Thesis Project Portfolio

Protecting Pilots: Designing a Variable Cervical Neck Brace to Mitigate Ejection Injuries

(Technical Report)

Female Integration in the Military: A Wicked Problem

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Military safety equipment, much like automobile safety equipment, has historically been researched and designed for the 50th percentile male. When a pilot flying a fighter jet faces an airplane failure, they must pull the ejection seat lever, which invites the ejection force to shoot up their spine and clear them from the plane. The ejection force was specifically designed to clear the 50th percentile male over the tail of the aircraft without drastically damaging his spine: this same force crumples the 5th percentile female, and can cause serious spinal injury to any anthropometry that deviates significantly from the 50th percentile male. The military must assess the hazards of reinstalling inclusive safety technology in each community, and start to take steps to break the barriers that bar females from serving. One step the military could take is a variable neck brace that inflates upon ejection from a failing aircraft, protecting the spines of all pilots and making the endeavour of flying fighter jets safer for smaller pilots.

A variable cervical neckbrace that sits passively on the upper spine until ejection could mitigate the incidence of cervical injuries from the ejection force. The design of the neckbrace is based upon a computationed modeled lump mass system, which quantitatively determinea which pressures are most advantageous to protect the upper spine from injury when faced with an ejection force. The three-chambered brace inflates to the quantitative pressures, which change depending on the anthrometry of the user. The brace is triggered to inflate based on an acceleration-based triggering mechanism, that recognizes the high acceleration levels of ejection and opens a valve for airflow from CO2 cartridges.

Female integration into the military is a wicked problem because it is an issue that is cyclical: it relies on itself. The military is designed mostly for men because historically, the

armed forces have been only male and then majority male. The systems in place that benefit the men in the military do not change, because the makeup of the military has not changed to even close to fifty percent female: the systems do not change, and create more obstacles to female participation in the military. The issue is cyclical. To break the integration cycle, the military must analyze each community within the Department of Defense and weigh their individual advantages and hazards upon diversifying. From there, technology and social change must be implemented in small scales for each community that would benefit from diversity.

Both projects together represent a two pronged approach to solving the issue of female integration into the armed forces. The technical report is a tangible device that could solve just one of many issues that plague females in the military: making ejection safer for smaller anthrometries. The STS Research paper analyzes the advantages and hazards of certain Naval communities, and how integration has reflected the adnavtages and hazards in those communities over time. Finally, the research paper looks to the future of a diversified military, with inclusive technologies such as the cervical neck brace allowing integration to become fruitful.