Society of U. S. Naval Flight Surgeons

Naval Aerospace Medical Institute, Code 10
Naval Air Station, Pensacola. FL 32508

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PRESIDENT'S COMMENTS

As in years past, the Marshall Pattern occasioned by the Aerospace Medical Association's Annual Scientific Meeting recently provided the SUSNFS flock with the opportunity to exchange/ disseminate items of professional interest and also to renew former contacts and close friendships. At the risk of showing my sentimental streak, I will share with you that I invariably leave our yearly meeting refreshed and with a sense of optimism. Five days of close association with so many colleagues who are bringing their impressive capabilities to bear upon the problems attendent with providing effective aeromedical support is, indeed, cause for optimism. Sure, there are problems. Rear Admiral Zimble's admonition at our Navy luncheon, that we must front our own aeromedical organization clearly identifies one such. I urge all of you to take his words aboard and get on with it. Problems beget opportunities. Our task is to discover and boresight them. This process is facilitated by sharing ideas— we should do much more of this. Most of the real neat solutions I've been able to come up with over the years have resulted from a synthesis of the ideas of others. So I am a great believer in the "Dial-a-thought" approach to problem solving. Our community is a mutually supportive one; use it freely.

HONORS

On behalf of the Society, I want to recognize and congratulate LCDR Harold Howell, of CNAP, as our 1985 winner of the Richard E Leuhrs Award - an honor richly deserved. Though there can be but orle awardee, we also owe a "Bravo Zulu" to the following runners-up:

LT PAUL WOLFF - I MAW
LCDR TERRY BINKS - II MAW
LT CRAIG BEREZNOFF - III MAW
CDR BOB SHIELDS - CNAL
LCDR DONNA SUE MULLER - CHNAVRES
LCDR GUY NOWLAN - CNATRA

'85-'86 LINEUP

As the Society begins its tenth year of operation, I would like to announce the election results of our recent meeting and to recap those remaining in office:

Vice President and '86 President Elect: CAPT GARY HOLTZMAN
Secretary-Treasurer: LCDR HOMER MOORE
Board of Governors:
Senior: CAPT DICK MILLINGTON (Exp. '87)
CAPT E. J. SACKS (Exp. '86)
Junior: LCDR DAVE LAWRENCE (Exp. '86)
LCDR BARRY HANEY (Exp. '87)
Emeritus: CAPT FRANK AUSTIN (Exp. '86)
Immediate Past President: CAPT FRANK DULLY

In addition to these, I have appointed the following Committee Chairmen for the coming years:

ASMA Nominating Committee Rep. - CAPT ROB DEANE
ASMA Executive Council Rep. - CAPT DICK MILLINGTON
Nominating Committee -CAPT JOHN BRANCH
Awards Committee -CAPT DON ANGELO
Handbook Committee - CDR JIM GRAVES

Please freely communicate your ideas/suggestions to these folks/ get involved and help your Society function.

INITIATIVES

At the initial meeting of our '85-'86 Board of Governors on 15 May 1985, the Surgeon General's direction that NAMI no longer perform final ETPF physicals on those candidates having received, and passed, a prior ETPF physical in the field, was discussed at length. Concern was raised in view of the 22% NAMI NPQ rate among candidates previously found PQ by field activities, and the fact that these individuals will now, absent NAMI's final filter, enter flight training. Accordingly, the Board drew up a resolution expressing this concern and this was, on the following day circulated and approved by Society members' signatures as follows: 66 In Favor, 1 Opposed, 1 Conditionally in Favor.

This concern of the membership will be communicated to the Surgeon General by letter.

A second initiative involves investigating the feasibility of the Society publishing a Naval Flight Surgeon's Handbook. I know, I know: the Air Force thought of it first. But the Brits first thought of the angled deck and the steam catapult. I have no problem giving credit where due - all are good ideas. It would be an exceedingly useful tool. In laying this project on CDR Jim Graves I asked that he concentrate on a publication slightly larger than NAVSEA 0994-LF-O14-5010, Revision 1, "U.S. Navy Recompression Chamber Operator's Handbook." The content is envisioned as the "Pearls" of the Flight Surgeon's trade in an easily accessible, flight suit pocket sized, soft cover booklet. Potential Pearls include:

