41^{†}$	0.11	$0.41^{†}$	0.10	$0.39^{†}$
MEQ	--	--	0.00	-0.01	0.00	0.02	0.00	0.02	0.00	0.03
Sleep Qual.	--	--	--	--	0.03	0.15	0.03	0.02	0.02	0.09
ESS	--	--	--	--	--	--	0.00	0.00	0.00	0.09
Experience	--	--	--	--	--	--	--	--	0.00	0.21
R^2	0.19		0.19		0.21		0.21		0.24	
F	$5.66^{†}$		3.70^{*}		3.13^{*}		2.45^{*}		2.39^{*}	
ΔR^2	0.19		0.00		0.02		0.00		0.03	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{†}p < 0.01$, $^{‡}p < 0.001$

Table C48. Trim Regressions Straight and Level (Maneuver Nine)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.05	--	-0.10	--	-0.12	--	-0.12	--	-0.15	--
Subject	0.00	0.15	0.00	0.14	0.00	0.15	0.00	0.15	0.00	0.12
Workload	0.09	$0.42^{\dagger}$	0.09	$0.42^{\dagger}$	0.08	$0.41^{\dagger}$	0.08	$0.42^{\dagger}$	0.08	$0.39^{\dagger}$
MEQ	--	--	0.00	0.09	0.00	0.09	0.00	0.10	0.00	0.11
Sleep Qual.	--	--	--	--	0.01	0.05	0.01	0.05	-0.01	-0.06
ESS	--	--	--	--	--	--	0.00	0.01	0.01	0.15
Experience	--	--	--	--	--	--	--	--	0.00	0.34^{*}
R^2	0.20		0.21		0.21		0.21		0.29	
F	$6.09^{\dagger}$		4.16^{*}		3.09^{*}		2.42^{*}		3.03^{*}	
ΔR^2	0.20		0.01		0.00		0.00		0.08	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C49. Trim Regressions Left 433 Degree Descending Standard Rate Turn

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.59	--	-0.66	--	-0.88	--	-0.88	--	-0.93	--
Subject	0.00	0.13	0.00	0.13	0.00	0.14	0.00	0.14	0.00	0.13
Workload	0.54	$0.62^{\ddagger}$	0.54	$0.62^{\ddagger}$	0.53	$0.61^{\ddagger}$	0.53	$0.61^{\ddagger}$	0.52	$0.60^{\ddagger}$
MEQ	--	--	0.00	0.03	0.00	0.05	0.00	0.05	0.00	0.05
Sleep Qual.	--	--	--	--	0.07	0.12	0.07	0.12	0.04	0.08
ESS	--	--	--	--	--	--	0.00	0.00	0.01	0.06
Experience	--	--	--	--	--	--	--	--	0.00	0.13
R^2	0.40		0.41		0.42		0.42		0.43	
F	$16.61^{\ddagger}$		$10.88^{\ddagger}$		$8.44^{\ddagger}$		$6.61^{\ddagger}$		$5.66^{\ddagger}$	
ΔR^2	0.40		0.00		0.01		0.00		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table C50. Trim Regressions Straight and Level (Maneuver Eleven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.04	--	0.15	--	0.19	--	0.16	--	0.13	--
Subject	0.00	-0.04	0.00	-0.03	0.00	-0.04	0.00	-0.04	0.00	-0.06
Workload	0.04	0.17	0.04	0.18	0.04	0.19	0.04	0.19	0.03	0.17
MEQ	--	--	0.00	-0.19	0.00	-0.20	0.00	-0.18	0.00	-0.17
Sleep Qual.	--	--	--	--	-0.01	-0.10	-0.01	-0.09	-0.02	-0.18
ESS	--	--	--	--	--	--	0.00	0.07	0.01	0.19
Experience	--	--	--	--	--	--	--	--	0.00	0.29
R^2	0.03		0.07		0.08		0.08		0.14	
F	0.79		1.12		0.96		0.80		1.19	
ΔR^2	0.03		0.03		0.01		0.00		0.06	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C51. Trim Regressions Straight Descent

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.01	--	-0.12	--	0.05	--	0.11	--	0.12	--
Subject	0.00	-0.01	0.00	-0.01	0.00	-0.03	0.00	-0.02	0.00	-0.02
Workload	0.13	0.34^*	0.11	0.33^*	0.12	0.35^*	0.12	0.35^*	0.12	0.36^*
MEQ	--	--	0.00	0.11	0.00	0.07	0.00	0.05	0.00	0.05
Sleep Qual.	--	--	--	--	-0.05	-0.23	-0.05	-0.24	-0.05	-0.21
ESS	--	--	--	--	--	--	0.00	-0.07	-0.01	-0.11
Experience	--	--	--	--	--	--	--	--	0.00	-0.10
R^2	0.11		0.13		0.18		0.18		0.19	
F	3.15		2.33		2.53		2.03		1.73	
ΔR^2	0.11		0.01		0.05		0.00		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table C52. Trim Regressions Straight and Level Deceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.11	--	-0.04	--	0.07	--	-0.08	--	-0.10	--
Subject	0.00	0.10	0.00	0.10	0.00	0.09	0.00	0.07	0.00	0.07
Workload	0.18	$0.47^{‡}$	0.18	$0.47^{‡}$	0.18	$0.48^{‡}$	0.19	$0.49^{‡}$	0.18	$0.48^{‡}$
MEQ	--	--	0.00	-0.07	0.00	-0.09	0.00	-0.04	0.00	-0.03
Sleep Qual.	--	--	--	--	-0.03	-0.13	-0.03	-0.10	-0.03	-0.14
ESS	--	--	--	--	--	--	0.01	0.15	0.01	0.20
Experience	--	--	--	--	--	--	--	--	0.00	0.11
R^2	0.23		0.24		0.25		0.27		0.28	
F	$7.33^{†}$		$4.91^{†}$		$3.96^{†}$		3.42^{*}		2.91^{*}	
ΔR^2	0.23		0.00		0.02		0.02		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{†}p < 0.01$, $^{‡}p < 0.001$

Appendix D. Psychophysiological Data Tables

Table D1. EEG Workload Descriptive Statistics

Maneuver	Minimum		Maximum		Mean		Std. Error		Std. Deviation	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
1 Hover	0.52	0.56	0.85	0.85	0.71	0.72	0.02	0.02	0.09	0.09
2 Takeoff	0.48	0.55	0.84	0.84	0.70	0.71	0.02	0.02	0.09	0.08
3 Straight & Level Accel.	0.48	0.52	0.82	0.81	0.68	0.70	0.02	0.02	0.09	0.09
4 Right Turn	0.51	0.53	0.83	0.83	0.69	0.71	0.02	0.02	0.10	0.09
5 Straight & Level	0.43	0.47	0.82	0.81	0.66	0.67	0.02	0.02	0.10	0.10
6 Right Turn	0.49	0.48	0.83	0.81	0.67	0.68	0.02	0.02	0.09	0.10
7 Straight & Level	0.49	0.47	0.80	0.81	0.67	0.67	0.02	0.02	0.10	0.11
8 Straight Climb	0.51	0.46	0.81	0.84	0.66	0.67	0.02	0.02	0.09	0.11
9 Straight & Level	0.46	0.47	0.82	0.81	0.68	0.67	0.02	0.02	0.09	0.10
10 Left Descend. Turn	0.45	0.49	0.83	0.83	0.68	0.69	0.02	0.02	0.10	0.10
11 Straight & Level	0.47	0.45	0.82	0.82	0.67	0.67	0.02	0.02	0.10	0.11
12 Straight Descent	0.49	0.50	0.84	0.83	0.69	0.69	0.02	0.02	0.09	0.10
13 Straight & Level Decel.	0.53	0.53	0.83	0.81	0.70	0.69	0.02	0.02	0.08	0.09
14 Landing	0.59	0.59	0.85	0.85	0.72	0.73	0.02	0.02	0.08	0.08

Table D2. EEG Workload Stationary Hover Power Check

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.66	--	0.69	--	0.61	--	0.78	--	0.78	--
Subject	0.00	0.28^*	0.00	0.28^*	0.00	0.27^*	0.00	0.30^*	0.00	0.30^*
Workload	0.01	0.06	0.01	0.06	0.01	0.07	0.01	0.06	0.01	0.07
MEQ	--	--	0.00	-0.06	0.00	-0.03	0.00	-0.15	0.00	-0.15
Sleep Qual.	--	--	--	--	0.03	0.22	0.01	0.12	0.02	0.16
ESS	--	--	--	--	--	--	-0.01	-0.35^*	-0.01	-0.39^*
Experience	--	--	--	--	--	--	--	--	0.00	-0.11
R^2	0.08		0.09		0.13		0.23		0.24	
F	2.26		1.56		1.83		2.88^*		2.45^*	
ΔR^2	0.08		0.00		0.05		0.10		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D3. EEG Workload Takeoff

