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Motion Inference During +Gz Acceleration

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Interim Report for May 2004 to October 2005

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14. ABSTRACT Introduction: In the combat setting there are times when the pilot's attention is drawn away from the target momentarily and then redirected back to the target. In this scenario the pilot must infer the target's new position based on information about its previous position. This study measured the effect of +G _z on the pilot's ability to make inferences about aircraft position. Methods: Seven subjects (5 male; 2 female) participated. Ages ranged from 24 to 35 years. Acceleration profiles included 3, 5, and 7 G _z for 15 sec and a 7 G simulated aerial combat maneuver. The psychomotor task involved a target light that traversed the curved path from left to right at a constant velocity and then disappeared. The observer stopped the target by estimating when the target would intersect a fixed point. A secondary task consisted of four letters inside a box; subjects responded to sets containing a vowel. Results: A repeated measures ANOVA was performed for the mean angle error change from baseline performance metric. A significant difference among the 3, 5, and 7 G _z plateaus, and SACM 7 G _z plateau ($p = 0.0013$; Greenhouse-Geisser epsilon = 0.69, adjusted $p = 0.0053$). Two-tailed t-tests using the subject means revealed that the 5 G _z ($p = 0.0274$), 7 G _z ($p = 0.0037$), and SACM 7 G _z ($p = 0.0005$) plateau means to be significantly different from zero. Conclusions: A pilot's perception of dynamic target position may be compromised during exposure to low and moderate +G _z acceleration.					
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Motion Inference During +Gz Acceleration

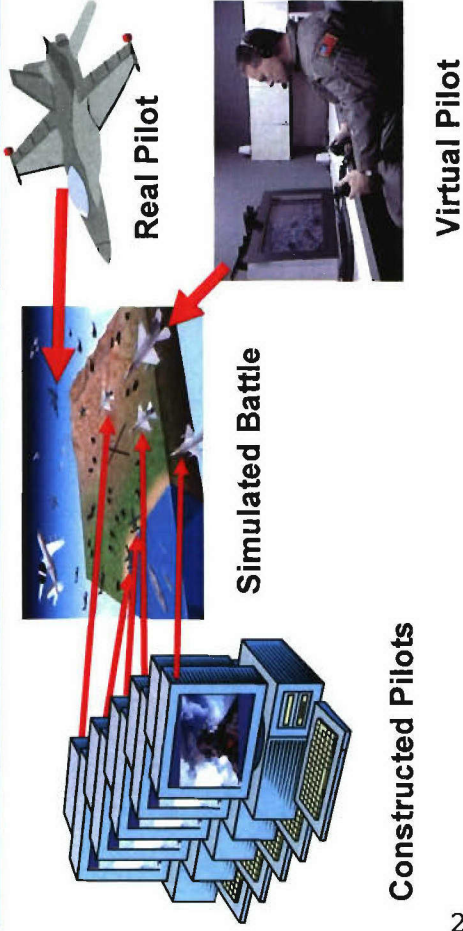
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Human Information Processing in Dynamic Environments Overview



Benefits to the War Fighter

- Modeling & Simulation tool-set useful for
 - Realistic training/wargaming
 - Improved mission planning
 - Simulation enhanced acquisition

Description

- Perform specific high G cognitive tasks on the W-P and Brooks centrifuges
- Measure subject performance throughout these tasks; use data to develop model
- Validate the model using additional data
- Integrate into one or more pilot models
- Provide the models to Simulation Tools: CART Joint Strike Fighter model, Eagles; JIMM (Joint Integrated Mission Model)

“The HIPDE model being developed in the Human Effectiveness Directorate is a significant addition to SIMAF simulation capabilities and products used for weapons systems performance evaluation. The integration of the HIPDE model will provide a more realistic simulation of real-world effects that limit pilot and operator interactions with simulated futuristic aircraft, avionics, weapons, and tactics in a variety of scenarios.”