Tables/Charts

WBGT -Activity Schedule
Hypothermia Signs/Symptoms vs. Temp
Blood Alcohol metabolism
NATO Casualty Identification, MedEvac Systems
NATO NBC Symbols
Crash Survivability Formulae
Physical Standards
G- Tolerance Limits
Nitrogen Washout Data
Time of Useful Consciousness

Synopses

Mechanisms of Spatial Disorientation
NP Evaluation Outline/Format
Ship Types: OR/Bed/Medical Capability
Projected Fleet Hospital Sitings
FMF Medical organization/Capability
Medical Disposition
MedEvac Procedures

Key Phone Numbers

NAMI, NAMRL, GEOCOMS, NAVHOSPS, AsMA, HQ MAC, TYCOM Surgeons, NAVSAFECEN, AFIP, COMNAMEDCOM, COMNAVMILPERSCOM, JAMRO

Key Instructions List

SECNAV, OPNAV, COMNAVMEDCOM, etc.

As one might imagine, the toughest part of this project is going to be keeping any such handbook to a manageable size. All hands are encouraged to get ideas/suggestions to Jim Graves; he and his committee will welcome your input. The pending revision of the Flight Surgeon's Manual, with updating of all sections, makes this Handbook Project a timely one. Jim can be reached at NAMI (Code 08) - AV 922-2257.

Finis

Enough for now. I look forward to serving as your President during the coming year. There is much we can accomplish.

"TWO BLOCK FOX'"

C. H. BERCIER, JR.
CAPT, MC, USN

SECRETARY-TREASURER NOTES

DUES ARE NOW DUE!!! The SUSNFS fiscal year begins in May and opens the season on accounts receivable. In reviewing our membership roster, it becomes apparent that more than a few have fallen behind in updating, even by as much as several *years!* Now, a wide distribution of the newsletter is in the larger interest of our community, so this problem of unpaid dues has heretofore been handled by benign neglect. Unfortunately, however, publishing and mailing is an expensive, crushing reality that we must surmount every quarter. As I take office as your Secretary-Treasurer, I see that *our cash flow situation is and has been uncomfortably tenuous.* Sad as it may be, there is just no such thing as a free lunch. The real fact of the matter is that the dues paYing membership has been subsidizing those others who have been in arrears. This *must* be remedied if we are to stay in business.

I ask that right now you take a single moment to check the mailing label affixed hereon. If the number heading the label is 86 or greater, then you are on record as paid up. If the number is 85 *or less, your account is delinquent.* LI means "life," and paid-up life memberships are still available to any who are interested. M implies that you are a full voting member of SUSNFS, while S indicates subscrilber status only. If there are any discrepancies in your status or address, please advise me, and the corrections will be made worthwith. The annual membership dues are still a bargain at $10.00, and a tax-deductable professional contribution at that.

For our non-member subscribers, the annual rate is *still* only $5.00. This amount *will be going up to at least double*, as soon as I can twist the collective arms of our board of governors. Thus, your renewal now will effect a 100% savings, and I will presently accept payment for as many years as you wish to commit at today's bargain rate.

So ...please *do* keep those cards and letters coming in!

DECALS -Gold Flight Surgeon Wings are still available as a service through SUSNFS. Size 7" x 2", with or without SUSNFS inscription. $1.00 each (at this price we might as well be giving them away!), and stamped addressed return envelope is requested. Order from SUSNFS Secretary-Treasurer.

HOMER MOORE, LCDR, MC, USN
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NAMI NOTES

EXERCISE STRESS TESTING

Printed below are the texts of policy statements from NAMI's Aeromedical Advisory Council for use by our Physical Qualifications Department (Code 14) on the matter of treadmill exercise stress testing a'nd coronary artery disease. These may be of use to you. They represent conclusions drawn from a comprehensive review of the. state of the art. A series of abnormal stress test results in otherwise asymptomatic and healthy aircrew members precipitated the study. These misguided airmen had convinced their respective flight surgeons that they would ". ..like to max the treadmill machine," and instead, got the shock of their lives. The problem, of course, is that an abnormal stress test is an indicator of coronary artery disease until proven otherwise, even though the incidence of false positive results may exceed 1 in 4. The treadmill policy statement of 22 May 1985 says:

"1. A positive exercise stress test shall be cause for immediate grounding pending further evaluation. As a minimum follow-up, a Thallium Scan shall be performed to include exercise perfusion studies and computer enhanced techniques where available. Evidence of coronary artery disease will be handled in accordance with the recommendations of the Aeromedical Advisory Council, 6 December 1984. (See below)

2. Routine exercise stress testing of asymptomatic aviation personnel under the age of 50 is not recommended.

3. Exercise stress testing may be appropriate in aviation personnel, ages 40 to 50, under the following circumstances:

a. Sedentary individuals who plan on entering a vigorous physical exercise program.
b. Individuals with a strong family history of coronary artery disease.
c. Individuals with multiple coronary risk factors identified on routine annual physical.