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.65	--	0.69	--	0.61	--	0.73	--	0.74	--
Subject	0.00	0.23	0.00	0.24	0.00	0.23	0.00	0.25	0.00	0.25
Workload	0.02	0.09	0.02	0.09	0.02	0.10	0.02	0.09	0.02	0.10
MEQ	--	--	0.00	-0.08	0.00	-0.05	0.00	-0.14	0.00	-0.14
Sleep Qual.	--	--	--	--	0.02	0.20	0.02	0.13	0.02	0.16
ESS	--	--	--	--	--	--	-0.01	-0.26	-0.01	-0.29
Experience	--	--	--	--	--	--	--	--	0.00	-0.09
R^2	0.06		0.07		0.11		0.17		0.17	
F	1.74		1.26		1.50		1.90		1.60	
ΔR^2	0.06		0.01		0.04		0.06		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D4. EEG Workload Straight & Level Acceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.63	--	0.70	--	0.64	--	0.75	--	0.76	--
Subject	0.00	0.21	0.00	0.22	0.00	0.21	0.00	0.23	0.00	0.23
Workload	0.02	0.11	0.02	0.11	0.02	0.12	0.02	0.11	0.02	0.11
MEQ	--	--	0.00	-0.14	0.00	-0.11	0.00	-0.19	0.00	-0.20
Sleep Qual.	--	--	--	--	0.02	0.16	0.01	0.09	0.02	0.13
ESS	--	--	--	--	--	--	-0.01	-0.24	-0.01	-0.29
Experience	--	--	--	--	--	--	--	--	0.00	-0.12
R^2	0.06		0.08		0.10		0.15		0.16	
F	1.60		1.40		1.37		1.67		1.45	
ΔR^2	0.06		0.02		0.02		0.05		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D5. EEG Workload Right Standard Rate Turn (Maneuver Four)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.65	--	0.67	--	0.62	--	0.77	--	0.78	--
Subject	0.00	0.24	0.00	0.25	0.00	0.24	0.00	0.26	0.00	0.27
Workload	0.01	0.05	0.01	0.05	0.01	0.06	0.01	0.05	0.01	0.05
MEQ	--	--	0.00	-0.05	0.00	-0.02	0.00	-0.13	0.00	-0.14
Sleep Qual.	--	--	--	--	0.02	0.13	0.01	0.04	0.01	0.09
ESS	--	--	--	--	--	--	-0.01	-0.31^*	-0.01	-0.36^*
Experience	--	--	--	--	--	--	--	--	0.00	-0.12
R^2	0.06		0.07		0.08		0.16		0.17	
F	1.71		1.16		1.07		1.82		1.58	
ΔR^2	0.06		0.00		0.02		0.08		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D6. EEG Workload Straight and Level (Maneuver Five)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.63	--	0.70	--	0.64	--	0.83	--	0.84	--
Subject	0.00	0.13	0.00	0.13	0.00	0.13	0.00	0.15	0.00	0.16
Workload	0.01	0.07	0.01	0.07	0.02	0.07	0.01	0.07	0.01	0.07
MEQ	--	--	0.00	-0.12	0.00	-0.10	0.00	-0.23	0.00	-0.23
Sleep Qual.	--	--	--	--	0.02	0.14	0.01	0.04	0.01	0.08
ESS	--	--	--	--	--	--	-0.01	-0.36*	-0.01	-0.41*
Experience	--	--	--	--	--	--	--	--	0.00	-0.11
R^2	0.02		0.04		0.05		0.16		0.17	
F	0.55		0.63		0.70		1.86		1.60	
ΔR^2	0.02		0.02		0.02		0.11		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D7. EEG Workload Right Standard Rate Turn (Maneuver Six)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.63	--	0.69	--	0.62	--	0.75	--	0.76	--
Subject	0.00	0.17	0.00	0.17	0.00	0.17	0.00	0.19	0.00	0.19
Workload	0.01	0.06	0.01	0.06	0.01	0.07	0.01	0.07	0.01	0.07
MEQ	--	--	0.00	-0.10	0.00	-0.08	0.00	-0.17	0.00	-0.17
Sleep Qual.	--	--	--	--	0.02	0.15	0.01	0.08	0.01	0.11
ESS	--	--	--	--	--	--	-0.01	-0.26	-0.01	-0.29
Experience	--	--	--	--	--	--	--	--	0.00	-0.06
R^2	0.03		0.04		0.07		0.12		0.13	
F	0.88		0.76		0.88		1.35		1.13	
ΔR^2	0.03		0.01		0.02		0.06		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D8. EEG Workload Straight and Level (Maneuver Seven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.64	--	0.72	--	0.65	--	0.84	--	0.85	--
Subject	0.00	0.10	0.00	0.11	0.00	0.10	0.00	0.13	0.00	0.13
Workload	0.01	0.03	0.01	0.03	0.01	0.04	0.01	0.03	0.01	0.03
MEQ	--	--	0.00	-0.13	0.00	-0.11	0.00	-0.23	0.00	-0.23
Sleep Qual.	--	--	--	--	0.02	0.15	0.01	0.05	0.01	0.09
ESS	--	--	--	--	--	--	-0.01	-0.35^{*}	-0.01	-0.40^{*}
Experience	--	--	--	--	--	--	--	--	0.00	-0.10
R^2	0.01		0.03		0.05		0.15		0.16	
F	0.30		0.50		0.65		1.73		1.49	
ΔR^2	0.01		0.02		0.02		0.10		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D9. EEG Workload Straight Climb

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.64	--	0.69	--	0.61	--	0.79	--	0.80	--
Subject	0.00	0.11	0.00	0.11	0.00	0.10	0.00	0.13	0.00	0.13
Workload	0.00	0.02	0.00	0.02	0.01	0.02	0.00	0.02	0.00	0.02
MEQ	--	--	0.00	-0.07	0.00	-0.05	0.00	-0.17	0.00	-0.17
Sleep Qual.	--	--	--	--	0.02	0.17	0.01	0.08	0.02	0.12
ESS	--	--	--	--	--	--	-0.01	-0.34^{*}	-0.01	-0.39^{*}
Experience	--	--	--	--	--	--	--	--	0.00	-0.12
R^2	0.01		0.02		0.05		0.14		0.15	
F	0.30		0.29		0.58		1.58		1.38	
ΔR^2	0.01		0.01		0.03		0.10		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D10. EEG Workload Straight and Level (Maneuver Nine)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.66	--	0.75	--	0.71	--	0.88	--	0.89	--
Subject	0.00	0.13	0.00	0.13	0.00	0.13	0.00	0.15	0.00	0.16
Workload	-0.01	-0.03	-0.01	-0.03	0.00	-0.02	-0.01	-0.03	-0.01	-0.03
MEQ	--	--	0.00	-0.17	0.00	-0.15	0.00	-0.27	0.00	-0.28
Sleep Qual.	--	--	--	--	0.02	0.12	0.00	0.03	0.01	0.08
ESS	--	--	--	--	--	--	-0.01	-0.34^{*}	-0.01	-0.39^{*}
Experience	--	--	--	--	--	--	--	--	0.00	-0.13
R^2	0.02		0.05		0.06		0.16		0.17	
F	0.42		0.81		0.79		1.76		1.55	
ΔR^2	0.02		0.03		0.01		0.10		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D11. EEG Workload Left 433 Degree Descending Standard Rate Turn

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.64	--	0.67	--	0.61	--	0.71	--	0.72	--
Subject	0.00	0.23	0.00	0.23	0.00	0.22	0.00	0.24	0.00	0.24
Workload	0.01	0.05	0.01	0.05	0.01	0.05	0.01	0.05	0.01	0.05
MEQ	--	--	0.00	-0.05	0.00	-0.03	0.00	-0.10	0.00	-0.10
Sleep Qual.	--	--	--	--	0.02	0.14	0.01	0.09	0.02	0.12
ESS	--	--	--	--	--	--	-0.01	-0.20	-0.01	-0.24
Experience	--	--	--	--	--	--	--	--	0.00	-0.09
R^2	0.05		0.06		0.08		0.11		0.11	
F	1.45		0.99		1.00		1.18		1.01	
ΔR^2	0.05		0.00		0.02		0.03		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D12. EEG Workload Straight and Level (Maneuver Eleven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.65	--	0.75	--	0.70	--	0.91	--	0.92	--
Subject	0.00	0.09	0.00	0.10	0.00	0.09	0.00	0.12	0.00	0.13
Workload	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
MEQ	--	--	0.00	-0.17	0.00	-0.15	0.00	-0.29^{*}	0.00	-0.29^{*}
Sleep Qual.	--	--	--	--	0.02	0.12	0.00	0.01	0.01	0.05
ESS	--	--	--	--	--	--	-0.01	$-0.39^{\dagger}$	-0.01	-0.43^{*}
Experience	--	--	--	--	--	--	--	--	0.00	-0.09
R^2	0.01		0.04		0.05		0.18		0.18	
F	0.22		0.65		0.66		2.07		1.75	
ΔR^2	0.01		0.03		0.01		0.13		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D13. EEG Workload Straight Descent

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.68	--	0.72	--	0.67	--	0.81	--	0.83	--
Subject	0.00	0.19	0.00	0.19	0.00	0.19	0.00	0.21	0.00	0.22
Workload	-0.01	-0.05	-0.01	-0.05	-0.01	-0.05	-0.01	-0.06	-0.01	-0.05
MEQ	--	--	0.00	-0.09	0.00	-0.07	0.00	-0.17	0.00	-0.17
Sleep Qual.	--	--	--	--	0.01	0.12	0.01	0.04	0.01	0.11
ESS	--	--	--	--	--	--	-0.01	-0.28	-0.01	-0.36^{*}
Experience	--	--	--	--	--	--	--	--	0.00	-0.18
R^2	0.04		0.05		0.06		0.13		0.15	
F	1.00		0.79		0.77		1.38		1.34	
ΔR^2	0.04		0.01		0.01		0.07		0.02	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D14. EEG Workload Straight and Level Deceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.67	--	0.72	--	0.69	--	0.80	--	0.81	--
Subject	0.00	0.28^{*}	0.00	0.29^{*}	0.00	0.28^{*}	0.00	0.30^{*}	0.00	0.31^{*}
Workload	-0.01	-0.07	-0.01	-0.07	-0.01	-0.06	-0.01	-0.07	-0.01	-0.07
MEQ	--	--	-0.01	-0.10	0.00	-0.08	0.00	-0.17	0.00	-0.17
Sleep Qual.	--	--	--	--	0.01	0.10	0.00	0.03	0.01	0.08
ESS	--	--	--	--	--	--	-0.01	-0.25	-0.01	-0.30
Experience	--	--	--	--	--	--	--	--	0.00	-0.13
R^2	0.08		0.09		0.10		0.15		0.16	
F	2.28		1.69		1.38		1.72		1.52	
ΔR^2	0.08		0.01		0.01		0.05		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D15. EEG Workload VMC Approach and Landing

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.66	--	0.68	--	0.62	--	0.76	--	0.76	--
Subject	0.00	$0.40^{\dagger}$	0.00	$0.40^{\dagger}$	0.00	$0.39^{\dagger}$	0.00	$0.42^{\dagger}$	0.00	$0.42^{\dagger}$
Workload	0.01	0.06	0.01	0.06	0.01	0.06	0.01	0.06	0.01	0.06
MEQ	--	--	0.00	-0.03	0.00	0.01	0.00	-0.11	0.00	-0.12
Sleep Qual.	--	--	--	--	0.02	0.17	0.01	0.08	0.01	0.09
ESS	--	--	--	--	--	--	-0.01	-0.33^{*}	-0.01	-0.34^{*}
Experience	--	--	--	--	--	--	--	--	0.00	-0.02
R^2	0.16		0.16		0.19		0.28		0.28	
F	4.86^{*}		3.19^{*}		2.83^{*}		$3.71^{\dagger}$		3.03^{*}	
ΔR^2	0.16		0.00		0.03		0.09		0.00	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D16. Beta Ratio Descriptive Statistics

