

SUBORBITAL SPACEFLIGHT PRE-LAUNCH PHYSIOLOGICAL PRIMING FOR ENHANCED G-FORCE (SWITCHING) TOLERANCE

Jungle Innovations

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ABSTRACT

"Your first moments in space are not always your best. The switch from 3-Gs of acceleration to sudden weightlessness can be abrupt enough to induce vomiting. I could feel the blood rushing, & in 30 seconds I was going 'uh oh', I am going to be one of the ones who is not going to feel good."

– Anna L. Fisher, NASA physician-astronaut

Suborbital spaceflight passengers will experience a duty-cycle of significant gravitational loading-unloading-reloading, here termed, *G-switching*, & for which no analog simulation can completely prepare them. Put simply, down-gearing from 4-G_z to 0-G & then 0-G to 6-G_x & with a couple of G_z is not merely a ΔG of 4 & 6, respectively, because passing through a 0-G force-field, for even short minutes, will result in unique, say, unearthly sensations that few have ever experienced & even fewer, if any, have had the opportunity to condition for. The real-world possibility that "*sudden*" G-switching to 0-G, as described by Fisher, especially from significantly more aggressive +G_z loaded position than even experience by professional astronauts may result in a higher-than-anticipated incidence of passengers becoming disoriented, nauseous, & vomiting, aside any risk of some experiencing G-LOC; there are no doubt other way things could go very wrong. Needless to say, the confined & shared, close-quartered, environment could trigger a *bystander effect*. Fisher was a young, fit & trained pilot exposed to less than 2-G_z exposure on her *Space Shuttle* flight yet she was still caught off-guard. Given that most passenger will be passed their physical prime & subjected to considerable greater pre-flight stress due to being strapped to an actual *rocket*, not a jet probably should not be underestimated. The possibility that the experience might be on par with expectations might result in a major public-relations disaster for these companies. Indeed, it is conceivable that if a passenger messes up their G-straining manoeuvres they may pass-out & not recover, let alone recall the experience. In response, outlined here, two new & novel anti-G countermeasures that might substantially mitigate such untoward effects & possibly even allow expanding the passenger pool by enhancing G_z-tolerance. The pre-launch cardiovascular & metabolic priming technique simply involves off-setting an otherwise disadvantaged & unprepared physiology by tapping into the divers response, an umbrella term for various protective physiological reflexes. Basically, the low-stress strategy permits launching from a more favorable G-tolerant cardio-metabolic position with some lingering effects into the stress of launch. The technique simply involves undertaking a series of judiciously timed & executed modified breath-holding manoeuvres that both accentuate & fast-track protection. The dive response involves prompt, substantial & largely lingering cardiovascular & metabolic effects that include: redistributing of peripheral blood flow-volume towards the thorax & brain, a so-called, blood-shift; extensive & profound peripheral & core (brain, viscera) body cooling, which can be on the order of several degrees (!); increased peripheral vascular resistance & blood pressure; increased cerebral vasodilation; increased oxygen loading & hypoxia tolerance; increased tolerance of chest compression. And, one notes that human +G_z tolerance, a poorly tolerated G-force, is increased by as about 1-G per degree of whole body-cooling. This in itself allows not just mitigating the risk of G-LOC but also permitting a greater absolute G-load before G-LOC, & greater ramp rate tolerance. Pre-loading both heart, brain & lungs with more blood, & increasing the cold-induced peripheral resistance (constriction) & stiffening (delayed relaxation) will definitely place one in a better cardiovascular & metabolic position to reduce-slow the *brain drain* & *chest-crush*. The specialized technique require some training beyond what is taught in, say, a technical freediving course, learning can be undertaken in a gradual, stepwise-personalized manner & does not involve prolonged, extreme, breath-holding nor any deep-diving; the two priming techniques overlap in their effect but basically promote G_z & G_x- priming via separate physiological mechanisms. The technique requires less than 5 minutes to reap some benefit, but a properly spaced series of up to five or so per-launch breath-holds, some 20-30 minutes of preparation, will generate the longest lingering & most profound effects. Once learned, the technique allows virtually unlimited self-practice at no cost-outlay, & with some know-how, a considerable & fast-tracked conditioning potential; off-the-shelf biofeedback gadgetry can further fast-track it all & help ID underlying potential problems. Considering the amount of money invested by service-providers & spent by passengers, reducing the risk of untoward events seems warranted. However, the technique has yet to be pitted against actual suborbital spaceflight 0-G-switching conditions.

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