4. Exercise stress testing of individuals under the age of 40 should be performed when medically indicated because of symptoms, history or physical findings.

5. The Aeromedical Advisory Council does not discourage persons from having an exercise stress test. Ralther, these persons should be fully informed concerning the stress test's predictive value under the given circumstances aruj the problems underwritten by an apparent abnormal response.."

In the matter of what angiographic findings are considered indicative of "significant heart disease," the policy statement of 6 December 1984 says:

> "An aviator is physically qualified if there is less than 30% occlusion of the left main coronary artery, or less than 50% occlusion of any other coronary artery. Occlusion of a single vessel (other than the left main), or the cumulative percentages of multiple vessels between 50-70% will be considered individually."

The present state-of-the-art considers coronary artery angiography to be "the gold standard." You need to' be aware that you may be forced into applying that gold standard whenever the treadmill is used.

FRANK E. DULLY, JR.
CAPT, MC, USN

DECONGESTANTS

Back in October there appeared in this newsletter a short article that addressed the perenial question: "Which Drugs May be Used in Aviators?" Unfortunately, some misinlformation was promulgated, namely that decongestants such as pseudoephedrine and phenylpropanolamine can be used on short term basis (no waiver required). This assertion is WRONG.

By coincidence, a pharmaceutical company which makes a well-known brand of phenylpropanolamine has been running eye-catching ads in *Aviation Space, and Environmental Medicine, U.S. Medicine*, and other publications frequented by Flight Surgeons. These ads depict an obviously congested fighter jock type in desperate need of their antihistamine-free product, The * Right * Stuff, ". ..so your patients at sea level can be as wide awake as those at 30,000 feet." Notwithstanding their disclaimer: "Granted, pilots can't fly while taking any kind of medication. .."

This media presentation would seem to convey a subliminal message. As of this writing, decongestants such as pseudoephedrine and phenyepropanolanine may *not* be prescribed for flight personnel unless a temporary grounding chit is issued. Prudence would also dictate an additional grounding interval after discontinuation of medication to permit metabolic and excretory clearance.

APPLICANT PHYSICALS

NAVMEDCOM has funded inspection trips, NAMI has certified select Navy examining facilities, and SECNAV has dictated that flight physicals on candidates for Naval Aviation accomplished at "certified" examining stations will be the sole qualifying physical for entrance. NAMI will not routinely repeat those physicals as in the, past. If you, as the examiner, certify the candidate as qualified in all respects —so be it! We will not "catch" your error or save the system by wearing the "black hat" which you declined to wear when you did the exam.

You should know, however, that 20% of those reporting to NAMI in the past for SNA were disqualified here. 75% of these disqualifications were for visual problems, not only distant visual acuity but also defective depth perception and color vision. The other 25% disqualifications range from back problems to headaches. Applicants cannot be handled as simply as annual designated aviator physicals; both commissioning and flight standards must be met prior to be qualified for training.

Under this new system —if you miss the problem Naval Aviation will live with it —or maybe pay $330,000 for it —think about it.

Questions? Call NAMI Code 14, AV 922-4501.

THE ANCIENT ENEMY

Although the problem of +Gz induced cerebral circulatory impairment has been with man since he assumed the upright posture, it became of paramount importance in this century, with the advent of 1:he flying machine. not only did man place himself in an accelerated environment, he did so in a manner which required his utmost concentration and lucidity at all times: the pilot cannot afford to take cat-naps.