Maneuver	Minimum		Maximum		Mean		Std. Error		Std. Deviation	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
1 Hover	0.55	0.51	0.77	0.72	0.65	0.62	0.01	0.01	0.06	0.06
2 Takeoff	0.55	0.52	0.79	0.76	0.66	0.64	0.01	0.01	0.06	0.06
3 Straight & Level Accel.	0.57	0.56	0.77	0.76	0.68	0.65	0.01	0.01	0.05	0.06
4 Right Turn	0.54	0.54	0.83	0.80	0.67	0.64	0.01	0.01	0.07	0.07
5 Straight & Level	0.55	0.55	0.77	0.76	0.67	0.66	0.01	0.01	0.06	0.06
6 Right Turn	0.50	0.50	0.74	0.77	0.66	0.66	0.01	0.01	0.07	0.07
7 Straight & Level	0.54	0.54	0.77	0.77	0.67	0.66	0.01	0.01	0.06	0.06
8 Straight Climb	0.53	0.55	0.75	0.78	0.67	0.66	0.01	0.01	0.06	0.07
9 Straight & Level	0.56	0.58	0.76	0.77	0.67	0.66	0.01	0.01	0.06	0.05
10 Left Descend. Turn	0.55	0.56	0.83	0.78	0.67	0.67	0.02	0.01	0.08	0.06
11 Straight & Level	0.56	0.57	0.77	0.78	0.66	0.67	0.01	0.01	0.06	0.06
12 Straight Descent	0.55	0.55	0.77	0.76	0.66	0.66	0.01	0.01	0.06	0.06
13 Straight & Level Decel.	0.54	0.56	0.77	0.78	0.66	0.66	0.01	0.01	0.06	0.06
14 Landing	0.50	0.48	0.76	0.76	0.64	0.63	0.01	0.01	0.07	0.06

Table D17. Beta Ratio Stationary Hover Power Check

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.72	--	0.68	--	0.74	--	0.66	--	0.68	--
Subject	0.00	-0.27	0.00	-0.26	0.00	-0.26	0.00	-0.28	0.00	-0.26
Workload	-0.04	-0.30^{*}	-0.04	-0.30^{*}	-0.04	-0.29^{*}	-0.04	-0.30^{*}	-0.04	-0.30^{*}
MEQ	--	--	0.00	0.10	0.00	0.06	0.00	0.15	0.00	0.14
Sleep Qual.	--	--	--	--	-0.02	-0.23	-0.01	-0.16	0.00	-0.03
ESS	--	--	--	--	--	--	0.01	0.24	0.00	0.09
Experience	--	--	--	--	--	--	--	--	0.00	-0.35^{*}
R^2	0.15		0.16		0.21		0.26		0.34	
F	4.63^{*}		3.27^{*}		3.34^{*}		3.41^{*}		$4.04^{\dagger}$	
ΔR^2	0.15		0.01		0.05		0.05		0.08	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D18. Beta Ratio Takeoff

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.72	--	0.68	--	0.67	--	0.59	--	0.61	--
Subject	0.00	-0.26	0.00	-0.26	0.00	-0.26	0.00	-0.28	0.00	-0.27
Workload	-0.03	-0.22	-0.03	-0.22	-0.03	-0.22	-0.03	-0.23	-0.03	-0.23
MEQ	--	--	0.00	0.11	0.00	0.12	0.00	0.20	0.00	0.19
Sleep Qual.	--	--	--	--	0.00	0.04	0.01	0.10	0.02	0.20
ESS	--	--	--	--	--	--	0.01	0.22	0.00	0.11
Experience	--	--	--	--	--	--	--	--	0.00	-0.27
R^2	0.11		0.12		0.13		0.17		0.21	
F	3.19^{*}		2.35		1.75		1.91		2.12	
ΔR^2	0.11		0.01		0.00		0.04		0.05	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D19. Beta Ratio Straight & Level Acceleration

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.73	--	0.69	--	0.70	--	0.67	--	0.68	--
Subject	0.00	-0.27	0.00	-0.28	0.00	-0.27	0.00	-0.28	0.00	-0.27
Workload	-0.03	-0.26	-0.03	-0.25	-0.03	-0.25	-0.03	-0.25	-0.03	-0.26
MEQ	--	--	0.00	0.13	0.00	0.12	0.00	0.16	0.00	0.15
Sleep Qual.	--	--	--	--	-0.01	-0.06	0.00	-0.03	0.01	0.06
ESS	--	--	--	--	--	--	0.00	0.11	0.00	0.01
Experience	--	--	--	--	--	--	--	--	0.00	-0.25
R^2	0.13		0.15		0.15		0.16		0.20	
F	3.94^{*}		2.95^{*}		2.23		1.89		2.00	
ΔR^2	0.13		0.02		0.00		0.01		0.04	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D20. Beta Ratio Right Standard Rate Turn (Maneuver Four)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.70	--	0.63	--	0.64	--	0.48	--	0.49	--
Subject	0.00	-0.07	0.00	-0.08	0.00	-0.08	0.00	-0.11	0.00	-0.11
Workload	-0.02	-0.16	-0.02	-0.16	-0.02	-0.16	-0.02	-0.17	-0.02	-0.17
MEQ	--	--	0.00	0.18	0.00	0.17	0.00	0.32^{*}	0.00	0.32^{*}
Sleep Qual.	--	--	--	--	0.00	-0.03	0.01	0.08	0.01	0.13
ESS	--	--	--	--	--	--	0.01	$0.41^{\dagger}$	0.01	0.36^{*}
Experience	--	--	--	--	--	--	--	--	0.00	-0.13
R^2	0.03		0.06		0.06		0.20		0.21	
F	0.77		1.09		0.81		2.46^{*}		2.14	
ΔR^2	0.03		0.03		0.00		0.14		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D21. Beta Ratio Straight and Level (Maneuver Five)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.70	--	0.63	--	0.67	--	0.63	--	0.65	--
Subject	0.00	-0.21	0.00	-0.21	0.00	-0.21	0.00	-0.22	0.00	-0.20
Workload	-0.01	-0.09	-0.01	-0.09	-0.01	-0.08	-0.01	-0.09	-0.01	-0.09
MEQ	--	--	0.00	0.19	0.00	0.16	0.00	0.21	0.00	0.20
Sleep Qual.	--	--	--	--	-0.01	-0.14	-0.01	-0.11	0.00	0.01
ESS	--	--	--	--	--	--	0.00	0.12	0.00	-0.01
Experience	--	--	--	--	--	--	--	--	0.00	-0.32
R^2	0.05		0.08		0.10		0.11		0.18	
F	1.33		1.54		1.40		1.24		1.70	
ΔR^2	0.05		0.04		0.02		0.01		0.06	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D22. Beta Ratio Right Standard Rate Turn (Maneuver Six)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.70	--	0.65	--	0.70	--	0.62	--	0.64	--
Subject	0.00	-0.21	0.00	-0.21	0.00	-0.21	0.00	-0.23	0.00	-0.21
Workload	-0.01	-0.06	-0.01	-0.06	-0.01	-0.05	-0.01	-0.06	-0.01	-0.06
MEQ	--	--	0.00	0.12	0.00	0.09	0.00	0.17	0.00	0.16
Sleep Qual.	--	--	--	--	-0.02	-0.19	-0.01	-0.13	0.00	-0.01
ESS	--	--	--	--	--	--	0.01	0.23	0.00	0.11
Experience	--	--	--	--	--	--	--	--	0.00	-0.31
R^2	0.05		0.06		0.10		0.14		0.20	
F	1.27		1.10		1.30		1.58		1.96	
ΔR^2	0.05		0.01		0.03		0.05		0.06	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D23. Beta Ratio Straight and Level (Maneuver Seven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.69	--	0.57	--	0.61	--	0.53	--	0.54	--
Subject	0.00	-0.05	0.00	-0.06	0.00	-0.05	0.00	-0.07	0.00	-0.06
Workload	-0.01	-0.11	-0.01	-0.10	-0.01	-0.10	-0.01	-0.10	-0.01	-0.11
MEQ	--	--	0.00	0.34*	0.00	0.31*	0.00	0.39†	0.00	0.39†
Sleep Qual.	--	--	--	--	-0.01	-0.15	-0.01	-0.08	0.00	0.01
ESS	--	--	--	--	--	--	0.01	0.24	0.00	0.13
Experience	--	--	--	--	--	--	--	--	0.00	-0.25
R^2	0.01		0.13		0.15		0.19		0.23	
F	0.34		2.39		2.10		2.29		2.38	
ΔR^2	0.01		0.11		0.02		0.05		0.04*	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table D24. Beta Ratio Straight Climb

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.69	--	0.59	--	0.63	--	0.57	--	0.59	--
Subject	0.00	-0.14	0.00	-0.15	0.00	-0.14	0.00	-0.15	0.00	-0.14
Workload	-0.01	-0.04	-0.01	-0.04	0.00	-0.03	0.00	-0.04	-0.01	-0.04
MEQ	--	--	0.00	0.27*	0.00	0.25	0.00	0.30*	0.00	0.30*
Sleep Qual.	--	--	--	--	-0.01	-0.14	-0.01	-0.10	0.00	0.01
ESS	--	--	--	--	--	--	0.00	0.15	0.00	0.04
Experience	--	--	--	--	--	--	--	--	0.00	-0.28
R^2	0.02		0.10		0.11		0.13		0.18	
F	0.54		1.75		1.58		1.48		1.75	
ΔR^2	0.02		0.08		0.02		0.02		0.05	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table D25. Beta Ratio Straight and Level (Maneuver Nine)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.69	--	0.59	--	0.60	--	0.56	--	0.57	--
Subject	0.00	-0.10	0.00	-0.11	0.00	-0.10	0.00	-0.12	0.00	-0.10
Workload	-0.01	-0.11	-0.01	-0.11	-0.01	-0.10	-0.01	-0.11	-0.01	-0.11
MEQ	--	--	0.00	0.32^*	0.00	0.31^*	0.00	0.36^*	0.00	0.36^*
Sleep Qual.	--	--	--	--	0.00	-0.04	0.00	0.00	0.01	0.12
ESS	--	--	--	--	--	--	0.00	0.15	0.00	0.01
Experience	--	--	--	--	--	--	--	--	0.00	-0.32
R^2	0.02		0.12		0.12		0.14		0.21	
F	0.53		2.30		1.71		1.57		2.02	
ΔR^2	0.02		0.10		0.00		0.02		0.10	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D26. Beta Ratio Left 433 Degree Descending Standard Rate Turn

