TARGET ACQUISITION BY PILOTS WEARING VARIOUS HEAD-SUPPORTED MASSES DURING SIMULATED FLIGHT

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INTRODUCTION

The modern U.S. Army helicopter helmet has evolved from a simple crash protection device to a mounting platform for advanced technologies, greatly increasing the effective combat power of the pilot. Current helmet designs are capable of supporting such devices as night vision goggles (NVGs), forward looking infrared (FLIR) display and weapon aiming systems. All of these devices add weight and displace the center of gravity (CG) of the helmet system forward to head and neck CG. This increased helmet load relative to the head and neck CG adds biomechanical stress to the neck and upper body of the pilot, which ultimately could lead to decrements in performance, including such tasks as searching for targets. To date, the relationship between the head-supported loads and the CG of the system and the effects on the pilots in low-G maneuvers has not been explored systematically. This paper investigates the effects of mounting additional mass on the helmet and displacing the CG location on the ability of a pilot to acquire targets placed throughout an NUH-60 helicopter cabin.

METHODS

To simulate various helmet weight moments, an HGU-56/P aviator helmet was modified to include fixtures that consisted of graduated rods extending forward relative to the direction the pilot was facing. This allowed for the addition of various weights at different distances. In addition to these modifications, a head motion tracker was attached to the top of the helmet using Velcro®. Within an NUH-60 flight simulator, five liquid crystal display targets were placed around the subject; and a computer controlled the presentation of targets and integrated information from the motion tracker, requiring the pilot to actually face the target to successfully 'acquire' it. The pilots flew a 2-hour flight pattern, with 5-minute blocks of target acquisition repeated six times. The time and accuracy of the acquisitions were recorded.

RESULTS

Multivariate analysis of variance was performed on the effect of the helmet on the acquisition times (Figure 1). The results showed that for targets lower left, upper left, upper center and upper right of the pilot, helmet mass had a significant effect, but center of gravity location did not. Post-hoc analyses showed that increasing mass increased acquisition time for these targets, except for the lower left target; where increasing mass decreased acquisition time. Comparisons of target-hit ratios were compared across all subjects for all targets, with no significant differences discovered. Also, there were no significant effects observed when testing for the effect of flight time on target hit ratios.

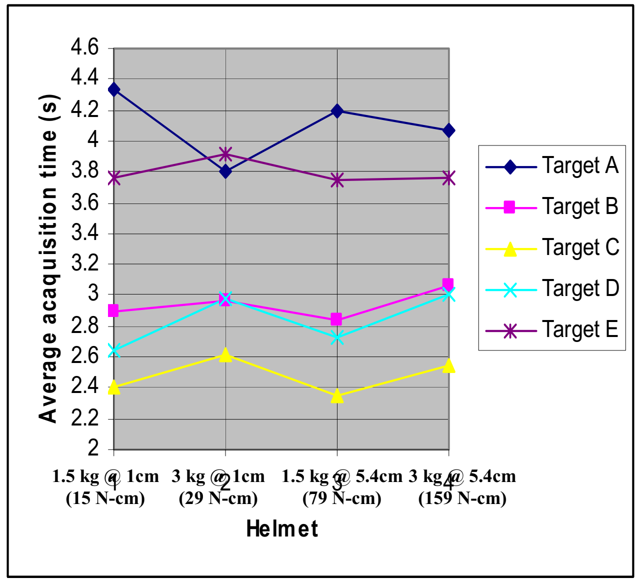

Figure 1: Average acquisition times by helmet and target

DISCUSSION

At six 5-minute intervals throughout a 120-minute flight, pilots were tasked to acquire targets placed throughout the cabin by pointing their helmet at the active target as quickly as possible. These tasks were repeated while the pilot wore four different head supported mass configurations. Overall, changes in helmet configuration did have a significant effect on target acquisition time, and it was the mass component of the system that produced the most significant effects in this aspect of performance. Helmets of greater mass (even if there was a lesser overall weight moment) performed worse on targets above the shoulders of the pilots, whereas a target on the center console of the aircraft performed better with the additional mass. The performance of the pilots in acquiring targets over the course of a 2-hour session did not change significantly. These results would indicate that reducing the mass of the helmet should be a priority in enhancing the effectiveness in pilots' head motion to detect and focus on targets in their environment.