Interestingly, it took years for the problem of G-induced loss of consciousness (LOC) to manifest itself. By 1917, the pressures of war and air combat development had produced surprisingly agile machines. The Fokker D-7, considered by many to be the finest aircraft of the conflict, was stressed to 12 G's. Despite the fragile appearance characteristic of externally braced biplanes, such craft had the potential for stressing the aviator beyond physiologic limits. (Other German planes, such as the Fokker DR I, and Allied models such as the SPAD XIII and the Sopwith Camel, were comparably maneuverable crafts.) Nevertheless, the World War I aeromedical literature is curiously devoid of reports of LOC during high G flight. Some of this may be due (like the similar lack of reports of departure from controlled flight while in non-instrumented flight in the clouds) to non-recognition of the problem. The aeromedical community was simply in its infancy, and not familiar with the problems surrounding acceleration in flight. Perhaps accidents were attributed inaccurately to other causes. However, it is highly probable that in large measure, LOC in WW I aircraft was indeed unusual. Although the machines were stressed to sustain high G forces, two factors protected the pilots consciousness: one was that aircraft powerplant technology was fortuitously also in its infancy, and these underpowered airplanes simply could not *sustain* a high +Gz load for any significant length of time. (Baron von Richtofen's triple-winged scourge of the skies, for example, was powered by a rotary Oberusel engine, which at its most agitated state of frantic activity churned out a neck-popping 100 horsepower). In that era, the pilot could still "beat" the airplane.

The post war years saw staggering advancements in aircraft engineering, as design moved from the hands of pioneers who drew an airplane outline in chalk on a garage floor and built around that (don't laugh, that's how the famous Gee Bee racers were born) to the college educated aeronautical engineers. A scant 10 years after the Red Baron's Oberusel was happily sluicing castor oil in the German's face, the Schneider Cup Race competition had produced propeller driven machines which attained speeds never surpassed until the advent of the jet airplane. The Macchi-Castoldi M 72, a 24 cylinder work of art, was capable of speeds over 400 miles per hour. It was hampered by the inefficiency of a fixed-pitch propeller and floats for water take offs and landings. The latter accoutrements were needed because the propeller's pitch was fixed for high speed flight, hence the aircraft had poor acceleration and needed the space available only on the water for its 2-minute take off run. This particular aircraft was also hampered by a peculiar design defect in its induction system which made it prone to backfire and explode in flames, but other than that annoying habit, it, like the other Schneider contenders (particularly the Supermarine models) had the potential for 400-knot speeds. The Schneider Cup regulations required a relatively short course with 2 to 4 pylon turns, and in the 1927 race, a phenomenon long suspected by experienced pilots reared its ugly head: during the sustained 6 to 8 G pylon turns, pilots began to suffer visual impairment, one of the first signs of the onset of LOC. Yet, pilots were still able to "unload" the aircraft by widening the turn radius somewhat, and an aircraft or pilot loss due s~tecifically to G-induced LOC was never recorded in the Schnelider Cup Races.

Except for such highly specialized events, however, the problem of G-induced LOC did not assume significant importance until the appearance of the Second Unpleasantness. With high powered, high performance aircraft, the physiologic effects of accelerated flight received extensive study, and the period saw the development of the G-suit and G-tolerance increasing physiologic maneuvers.

An inkling of things to come was demonstrated by the JU-87, the infamous siren-wielding German Stuka dive bomber. For various technical reasons, test pilots determined that the optimum dive angle for ordnance delivery was a 70^0 dive. A pull out from this attitude was a delicate operation; moreover, the low level attained at the nadir of the dive, and the added complication of hostile fire allowed little room to maneuver. The pilot *had* to release his load, pullout of the dive and exit the area expeditiously. When this was done, the pilot would almost always experience G-induced LOC. The "fix" at that time was an ingenious automatic pull-out device which allowed the pilot to experience a brief period of unconsciousness while the plane flew itself out of the dive. This, of course, made the plane hideously vulnerable to hostile aircraft, and whenever enemy fighter cover was available, the Stukas were effectively neutralized. But notice the real omen here —within this flight envelope, the pilot often could no longer "beat" the airplane.

As the techniques of dive bombing fell into well deserved disfavor, aircraft such as the Stuka (and its Allied counterparts, the Curtiss SB2C Helldiver, and the Douglass SBD Dauntless) began to disappear from the inventory. The advent of jet aircraft changed the nature of air combat. Although pure jet aircraft could attain much higher speeds than propeller driven machines, and thus theoretically subject the pilots to a more violent acceleration environment, mission profile as well as practical airframe and early generation jet engine limitatiolns still allowed the pilot, especially with the aid of efficient G-suits and properly performed M-1 maneuvers, to "titrate" the G-ioads to his own tolerance. Thus, the phenomenon of G-induced LOC remained, although an incompletely understood event, also a rare one. Now, this problem has resurfaced with a vengeance.