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.70	--	0.63	--	0.63	--	0.59	--	0.60	--
Subject	0.00	-0.20	0.00	-0.20	0.00	-0.20	0.00	-0.21	0.00	-0.20
Workload	-0.01	-0.04	-0.01	-0.04	-0.01	-0.03	-0.01	-0.04	-0.01	-0.04
MEQ	--	--	0.00	0.17	0.00	0.16	0.00	0.21	0.00	0.20
Sleep Qual.	--	--	--	--	0.00	-0.01	0.00	0.03	0.01	0.12
ESS	--	--	--	--	--	--	0.00	0.13	0.00	0.02
Experience	--	--	--	--	--	--	--	--	0.00	-0.27
R^2	0.04		0.07		0.07		0.08		0.13	
F	1.04		1.19		0.87		0.84		1.12	
ΔR^2	0.04		0.03		0.00		0.01		0.04	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D27. Beta Ratio Straight and Level (Maneuver Eleven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.66	--	0.58	--	0.61	--	0.57	--	0.59	--
Subject	0.00	0.02	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.02
Workload	0.01	0.03	0.00	0.04	0.01	0.04	0.00	0.04	0.00	0.03
MEQ	--	--	0.00	0.23	0.00	0.21	0.00	0.26	0.00	0.25
Sleep Qual.	--	--	--	--	-0.01	-0.13	-0.01	-0.08	0.01	0.06
ESS	--	--	--	--	--	--	0.00	0.15	0.00	-0.01
Experience	--	--	--	--	--	--	--	--	0.00	-0.39^{*}
R^2	0.00		0.06		0.07		0.09		0.19	
F	0.04		0.97		0.92		0.93		1.77	
ΔR^2	0.00		0.05		0.02		0.02		0.10	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D28. Beta Ratio Straight Descent

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.68	--	0.62	--	0.63	--	0.56	--	0.58	--
Subject	0.00	-0.16	0.00	-0.17	0.00	-0.17	0.00	-0.18	0.00	-0.17
Workload	0.00	-0.03	0.00	-0.02	0.00	-0.02	0.00	-0.03	0.00	-0.03
MEQ	--	--	0.00	0.17	0.00	0.16	0.00	0.24	0.00	0.23
Sleep Qual.	--	--	--	--	0.00	-0.05	0.00	0.01	0.01	0.14
ESS	--	--	--	--	--	--	0.00	0.22	0.00	0.07
Experience	--	--	--	--	--	--	--	--	0.00	-0.35^{*}
R^2	0.03		0.06		0.06		0.10		0.17	
F	0.70		1.00		0.77		1.04		1.66	
ΔR^2	0.03		0.03		0.00		0.04		0.08	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D29. Beta Ratio Straight and Level Deceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.68	--	0.64	--	0.66	--	0.61	--	0.63	--
Subject	0.00	-0.23	0.00	-0.23	0.00	-0.23	0.00	-0.24	0.00	-0.23
Workload	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.01	0.00	0.01
MEQ	--	--	0.00	0.12	0.00	0.10	0.00	0.16	0.00	0.16
Sleep Qual.	--	--	--	--	-0.01	-0.09	0.00	-0.05	0.01	0.07
ESS	--	--	--	--	--	--	0.00	0.16	0.00	0.03
Experience	--	--	--	--	--	--	--	--	0.00	-0.32
R^2	0.05		0.07		0.08		0.10		0.16	
F	1.39		1.18		0.99		1.03		1.52	
ΔR^2	0.05		0.02		0.01		0.02		0.07	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table D30. Beta Ratio VMC Approach and Landing

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.68	--	0.65	--	0.73	--	0.65	--	0.67	--
Subject	0.00	-0.30	0.00	-0.30	0.00	-0.29	0.00	-0.31	0.00	-0.29
Workload	-0.01	-0.06	-0.01	-0.06	-0.01	-0.04	-0.01	-0.05	-0.01	-0.06
MEQ	--	--	0.00	0.08	0.00	0.03	0.00	0.12	0.00	0.11
Sleep Qual.	--	--	--	--	-0.03	-0.31^*	-0.02	-0.24	-0.01	-0.12
ESS	--	--	--	--	--	--	0.01	0.25	0.00	0.12
Experience	--	--	--	--	--	--	--	--	0.00	-0.32^*
R^2	0.09		0.10		0.19		0.24		0.30	
F	2.50		1.77		2.80^*		2.97^*		$3.34^†$	
ΔR^2	0.09		0.01		0.09		0.05		0.06	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table D31. Heart Rate (BPM) Descriptive Statistics

Maneuver	Minimum		Maximum		Mean		Std. Error		Std. Deviation	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Baseline	44.48	44.48	81.07	81.07	59.05	57.95	1.78	1.70	9.09	8.33
1 Hover	47.34	46.92	83.96	78.79	65.63	64.07	1.76	1.76	8.31	8.05
2 Takeoff	47.64	47.32	79.12	89.85	63.93	66.27	1.70	2.16	8.33	11.03
3 Straight & Level Accel.	49.37	47.44	81.54	81.05	63.43	64.05	1.66	1.98	8.28	9.51
4 Right Turn	48.10	51.67	81.43	89.09	63.89	67.25	1.73	2.08	8.65	10.59
5 Straight & Level	47.32	45.31	81.79	84.71	62.23	64.69	1.70	1.89	8.51	9.66
6 Right Turn	47.21	45.36	79.44	85.26	62.33	65.15	1.76	2.05	8.78	10.26
7 Straight & Level	47.15	46.12	82.30	82.05	62.15	64.12	1.74	1.77	8.68	8.87
8 Straight Climb	47.70	46.88	81.29	78.77	61.88	64.21	1.69	1.58	8.46	7.56
9 Straight & Level	47.49	48.50	81.75	78.45	63.38	64.64	1.71	1.67	8.56	8.02
10 Left Descend. Turn	47.89	49.30	84.17	81.61	63.68	65.02	1.71	2.03	8.56	9.53
11 Straight & Level	48.07	49.73	80.97	81.04	63.42	63.88	1.73	1.66	8.66	7.95
12 Straight Descent	47.76	47.55	79.00	80.00	62.68	64.00	1.63	1.75	8.13	8.39
13 Straight & Level Decel.	49.17	50.45	83.17	89.81	63.61	66.46	1.77	1.96	8.84	9.79
14 Landing	52.79	52.58	91.40	90.83	66.36	69.67	2.39	2.05	10.67	10.44

Table D32. Heart Rate (BPM) Stationary Hover Power Check

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	5.13	--	1.54	--	-5.33	--	-4.75	--	-4.84	--
Subject	0.05	0.15	0.05	0.15	0.06	0.19	0.06	0.19	0.06	0.19
Workload	0.05	0.00	-0.02	0.00	0.04	0.00	0.05	0.00	0.06	0.00
MEQ	--	--	0.06	0.10	0.10	0.15	0.09	0.14	0.09	0.14
Sleep Qual.	--	--	--	--	1.67	0.21	1.64	0.21	1.61	0.21
ESS	--	--	--	--	--	--	-0.03	-0.02	-0.02	-0.01
Experience	--	--	--	--	--	--	--	--	0.00	0.01
R^2	0.02		0.03		0.07		0.07		0.07	
F	0.47		0.45		0.80		0.62		0.51	
ΔR^2	0.02		0.01		0.04		0.00		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D33. Heart Rate (BPM) Takeoff

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.23	--	9.25	--	2.85	--	14.48	--	13.78	--
Subject	0.11	0.21	0.10	0.19	0.11	0.21	0.12	0.22	0.12	0.22
Workload	2.07	0.10	2.08	0.10	2.13	0.10	2.23	0.10	2.26	0.11
MEQ	--	--	-0.15	-0.14	-0.12	-0.11	-0.20	-0.19	-0.20	-0.19
Sleep Qual.	--	--	--	--	1.55	0.12	0.95	0.07	0.78	0.06
ESS	--	--	--	--	--	--	-0.70	-0.20	-0.63	-0.18
Experience	--	--	--	--	--	--	--	--	0.00	0.77
R^2	0.05		0.07		0.08		0.12		0.12	
F	1.19		1.10		0.96		1.07		0.88	
ΔR^2	0.05		0.02		0.01		0.03		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D34. Heart Rate (BPM) Straight & Level Acceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.16	--	-3.13	--	-5.79	--	-3.11	--	-3.54	--
Subject	0.08	0.25	0.08	0.26	0.08	0.27	0.09	0.27	0.08	0.27
Workload	-0.42	-0.03	-0.56	-0.05	-0.57	-0.05	-0.54	-0.04	-0.51	-0.04
MEQ	--	--	0.10	0.16	0.12	0.18	0.10	0.15	0.10	0.15
Sleep Qual.	--	--	--	--	0.68	0.09	0.55	0.07	0.42	0.05
ESS	--	--	--	--	--	--	-0.15	-0.07	-0.10	-0.05
Experience	--	--	--	--	--	--	--	--	0.00	0.36
R^2	0.06		0.09		0.10		0.10		0.10	
F	1.48		1.40		1.12		0.92		0.77	
ΔR^2	0.06		0.03		0.01		0.00		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D35. Heart Rate (BPM) Right Standard Rate Turn (Maneuver Four)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	5.02	--	-7.98	--	-13.10	--	-4.81	--	-4.77	--
Subject	0.08	0.22	0.09	0.23	0.10	0.25	0.10	0.26	0.10	0.26
Workload	-0.94	-0.06	-1.23	-0.08	-1.24	-0.08	-1.14	-0.07	-1.14	-0.07
MEQ	--	--	0.22	0.27	0.24	0.30	0.18	0.22	0.18	0.22
Sleep Qual.	--	--	--	--	1.31	0.14	0.90	0.09	0.91	0.10
ESS	--	--	--	--	--	--	-0.46	-0.18	-0.47	-0.18
Experience	--	--	--	--	--	--	--	--	0.00	-0.01
R^2	0.05		0.13		0.14		0.17		0.17	
F	1.20		2.07		1.77		1.67		1.36	
ΔR^2	0.05		0.07		0.02		0.03		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D36. Heart Rate (BPM) Straight and Level (Maneuver Five)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.98	--	-4.84	--	-6.07	--	-7.37	--	-7.74	--
Subject	0.05	0.16	0.05	0.18	0.05	0.18	0.05	0.18	0.05	0.18
Workload	-0.33	-0.03	-0.51	-0.04	-0.51	-0.04	-0.52	-0.05	-0.50	-0.04
MEQ	--	--	0.13	0.22	0.14	0.23	0.15	0.25	0.15	0.24
Sleep Qual.	--	--	--	--	0.31	0.04	0.38	0.05	0.27	0.04
ESS	--	--	--	--	--	--	0.07	0.04	0.12	0.06
Experience	--	--	--	--	--	--	--	--	0.00	0.06
R^2	0.03		0.08		0.08		0.08		0.08	
F	0.63		1.17		0.88		0.70		0.59	
ΔR^2	0.03		0.04		0.00		0.00		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table D37. Heart Rate (BPM) Right Standard Rate Turn (Maneuver Six)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	4.61	--	-4.26	--	-7.66	--	-8.20	--	-8.50	--
Subject	0.05	0.16	0.05	0.17	0.06	0.19	0.06	0.19	0.06	0.18
Workload	-1.31	-0.11	-1.51	-0.12	-1.52	-0.12	-1.52	-0.12	-1.51	-0.12
MEQ	--	--	0.15	0.23	0.16	0.26	0.17	0.27	0.17	0.27
Sleep Qual.	--	--	--	--	0.87	0.12	0.90	0.12	0.80	0.11
ESS	--	--	--	--	--	--	0.03	0.02	0.07	0.03
Experience	--	--	--	--	--	--	--	--	0.00	0.05
R^2	0.04		0.09		0.11		0.11		0.11	
F	0.86		1.46		1.23		0.96		0.79	
ΔR^2	0.04		0.06		0.01		0.00		0.00	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table D38. Heart Rate (BPM) Straight and Level (Maneuver Seven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.51	--	-2.70	--	-2.59	--	-5.69	--	-6.47	--
Subject	0.05	0.16	0.05	0.16	0.05	0.16	0.05	0.16	0.05	0.15
Workload	-0.70	-0.06	-0.84	-0.07	-0.84	-0.07	-0.87	-0.07	-0.83	-0.07
MEQ	--	--	0.10	0.17	0.10	0.17	0.13	0.21	0.12	0.21
Sleep Qual.	--	--	--	--	-0.03	0.00	0.13	0.02	-0.11	-0.02
ESS	--	--	--	--	--	--	0.17	0.09	0.27	0.14
Experience	--	--	--	--	--	--	--	--	0.00	0.12
R^2	0.03		0.06		0.06		0.06		0.07	
F	0.63		0.87		0.64		0.55		0.53	
ΔR^2	0.03		0.03		0.00		0.01		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table D39. Heart Rate (BPM) Straight Climb

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.14	--	-3.90	--	-8.70	--	-14.83	--	-15.50	--
Subject	0.04	0.13	0.05	0.14	0.05	0.16	0.05	0.16	0.05	0.15
Workload	-0.25	-0.02	-0.41	-0.03	-0.41	-0.03	-0.49	-0.04	-0.45	-0.04
MEQ	--	--	0.12	0.18	0.14	0.21	0.19	0.28	0.19	0.28
Sleep Qual.	--	--	--	--	1.23	0.16	1.54	0.19	1.33	0.17
ESS	--	--	--	--	--	--	0.34	0.16	0.42	0.20
Experience	--	--	--	--	--	--	--	--	0.00	0.10
R^2	0.02		0.05		0.07		0.09		0.10	
F	0.42		0.75		0.82		0.84		0.74	
ΔR^2	0.02		0.03		0.02		0.02		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^†p < 0.01$, $^‡p < 0.001$

Table D40. Heart Rate (BPM) Straight and Level (Maneuver Nine)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.89	--	-2.62	--	-3.65	--	-4.55	--	-5.27	--
Subject	0.05	0.17	0.05	0.18	0.05	0.18	0.05	0.18	0.05	0.18
Workload	-0.22	-0.02	-0.36	-0.03	-0.36	-0.03	-0.37	-0.03	-0.34	-0.03
MEQ	--	--	0.11	0.18	0.11	0.19	0.12	0.20	0.12	0.20
Sleep Qual.	--	--	--	--	0.26	0.04	0.31	0.04	0.09	0.01
ESS	--	--	--	--	--	--	0.05	0.03	0.14	0.07
Experience	--	--	--	--	--	--	--	--	0.00	0.11
R^2	0.03		0.06		0.06		0.06		0.07	
F	0.65		0.92		0.69		0.54		0.51	
ΔR^2	0.03		0.03		0.00		0.00		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D41. Heart Rate (BPM) Left 433 Degree Descending Standard Rate Turn

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.09	--	-7.04	--	-12.94	--	-13.51	--	-15.10	--
Subject	0.06	0.20	0.07	0.20	0.07	0.22	0.07	0.22	0.07	0.21
Workload	0.85	0.06	0.64	0.05	0.63	0.05	0.63	0.05	0.71	0.05
MEQ	--	--	0.15	0.22	0.18	0.26	0.18	0.27	0.18	0.27
Sleep Qual.	--	--	--	--	1.51	0.19	1.54	0.19	1.05	0.13
ESS	--	--	--	--	--	--	0.03	0.02	0.22	0.10
Experience	--	--	--	--	--	--	--	--	0.00	0.22
R^2	0.04		0.09		0.12		0.12		0.16	
F	0.88		1.38		1.44		1.12		1.23	
ΔR^2	0.04		0.05		0.03		0.00		0.04	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D42. Heart Rate (BPM) Straight and Level (Maneuver Eleven)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.50	--	-2.39	--	-4.64	--	-8.26	--	-9.55	--
Subject	0.05	0.17	0.05	0.17	0.05	0.18	0.05	0.18	0.05	0.17
Workload	-0.14	-0.01	-0.28	-0.03	-0.28	-0.03	-0.32	-0.03	-0.26	-0.02
MEQ	--	--	0.10	0.17	0.11	0.19	0.14	0.24	0.13	0.23
Sleep Qual.	--	--	--	--	0.58	0.08	0.76	0.11	0.36	0.05
ESS	--	--	--	--	--	--	0.20	0.11	0.36	0.19
Experience	--	--	--	--	--	--	--	--	0.00	0.21
R^2	0.03		0.06		0.06		0.07		0.11	
F	0.62		0.86		0.70		0.64		0.78	
ΔR^2	0.03		0.03		0.01		0.01		0.03	

Note. R^2 change based on previous model. $^*p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D43. Heart Rate (BPM) Straight Descent

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.99	--	-6.06	--	-14.11	--	-14.24	--	-14.94	--
Subject	0.05	0.15	0.05	0.16	0.06	0.20	0.06	0.20	0.06	0.19
Workload	-0.42	-0.03	-0.65	-0.05	-0.66	-0.05	-0.66	-0.05	-0.62	-0.05
MEQ	--	--	0.17	0.27	0.20	0.33	0.21	0.33	0.20	0.33
Sleep Qual.	--	--	--	--	2.06	0.27	2.07	0.28	1.85	0.25
ESS	--	--	--	--	--	--	0.01	0.00	0.09	0.05
Experience	--	--	--	--	--	--	--	--	0.00	0.11
R^2	0.02		0.10		0.17		0.17		0.17	
F	0.54		1.50		2.08		1.62		1.40	
ΔR^2	0.02		0.07		0.07		0.00		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D44. Heart Rate (BPM) Straight and Level Deceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.22	--	-7.55	--	-15.18	--	-14.97	--	-16.41	--
Subject	0.07	0.21	0.08	0.22	0.09	0.25	0.09	0.25	0.08	0.24
Workload	0.07	0.01	-0.17	-0.01	-0.18	-0.01	-0.17	-0.01	-0.10	-0.01
MEQ	--	--	0.18	0.26	0.21	0.31	0.21	0.31	0.21	0.30
Sleep Qual.	--	--	--	--	1.95	0.23	1.94	0.23	1.50	0.18
ESS	--	--	--	--	--	--	-0.01	-0.01	0.16	0.07
Experience	--	--	--	--	--	--	--	--	0.00	0.20
R^2	0.04		0.11		0.16		0.16		0.19	
F	1.01		1.77		2.01		1.57		1.55	
ΔR^2	0.04		0.07		0.05		0.00		0.03	

Note. R^2 change based on previous model. $^*p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D45. Heart Rate (BPM) VMC Approach and Landing

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.61	--	-7.23	--	-21.51	--	-26.22	--	-26.86	--
Subject	0.09	0.23	0.10	0.25	0.10	0.25	0.09	0.23	0.09	0.23
Workload	1.39	0.09	1.23	0.08	0.31	0.02	0.11	0.01	0.28	0.02
MEQ	--	--	0.16	0.21	0.23	0.30^*	0.27	0.35^*	0.26	0.34^*
Sleep Qual.	--	--	--	--	4.47	$0.44^{\dagger}$	4.77	$0.47^{\dagger}$	4.36	0.43^*
ESS	--	--	--	--	--	--	0.28	0.11	0.39	0.15
Experience	--	--	--	--	--	--	--	--	0.00	0.13
R^2	0.06		0.10		0.28		0.29		0.30	
F	1.13		1.36		3.60^*		2.93^*		2.52^*	
ΔR^2	0.06		0.04		0.18		0.01		0.01	

Note. R^2 change based on previous model. $^*p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D46. Heart Rate Ratio Descriptive Statistics