Ultra modern aircraft such as the F-16 can easily exceed and sustain G loads far in excess of what a mere mortal can tolerate, even with a G-suit. Furthermore (and probably of pivotal importance) flight controls are now electronic and computer controlled. A pilot does not have to fight aerodynamic forces acting through cables, pulleys and torque tubes to exert a full throw control deflection. One easy yank of the stick and the aircraft responds with an alacrity never before seen in less sophisticated airplanes. Thus, the rate of onset of G's is phenomenal. the pilot is hammered by G-induced LOC so rapidly, *he does not have time to "unload" the aircraft.* The late General Jerome F. O'Malley, Commander of Air Force Tactical Air Com-

- EDITORIAL POLICY -

The views expressed herein are those of the individual authors and not necessarily those of the Society of U.S. Naval Flight Surgeons.

This Newsletter is published quarterly by the Society on the first of January, April, July, October. Material for publication is solicited from the members and should be typed double space, reaching the Editor at least one month prior to the scheduled date of publication. Unsigned material will not be considered. Correspondence should be addressed to:

CAPT D.S. Angelo, MC, USN, Editor, SUSNFS Newsletter, Naval Aerospace Medical Institute, Code 10, NAS, Pensacola, FL 32508

mand, went on record stating that the electronic flight controls of the F-16 "Can totally incapacitate the pilot. ..you can apply intolerable levels of G forces instantaneously in an F-16."

Realistically, one can see total loss of consciousness, with abrupt onset, and lasting 20-25 seconds. Furthermore, there is some disorientatiorl and performance decrement on regaining consciousness. Obviously, a 20 second nap followed by a variable period of incapacitation, while flying at 200 feet or in air combat could be disastrous. At worst -an uncontrolled collision with the ground, at best -remember the helpless Stukas?

One answer to this problem sends shivers up and down the collective spines of all wing wearers. That is: the RPV, or "remotely piloted vehicle." There are those who state, allegedly with irrefragable logic, that aircraft technology has already far surpassed human tolerances. It would be folly to retrace our steps and design less capable aircraft. Therefore, take the weak link out of the loop. It is the frail carcass of skin and bone, that fragile moist nexus of negative entropy that prevents the airplane from performing at its fullest. Remove him from the cockpit, and while you are at it, save weight and money by removing all the other non-essentials, such as egress systems, oxygen systems, pressurization systems, etc. Then, place the "pilot" in some cool, one-G Combat Information Center. Present day technology can provide controls, visual, graphic and digital displays adequate enough to allow the smaller, cheaper, and *more capable* RPV to bomb that bridge or accomplish whatever mission with no risk to life. But the future would not be totally bleak —you still will need pilots to fly the station C-12, and someone needs to get the Flight Surgeons their flight time!

Unlikely scenario? Perhaps. In the meantime, the study of G-induced LOC has been given top priority. Various studies are underway to determine the effects of body habitus, weight vs. aerobic training, redesigned G-suits and G-suit valves, and age and experience level on G tolerance.

Elsewhere in this newsletter, LT McBride and coworkers report results of their research at the Naval Air Development Center concerning G-induced LOC. This forms part of the intense current efforts to elucidate the true nature and possible defenses against the pilot's ancient emeny.

LCDR CARLOS DIAZ

RECOVERY FROM +Gz-INDUCED LOSS OF CONSCIOUSNESS (LOC)

While assigned to the Naval Air Development Center, the authors conducted a controlled study aimed specifically at determining the behavioral and physiological consequences of acceleration-induced LOC. The findings and interpretations will be published soon in *Aviation Space and Environmental Medicine.* This report is a condensed version; many of the details of methodology and scientific rigor are not addressed here.

Eight volunteer, non-pilot, subjects (one female, seven males) were pre-tested on a battery of medical, psychoneurological and physiological examinations prior to qualifying for participation. Ages ranged from 18 to 39 (mean = 29). Cardiovascular health, as indicatecj by performance on the extended Bruce Treadmill Test, was not unlike that of a sample of naval aviators. Subjects trained for two weeks on three tasks specifically chosen to emulate those required in flying aircraft: (a) a continuous, joystick-controlled, two-dimensional tracking task, (b) a choice reaction time task in which the subject was required to depress an appropriate left or right foot-switch on cue (approximately every six seconds), and (c) a vocal response, arithmetic computation task (response required every 10 seconds). After becoming experts at performing all three tasks simultaneously, each subject was tested for G-tolerance in the NADC centrifuge at each of three acceleration profiles. There were two Rapid Onset Rates (ROR) (a) a 2-second sinusoidal rise time, and (b) a 4-second rise, and (c) a linear, .067 G/second Gradual Onset Rate (GOR).

The LOC runs followed a specific protocol: (a) after insertion in the centrifuge gondola, a runway assignment was provided to the subject over the intercom (e.g., "runway two seven, right") which the subject committed to memory, (b) five minutes of simultaneous execution of the three behavioral tasks, (c) thirty seconds of stabilizing the peripheral light loss instrumentation, (d) a runway re-assignment (e.g., "runway three six, left"), (e) acceleration onset according to one of the three onset profiles selected for any particular day's run (one per subject per day), until LOC occurred (15 seconds at plateau, maximum), (f) absolute incapacitation (head dropped, no voluntary movement), (g) relative incapacitation (head up, confusion, no tracking), (h) normalization (tracking re-engagement) , including seven minutes of simultaneous task execution, (i) prompt for recall of runway assignment, (j) a structured, debrief interview, and finally, (k) extraction from the gondola and medical examination. Neither straining maneuvers nor anti-G garments were used. All subjects were centrifuged in an approximate 10^0 seat-back angle.

SUMMARY OF FINDINGS:

*Acceleration required to produce LOC ranged from 5.0 to 8.0 +Gz (mean = 6.5) across ROR and GOR conditions.

*Elapsed time required at > 1 G ranged from 7.0 to 23.0 seconds (mean = 17.6 seconds) for ROR, from 67 to 105 seconds (mean = 83.5 seconds) for GOR.

*Warning times (that which elapses from loss of peripheral visual loss (re: 60 central subtense to onset of LOC) ranged considerably across individuals (1.5 -8.1 seconds, mean = 4.5 seconds) under ROR conditions. Warning times recorded under GOR circumstances were exceedingly long (mean = 37 seconds) and variable. Peripheral visual loss is not considered to be effective as a premonitory cue under slow G-olnset conditions.

*Mean absolute incapacitation for ROR conditions was 12.1 seconds; for GOR runs, mean absolute incapacitation was 16.6 seconds.

*Mean total (absolute + relative) incapacitation was 23.7 seconds for ROR, 32.3 seconds for GOR.

*Normalization (time elapsed from onset of post-LOC multitask engagement to the establishment of pre-G baseline proficiency) was almost immediate for the *tracking* task. Performance on the *secondary* tasks was substantially disrupted for approximately 2 minutes. As a combination of total incapacitation and normalization times, the composite profile of significantly impaired multi-task piloting is roughly three minutes. Statistically speaking, a profile of just over $3_{1/2}$ minutes is as likely as one of slightly less than $2_{1/2}$ minutes, and approximately two of every three profiles would be expected to fall between these anchor points. These figures are probably conservative for a number of reasons (beyond the scope of this report).

*Evidence for amnesia effects was equivocal. If, when queried, the subject reported the original versus the updated runway assignment, the error suggested that amnesia effects were involved. In three of the eight runs where amnesia effects were being examined, the-subject reported the original runway ($p>.05$; n.s.). It is reasonable that if there is an amnesia effect, that it is in fact only temporary, the paradigm used may have been insensitive, or the sample may have been inadequate, etc. Nevertheless, subsequent to 3 of the 21 LOC episodes, the subject refused to believe LOC had occurred until a review of the videotape was provided.

*G- Tolerance measures (e.g., max-G, warning time, time at G) were found not to covary with indices of LOC recoverability (e.g., LOC duration). That is, G-tolerance/capacity does not reliably predict one's ability to recover from LOC given that LOC occurs.

*Statistically reliable *negative* correlations among several aerobic fitness parameters, and various G-tolerance and LOC-recoverability measures were discovered. That aerobic fitness may contribute negatively to G-tolerance is not so surprising—others have reported similar effects- However, that aerobic fitness may serve to protract or aggravate the already debilitating effects of LOC *is* a puzzle, and the implications fly in the face of prevailing approaches to aircrew training. The evidence is based on correlational analysis; follow-on experimentation is required.

*An empirically-based user's guide for forensically determining the likelihood of LOC is in preparation.

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