Maneuver	Minimum		Maximum		Mean		Std. Error		Std. Deviation	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Baseline	0.12	0.12	8.64	5.28	2.14	1.79	0.38	0.28	1.92	1.38
1 Hover	0.24	0.24	13.50	6.25	3.97	2.38	0.66	0.38	3.24	1.73
2 Takeoff	0.55	0.34	11.02	6.35	3.45	2.72	0.51	0.28	2.51	1.44
3 Straight & Level Accel.	0.57	0.69	8.31	6.38	2.97	2.67	0.45	0.33	2.26	1.60
4 Right Turn	0.17	0.13	2.99	6.78	0.77	1.32	0.13	0.30	0.64	1.55
5 Straight & Level	0.57	0.57	7.59	6.96	2.59	2.51	0.33	0.32	1.66	1.62
6 Right Turn	0.59	0.44	13.27	6.53	3.42	3.08	0.58	0.36	2.91	1.78
7 Straight & Level	0.98	0.67	9.07	5.67	3.37	3.01	0.45	0.31	2.27	1.54
8 Straight Climb	0.36	0.18	6.75	6.33	3.56	2.71	0.32	0.37	1.62	1.75
9 Straight & Level	0.87	0.54	9.12	6.27	3.56	3.35	0.48	0.37	2.38	1.77
10 Left Descend. Turn	0.82	0.45	11.00	6.08	3.20	2.32	0.48	0.30	2.41	1.40
11 Straight & Level	1.01	0.67	7.19	6.37	3.19	2.88	0.37	0.34	1.86	1.63
12 Straight Descent	0.48	0.81	11.72	6.43	3.75	2.98	0.50	0.30	2.49	1.45
13 Straight & Level Decel.	0.21	0.56	6.75	5.76	2.15	2.91	0.37	0.33	1.86	1.66
14 Landing	0.12	0.17	8.08	5.98	2.60	2.07	0.53	0.33	2.35	1.70

Table D47. Heart Rate Variability Stationary Hover Power Check

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.95	--	0.98	--	-0.68	--	-5.47	--	0.54	--
Subject	0.05	0.46 †	0.04	0.42 †	0.05	0.47 †	0.05	0.48 †	0.04	0.37*
Workload	0.23	0.06	0.24	0.06	0.26	0.07	0.21	0.05	0.15	0.04
MEQ	--	--	-0.03	-0.15	-0.02	-0.09	0.02	0.11	-0.02	-0.08
Sleep Qual.	--	--	--	--	0.29	0.12	0.57	0.23	0.42	0.17
ESS	--	--	--	--	--	--	0.20	0.30	0.00	0.00
Experience	--	--	--	--	--	--	--	--	0.00	-0.54‡
R^2	0.21		0.23		0.24		0.29		0.51	
F	4.83		3.53		2.71		2.80		5.67	
ΔR^2	0.21		0.02		0.01		0.06		0.22	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D48. Heart Rate Variability Takeoff

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-1.40	--	1.83	--	2.44	--	1.44	--	2.78	--
Subject	0.04	0.46 †	0.04	0.43 †	0.04	0.42 †	0.04	0.41 †	0.04	0.40 †
Workload	0.56	0.16	0.60	0.17	0.58	0.16	0.55	0.16	0.43	0.12
MEQ	--	--	-0.05	-0.29*	-0.06	-0.31*	-0.05	-0.26	-0.05	-0.26
Sleep Qual.	--	--	--	--	-0.14	-0.06	-0.10	-0.04	0.12	0.05
ESS	--	--	--	--	--	--	0.06	0.11	-0.04	-0.06
Experience	--	--	--	--	--	--	--	--	0.00	-0.46 †
R^2	0.22		0.31		0.31		0.32		0.49	
F	6.05*		6.04*		4.49†		3.65†		5.96‡	
ΔR^2	0.22		0.08		0.00		0.01		0.17	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D49. Heart Rate Variability Straight & Level Acceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.13	--	1.11	--	1.71	--	0.84	--	2.81	--
Subject	0.04	$0.46^{\dagger}$	0.04	$0.45^{\dagger}$	0.04	$0.43^{\dagger}$	0.04	$0.43^{\dagger}$	0.04	$0.38^{\dagger}$
Workload	-0.51	-0.13	-0.47	-0.12	-0.50	-0.12	-0.48	-0.13	-0.47	-0.12
MEQ	--	--	-0.02	-0.11	-0.02	-0.13	-0.02	-0.09	-0.02	-0.13
Sleep Qual.	--	--	--	--	-0.14	-0.06	-0.10	-0.04	-0.01	-0.01
ESS	--	--	--	--	--	--	0.05	0.08	-0.05	-0.07
Experience	--	--	--	--	--	--	--	--	0.00	-0.39^{*}
R^2	0.23		0.24		0.24		0.25		0.37	
F	$5.97^{\dagger}$		4.13^{*}		3.06^{*}		2.45		$3.57^{\dagger}$	
ΔR^2	0.23		0.01		0.00		0.01		0.12	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

*Table D*50 Heart Rate Variability Right Standard Rate Turn (Maneuver Four)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-1.24	--	0.87	--	-0.44	--	-6.96	--	-6.43	--
Subject	0.02	0.24	0.02	0.23	0.03	0.25	0.02	0.22	0.02	0.23
Workload	-0.33	-0.08	-0.28	-0.07	-0.28	-0.07	-0.36	-0.09	-0.39	-0.10
MEQ	--	--	-0.04	-0.17	-0.03	-0.14	0.02	0.11	0.02	0.11
Sleep Qual.	--	--	--	--	0.34	0.14	0.66	0.27	0.83	0.34^{*}
ESS	--	--	--	--	--	--	0.36	$0.55^{\ddagger}$	0.30	$0.45^{\dagger}$
Experience	--	--	--	--	--	--	--	--	0.00	-0.25
R^2	0.07		0.09		0.11		0.35		0.40	
F	1.53		1.50		1.33		$4.41^{\dagger}$		$4.35^{\dagger}$	
ΔR^2	0.07		0.03		0.02		0.24		0.05	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D51. Heart Rate Variability Straight and Level (Maneuver Five)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.72	--	-0.93	--	-0.29	--	-2.82	--	-2.03	--
Subject	0.03	$0.38^{\dagger}$	0.03	$0.38^{\dagger}$	0.03	0.37^{*}	0.03	0.36^{*}	0.03	$0.38^{\dagger}$
Workload	-0.02	-0.01	-0.03	-0.01	-0.03	-0.01	-0.06	-0.02	-0.10	-0.03
MEQ	--	--	0.00	0.02	0.00	0.00	0.02	0.11	0.02	0.13
Sleep Qual.	--	--	--	--	-0.16	-0.08	-0.04	-0.02	0.21	0.10
ESS	--	--	--	--	--	--	0.14	0.25	0.05	0.08
Experience	--	--	--	--	--	--	--	--	0.00	$-0.42^{\dagger}$
R^2	0.15		0.15		0.15		0.20		0.33	
F	3.74^{*}		2.44		1.87		2.04		3.27^{*}	
ΔR^2	0.15		0.00		0.01		0.05		0.13	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D52. Heart Rate Variability Right Standard Rate Turn (Maneuver Six)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.31	--	1.08	--	-0.81	--	-2.02	--	-1.02	--
Subject	0.04	$0.43^{\dagger}$	0.04	$0.42^{\dagger}$	0.05	$0.45^{\dagger}$	0.05	$0.44^{\dagger}$	0.05	$0.46^{\ddagger}$
Workload	-0.10	-0.02	-0.07	-0.02	-0.07	-0.02	-0.09	-0.02	-0.14	-0.03
MEQ	--	--	-0.02	-0.11	-0.01	-0.07	-0.01	-0.02	0.00	-0.01
Sleep Qual.	--	--	--	--	0.48	0.19	0.54	0.21	0.85	0.33^{*}
ESS	--	--	--	--	--	--	0.07	0.10	-0.05	-0.08
Experience	--	--	--	--	--	--	--	--	0.00	$-0.44^{\dagger}$
R^2	0.18		0.20		0.23		0.24		0.38	
F	4.94^{*}		3.48^{*}		3.12^{*}		2.54^{*}		$4.10^{\dagger}$	
ΔR^2	0.18		0.01		0.03		0.01		0.14	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D53. Heart Rate Variability Straight and Level (Maneuver Seven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.32	--	1.54	--	3.01	--	-1.28	--	0.15	--
Subject	0.04	0.38*	0.03	0.35*	0.03	0.32*	0.03	0.36*	0.03	0.35*
Workload	0.01	0.00	0.04	0.01	0.04	0.01	0.01	0.00	0.00	0.00
MEQ	--	--	-0.03	-0.15	-0.04	-0.20	0.00	-0.01	-0.01	-0.04
Sleep Qual.	--	--	--	--	-0.31	-0.14	-0.06	-0.03	0.12	0.05
ESS	--	--	--	--	--	--	0.18	0.29	0.07	0.12
Experience	--	--	--	--	--	--	--	--	0.00	-0.38*
R^2	0.14		0.17		0.18		0.24		0.34	
F	3.54*		2.72		2.24		2.42		3.28*	
ΔR^2	0.14		0.02		0.02		0.05		0.11	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D54. Heart Rate Variability Straight Climb

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.20	--	1.63	--	2.11	--	-0.60	--	0.17	--
Subject	0.02	0.25	0.02	0.24	0.02	0.23	0.02	0.23	0.02	0.24
Workload	-0.34	-0.10	-0.29	-0.08	-0.28	-0.08	-0.33	-0.10	-0.38	-0.11
MEQ	--	--	-0.02	-0.14	-0.03	-0.15	-0.01	-0.03	-0.01	-0.03
Sleep Qual.	--	--	--	--	-0.12	-0.06	0.03	0.01	0.16	0.08
ESS	--	--	--	--	--	--	0.15	0.25	0.07	0.13
Experience	--	--	--	--	--	--	--	--	0.00	-0.26
R^2	0.07		0.09		0.09		0.14		0.19	
F	1.51		1.28		0.97		1.23		1.40	
ΔR^2	0.07		0.02		0.00		0.05		0.05	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D55. Heart Rate Variability Straight and Level (Maneuver Nine)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	1.13	--	1.24	--	2.55	--	-0.67	--	0.07	--
Subject	0.04	0.38^*	0.04	0.38^*	0.03	0.36^*	0.03	0.34^*	0.03	0.34^*
Workload	-0.81	-0.23	-0.81	-0.23	-0.83	-0.23	-0.92	-0.26	-0.92	-0.26
MEQ	--	--	0.00	-0.01	-0.01	-0.05	0.02	0.10	0.02	0.09
Sleep Qual.	--	--	--	--	-0.29	-0.14	-0.15	-0.07	-0.07	-0.03
ESS	--	--	--	--	--	--	0.17	0.30	0.12	0.21
Experience	--	--	--	--	--	--	--	--	0.00	-0.21
R^2	0.20		0.20		0.21		0.28		0.31	
F	4.61^*		3.00^*		2.41		2.71^*		2.60^*	
ΔR^2	0.20		0.00		0.02		0.07		0.04	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D56. Heart Rate Variability Left 433 Degree Descending Standard Rate Turn

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.04	--	0.97	--	0.53	--	-7.50	--	-5.81	--
Subject	0.02	0.24	0.02	0.24	0.02	0.25	0.03	0.29	0.03	0.29^*
Workload	-0.22	-0.06	-0.22	-0.06	-0.22	-0.06	-0.18	-0.05	-0.18	-0.05
MEQ	--	--	-0.01	-0.07	-0.01	-0.06	0.06	0.28	0.05	0.25
Sleep Qual.	--	--	--	--	0.09	0.04	0.54	0.25	0.71	0.32
ESS	--	--	--	--	--	--	0.30	0.51^*	0.18	0.31
Experience	--	--	--	--	--	--	--	--	0.00	-0.42^*
R^2	0.06		0.07		0.07		0.22		0.35	
F	1.31		0.92		0.69		2.04		3.14^*	
ΔR^2	0.06		0.01		0.00		0.15		0.13	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D57. Heart Rate Variability Straight and Level (Maneuver Eleven)

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-0.22	--	0.74	--	0.30	--	-2.98	--	-2.15	--
Subject	0.04	0.41 †	0.04	0.40 †	0.04	0.41 †	0.04	0.42 †	0.04	0.42 †
Workload	-0.13	-0.03	-0.09	-0.02	-0.10	-0.03	-0.19	-0.05	-0.19	-0.05
MEQ	--	--	-0.02	-0.08	-0.01	-0.07	0.01	0.06	0.01	0.06
Sleep Qual.	--	--	--	--	0.11	0.05	0.28	0.12	0.43	0.18
ESS	--	--	--	--	--	--	0.17	0.26	0.10	0.15
Experience	--	--	--	--	--	--	--	--	0.00	-0.26
R^2	0.17		0.18		0.18		0.23		0.28	
F	4.27*		2.90*		2.15		2.31		2.44*	
ΔR^2	0.17		0.01		0.00		0.05		0.05	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D58. Heart Rate Variability Straight Descent

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.66	--	1.72	--	0.39	--	-1.78	--	0.38	--
Subject	0.02	0.26	0.02	0.25	0.03	0.29	0.03	0.27	0.02	0.23
Workload	-0.11	-0.03	-0.08	-0.02	-0.09	-0.02	-0.15	-0.04	-0.17	-0.05
MEQ	--	--	-0.02	-0.10	-0.01	-0.05	0.01	0.04	0.00	0.00
Sleep Qual.	--	--	--	--	0.29	0.13	0.38	0.16	0.46	0.20
ESS	--	--	--	--	--	--	0.13	0.21	0.03	0.04
Experience	--	--	--	--	--	--	--	--	0.00	-0.43 †
R^2	0.07		0.08		0.09		0.13		0.28	
F	1.48		1.10		0.95		1.07		2.31	
ΔR^2	0.07		0.01		0.01		0.04		0.15	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

*Table D*59 Heart Rate Variability Straight and Level Deceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-1.37	--	-1.16	--	-3.16	--	-5.49	--	-4.39	--
Subject	0.06	$0.51^{‡}$	0.06	$0.51^{‡}$	0.06	$0.54^{‡}$	0.06	$0.53^{‡}$	0.06	$0.53^{‡}$
Workload	-0.02	-0.01	-0.01	0.00	-0.05	-0.01	-0.07	-0.02	-0.06	-0.02
MEQ	--	--	0.00	-0.02	0.01	0.03	0.03	0.11	0.03	0.11
Sleep Qual.	--	--	--	--	0.50	0.18	0.60	0.22	0.83	0.30^{*}
ESS	--	--	--	--	--	--	0.14	0.19	0.03	0.04
Experience	--	--	--	--	--	--	--	--	0.00	$-0.38^{†}$
R^2	0.26		0.26		0.29		0.32		0.43	
F	$7.64^{†}$		$4.98^{†}$		$4.23^{†}$		$3.76^{†}$		$4.95^{†}$	
ΔR^2	0.26		0.00		0.03		0.03		0.11	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{†}p < 0.01$, $^{‡}p < 0.001$

Table D60. Heart Rate Variability VMC Approach and Landing

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	-2.31	--	1.33	--	1.42	--	-1.16	--	-0.65	--
Subject	0.05	$0.48^{†}$	0.05	$0.46^{†}$	0.05	$0.46^{†}$	0.05	$0.43^{†}$	0.05	$0.43^{†}$
Workload	0.26	0.06	0.33	0.08	0.34	0.08	0.23	0.05	0.09	0.02
MEQ	--	--	-0.06	-0.28^{*}	-0.06	-0.28	-0.04	-0.18	-0.03	-0.15
Sleep Qual.	--	--	--	--	-0.03	-0.01	0.13	0.05	0.46	0.17
ESS	--	--	--	--	--	--	0.15	0.22	0.06	0.09
Experience	--	--	--	--	--	--	--	--	0.00	-0.38^{*}
R^2	0.23		0.30		0.30		0.34		0.45	
F	$5.54^{†}$		$5.38^{†}$		$3.93^{†}$		3.59^{*}		$4.57^{†}$	
ΔR^2	0.23		0.08		0.00		0.04		0.11	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{†}p < 0.01$, $^{‡}p < 0.001$

Table D61. Respiration Rate Descriptive Statistics

Maneuver	Minimum		Maximum		Mean		Std. Error		Std. Deviation	
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Baseline	8.26	8.26	18.84	18.84	13.64	13.55	0.68	0.58	2.98	2.95
1 Hover	10.08	12.21	28.01	39.55	18.19	19.97	1.05	1.19	4.60	6.07
2 Takeoff	7.01	9.11	24.13	26.72	16.37	19.07	1.08	0.80	4.70	4.09
3 Straight & Level Accel.	1.53	4.89	22.37	25.52	16.67	18.67	1.12	0.93	4.90	4.75
4 Right Turn	0.87	4.34	29.04	26.02	17.24	18.05	1.53	1.04	6.67	5.31
5 Straight & Level	10.09	11.89	21.70	23.89	16.26	18.02	0.83	0.63	3.62	3.21
6 Right Turn	8.25	9.28	24.38	27.31	16.92	18.60	1.06	0.91	4.63	4.65
7 Straight & Level	5.11	9.95	23.65	22.91	16.06	16.99	1.12	0.65	4.86	3.33
8 Straight Climb	4.66	8.14	22.43	24.92	16.28	17.24	1.02	0.80	4.45	4.05
9 Straight & Level	7.84	9.00	23.08	23.05	15.18	16.42	1.01	0.72	4.41	3.69
10 Left Descend. Turn	4.26	6.55	34.48	24.13	17.04	17.63	1.57	0.88	6.84	4.49
11 Straight & Level	3.41	7.66	22.60	22.09	15.17	16.41	1.03	0.68	4.49	3.47
12 Straight Descent	9.69	6.08	22.23	24.03	16.74	17.44	0.94	0.77	4.08	3.91
13 Straight & Level Decel.	1.29	9.36	33.24	26.12	19.53	18.28	1.52	0.81	6.64	4.12
14 Landing	2.77	8.38	31.69	26.26	20.64	17.89	1.57	0.85	6.84	4.32

Table D62. Respiration Rate Stationary Hover Power Check

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.99	--	7.80	--	-3.05	--	-6.49	--	-4.82	--
Subject	0.00	-0.01	-0.01	-0.02	0.01	0.05	0.01	0.04	0.01	0.05
Workload	0.94	0.09	0.87	0.08	0.98	0.09	0.99	0.09	0.98	0.09
MEQ	--	--	-0.06	-0.10	0.01	0.01	0.03	0.06	0.03	0.05
Sleep Qual.	--	--	--	--	2.24	0.35*	2.44	0.38*	3.02	0.47†
ESS	--	--	--	--	--	--	0.18	0.10	-0.01	0.00
Experience	--	--	--	--	--	--	--	--	0.00	-0.26
R^2	0.01		0.02		0.12		0.13		0.18	
F	0.18		0.27		1.52		1.27		1.48	
ΔR^2	0.01		0.01		0.11		0.01		0.05	

Note. R^2 change based on previous model. $^*p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D63. Respiration Rate Takeoff

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.37	--	2.06	--	-8.10	--	-15.62	--	-12.97	--
Subject	-0.02	-0.06	-0.02	-0.06	0.00	0.01	0.00	0.00	0.00	0.01
Workload	1.51	0.16	1.51	0.16	1.62	0.17	1.64	0.17	1.62	0.17
MEQ	--	--	0.01	0.01	0.07	0.13	0.12	0.24	0.11	0.22
Sleep Qual.	--	--	--	--	2.09	0.37*	2.53	0.44†	3.46	0.61‡
ESS	--	--	--	--	--	--	0.39	0.24	0.10	0.06
Experience	--	--	--	--	--	--	--	--	0.00	-0.47†
R^2	0.03		0.03		0.14		0.19		0.34	
F	0.65		0.42		1.81		1.96		3.46†	
ΔR^2	0.03		0.00		0.12		0.05		0.15	

Note. R^2 change based on previous model. $^*p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D64. Respiration Rate Straight & Level Acceleration

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.29	--	8.63	--	0.11	--	-5.89	--	-3.55	--
Subject	0.00	-0.02	-0.01	-0.03	0.01	0.02	0.00	0.02	0.01	0.03
Workload	1.24	0.12	1.16	0.11	1.16	0.11	1.21	0.12	1.21	0.12
MEQ	--	--	-0.10	-0.18	-0.05	-0.09	0.00	-0.01	-0.01	-0.02
Sleep Qual.	--	--	--	--	1.86	0.30^{*}	2.22	0.36^{*}	3.12	$0.51^{\dagger}$
ESS	--	--	--	--	--	--	0.30	0.18	0.02	0.01
Experience	--	--	--	--	--	--	--	--	0.00	0.01^{*}
R^2	0.02		0.05		0.13		0.15		0.27	
F	0.34		0.76		1.65		1.56		2.57^{*}	
ΔR^2	0.02		0.03		0.08		0.02		0.12	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D65. Respiration Rate Right Standard Rate Turn (Maneuver Four)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	4.35	--	8.71	--	3.87	--	-3.31	--	-2.57	--
Subject	-0.03	-0.08	-0.03	-0.09	-0.02	-0.06	-0.02	-0.07	-0.02	-0.07
Workload	0.40	0.03	0.34	0.03	0.34	0.03	0.40	0.03	0.40	0.03
MEQ	--	--	-0.07	-0.11	-0.04	-0.06	0.01	0.02	0.01	0.02
Sleep Qual.	--	--	--	--	1.06	0.15	1.48	0.21	1.77	0.25
ESS	--	--	--	--	--	--	0.36	0.18	0.27	0.14
Experience	--	--	--	--	--	--	--	--	0.00	-0.11
R^2	0.01		0.02		0.04		0.07		0.07	
F	0.18		0.30		0.45		0.60		0.56	
ΔR^2	0.01		0.01		0.02		0.03		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D66. Respiration Rate Straight and Level (Maneuver Five)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.29	--	3.16	--	-4.12	--	-6.37	--	-5.09	--
Subject	0.00	-0.01	0.00	-0.01	0.01	0.05	0.01	0.05	0.01	0.06
Workload	0.75	0.10	0.73	0.09	0.74	0.09	0.76	0.10	0.76	0.10
MEQ	--	--	-0.01	-0.03	0.03	0.07	0.05	0.11	0.04	0.10
Sleep Qual.	--	--	--	--	1.59	0.34*	1.72	0.37*	2.22	0.47†
ESS	--	--	--	--	--	--	0.11	0.09	-0.04	-0.03
Experience	--	--	--	--	--	--	--	--	0.00	-0.30
R^2	0.01		0.01		0.11		0.12		0.18	
F	0.21		0.15		1.38		1.14		1.50	
ΔR^2	0.01		0.00		0.10		0.01		0.06	

Note. R^2 change based on previous model. $^*p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D67. Respiration Rate Right Standard Rate Turn (Maneuver Six)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.35	--	2.67	--	-5.95	--	-8.36	--	-5.98	--
Subject	-0.03	-0.11	-0.03	-0.11	-0.02	-0.06	-0.02	-0.06	-0.01	-0.04
Workload	1.18	0.11	1.19	0.11	1.19	0.11	1.21	0.11	1.21	0.11
MEQ	--	--	0.01	0.02	0.06	0.11	0.08	0.14	0.07	0.13
Sleep Qual.	--	--	--	--	1.88	0.29	2.03	0.32	2.94	0.46†
ESS	--	--	--	--	--	--	0.12	0.07	-0.17	-0.09
Experience	--	--	--	--	--	--	--	--	0.00	-0.40*
R^2	0.02		0.02		0.10		0.10		0.21	
F	0.55		0.36		1.22		0.99		1.87	
ΔR^2	0.02		0.00		0.08		0.00		0.11	

Note. R^2 change based on previous model. $^*p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D68. Respiration Rate Straight and Level (Maneuver Seven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.10	--	-0.12	--	-12.65	--	-16.49	--	-15.91	--
Subject	-0.03	-0.12	-0.03	-0.11	-0.01	-0.03	-0.01	-0.03	-0.01	-0.03
Workload	0.37	0.04	0.41	0.04	0.42	0.04	0.44	0.05	0.44	0.05
MEQ	--	--	0.05	0.10	0.12	0.24	0.15	0.30	0.15	0.30
Sleep Qual.	--	--	--	--	2.74	0.48†	2.96	0.52†	3.18	0.55†
ESS	--	--	--	--	--	--	0.19	0.12	0.12	0.08
Experience	--	--	--	--	--	--	--	--	0.00	-0.11
R^2	0.02		0.03		0.23		0.24		0.24	
F	0.35		0.38		3.19*		2.65*		2.25	
ΔR^2	0.02		0.01		0.20		0.01		0.01	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D69. Respiration Rate Straight Climb

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.72	--	-4.39	--	-11.76	--	-12.61	--	-11.53	--
Subject	0.00	-0.01	0.00	0.00	0.01	0.05	0.01	0.04	0.01	0.05
Workload	1.14	0.11	1.21	0.12	1.21	0.12	1.22	0.12	1.22	0.12
MEQ	--	--	0.08	0.15	0.12	0.32	0.13	0.24	0.13	0.24
Sleep Qual.	--	--	--	--	1.61	0.27	1.66	0.28	2.07	0.35
ESS	--	--	--	--	--	--	0.04	0.03	-0.09	-0.05
Experience	--	--	--	--	--	--	--	--	0.00	-0.19
R^2	0.01		0.04		0.10		0.10		0.12	
F	0.30		0.55		1.21		0.95		0.99	
ΔR^2	0.01		0.02		0.06		0.00		0.03	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D70. Respiration Rate Straight and Level (Maneuver Nine)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	0.98	--	2.77	--	-6.53	--	-8.64	--	-7.75	--
Subject	-0.01	-0.03	-0.01	-0.03	0.01	0.04	0.01	0.03	0.01	0.04
Workload	0.88	0.10	0.86	0.10	0.86	0.10	0.88	0.10	0.88	0.10
MEQ	--	--	-0.03	-0.06	0.03	0.06	0.04	0.10	0.04	0.10
Sleep Qual.	--	--	--	--	2.03	0.41 †	2.16	0.43 †	2.50	0.50 †
ESS	--	--	--	--	--	--	0.11	0.08	0.00	0.00
Experience	--	--	--	--	--	--	--	--	0.00	-0.19
R^2	0.01		0.02		0.16		0.17		0.19	
F	0.27		0.24		2.11		1.71		1.65	
ΔR^2	0.01		0.00		0.15		0.00		0.03	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D71. Respiration Rate Left 433 Degree Descending Standard Rate Turn

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	3.84	--	1.84	--	-13.17	--	-14.70	--	-12.45	--
Subject	-0.02	-0.08	-0.02	-0.08	0.00	0.00	0.00	0.00	0.00	0.02
Workload	0.51	0.04	0.53	0.05	0.54	0.05	0.55	0.05	0.55	0.05
MEQ	--	--	0.03	0.05	0.12	0.20	0.13	0.22	0.12	0.21
Sleep Qual.	--	--	--	--	3.28	0.48 †	3.37	0.50 †	4.23	0.62‡
ESS	--	--	--	--	--	--	0.08	0.04	-0.19	-0.10
Experience	--	--	--	--	--	--	--	--	0.00	-0.36*
R^2	0.01		0.01		0.22		0.22		0.30	
F	0.20		0.17		3.06*		2.41		3.06*	
ΔR^2	0.01		0.00		0.21		0.00		0.09	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D72. Respiration Rate Straight and Level (Maneuver Eleven)

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	1.05	--	0.23	--	-8.67	--	-11.75	--	-10.37	--
Subject	0.00	-0.01	0.00	-0.01	0.01	0.05	0.01	0.05	0.01	0.06
Workload	0.71	0.08	0.73	0.08	0.73	0.08	0.75	0.08	0.75	0.08
MEQ	--	--	0.01	0.03	0.07	0.14	0.09	0.19	0.08	0.18
Sleep Qual.	--	--	--	--	1.94	0.37^{*}	2.13	0.40^{*}	2.66	$0.50^{\dagger}$
ESS	--	--	--	--	--	--	0.15	0.10	-0.01	-0.01
Experience	--	--	--	--	--	--	--	--	0.00	-0.28
R^2	0.01		0.01		0.13		0.14		0.19	
F	0.15		0.11		1.60		1.34		1.62	
ΔR^2	0.01		0.00		0.12		0.01		0.05	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D73. Respiration Rate Straight Descent

	Model 1		Model 2		Model 3		Model 4		Model 5	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	2.75	--	2.01	--	-5.22	--	-9.59	--	-8.50	--
Subject	-0.03	-0.12	-0.03	-0.12	-0.02	-0.07	-0.02	-0.07	-0.02	-0.06
Workload	0.69	0.08	0.70	0.08	0.70	0.08	0.73	0.08	0.74	0.08
MEQ	--	--	0.01	0.02	0.05	0.11	0.09	0.18	0.08	0.17
Sleep Qual.	--	--	--	--	1.58	0.29	1.84	0.34^{*}	2.26	0.41^{*}
ESS	--	--	--	--	--	--	0.22	0.14	0.09	0.06
Experience	--	--	--	--	--	--	--	--	0.00	-0.22
R^2	0.02		0.02		0.09		0.11		0.14	
F	0.45		0.30		1.15		1.06		1.15	
ΔR^2	0.02		0.00		0.08		0.02		0.03	

Note. R^2 change based on previous model. $^{*}p < 0.05$, $^{\dagger}p < 0.01$, $^{\ddagger}p < 0.001$

Table D74. Respiration Rate Straight and Level Deceleration

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	8.63	--	5.92	--	4.36	--	0.29	--	1.98	--
Subject	-0.07	-0.23	-0.07	-0.23	-0.07	-0.22	-0.07	-0.22	-0.06	-0.21
Workload	-0.97	-0.08	-0.94	-0.08	-0.94	-0.08	-0.91	-0.08	-0.91	-0.08
MEQ	--	--	0.04	0.07	0.05	0.08	0.08	0.13	0.08	0.12
Sleep Qual.	--	--	--	--	0.34	0.05	0.58	0.08	1.23	0.18
ESS	--	--	--	--	--	--	0.20	0.11	0.00	0.00
Experience	--	--	--	--	--	--	--	--	0.00	-0.26
R^2	0.06		0.07		0.07		0.08		0.12	
F	1.48		1.05		0.80		0.70		0.97	
ΔR^2	0.06		0.01		0.00		0.01		0.05	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

Table D75. Respiration Rate VMC Approach and Landing

	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Variable	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**	**B**	**β**
Constant	9.83	--	11.15	--	2.46	--	3.85	--	4.08	--
Subject	-0.02	-0.06	-0.02	-0.07	-0.02	-0.05	-0.01	-0.05	-0.01	-0.04
Workload	-2.57	-0.22	-2.62	-0.23	-3.05	-0.26	-3.02	-0.26	-2.97	-0.26
MEQ	--	--	-0.02	-0.03	0.03	0.05	0.02	0.03	0.03	0.05
Sleep Qual.	--	--	--	--	2.39	0.33^*	2.29	0.32	2.99	0.41^*
ESS	--	--	--	--	--	--	-0.08	-0.04	-0.23	-0.12
Experience	--	--	--	--	--	--	--	--	0.00	-0.26
R^2	0.05		0.05		0.15		0.15		0.20	
F	1.06		0.70		1.68		1.32		1.48	
ΔR^2	0.05		0.00		0.10		0.00		0.05	

Note. R^2 change based on previous model. $^*p < 0.05$, $^\dagger p < 0.01$, $^\ddagger p < 0.001$

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