ASC/HP- Modeling & Simulation Division
(SIMAF)



THE G-PASS TEST BATTERY



- **Test 1: Perception of Relative Motion**
- **Test 2: Precision Timing**
- **Test 3: Motion Inference**
- **Test 4: Pitch/Roll Capture**
- **Test 5: Peripheral Vision**
- **Test 6: Rapid Decision Making**
- **Test 7: Basic Flying Skills**
- **Test 8: Gunsight Tracking**
- **Test 9: Situation Awareness**
- **Test 10: Unusual Attitude Recovery**
- **Test 11: Short-term Memory with Distraction**
- **Test 12: Visual Monitoring**



Methods



- **Experimental Design:**
 - **Seven Subjects (5 male; 2 female)**
 - **Static & Dynamic Tracking Task Training**
 - **Subjects' performance varied less than 10% between training days**
 - **3 Experimental Test Days**
 - **Dynamic baseline data recorded each run**
 - **G-exposures per day (3, 5, 7 G_z - 15sec plateaus; 7G_z SACM 5sec plateaus)**

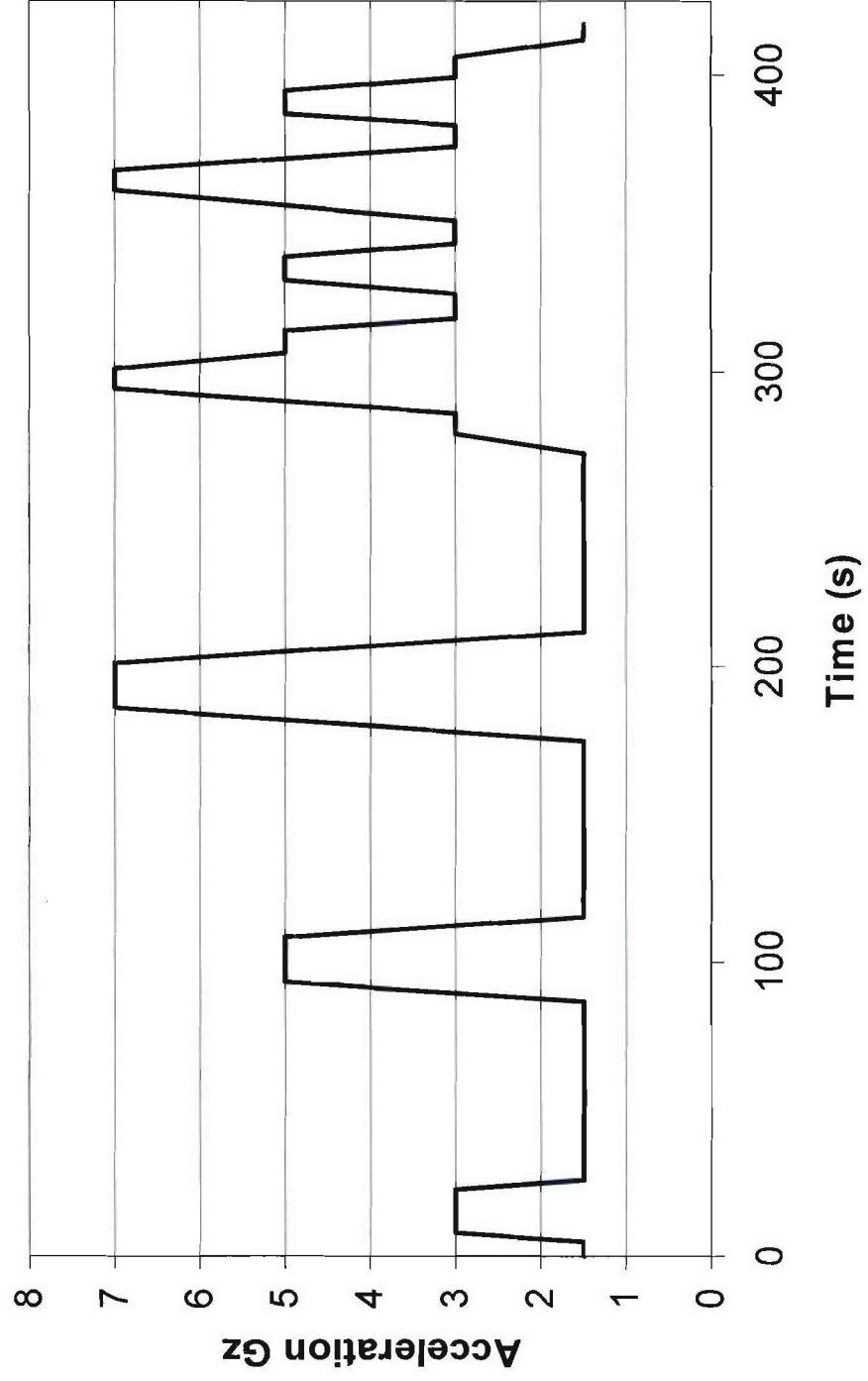


Methods

G_z Profiles



HIPDE G_z Profiles

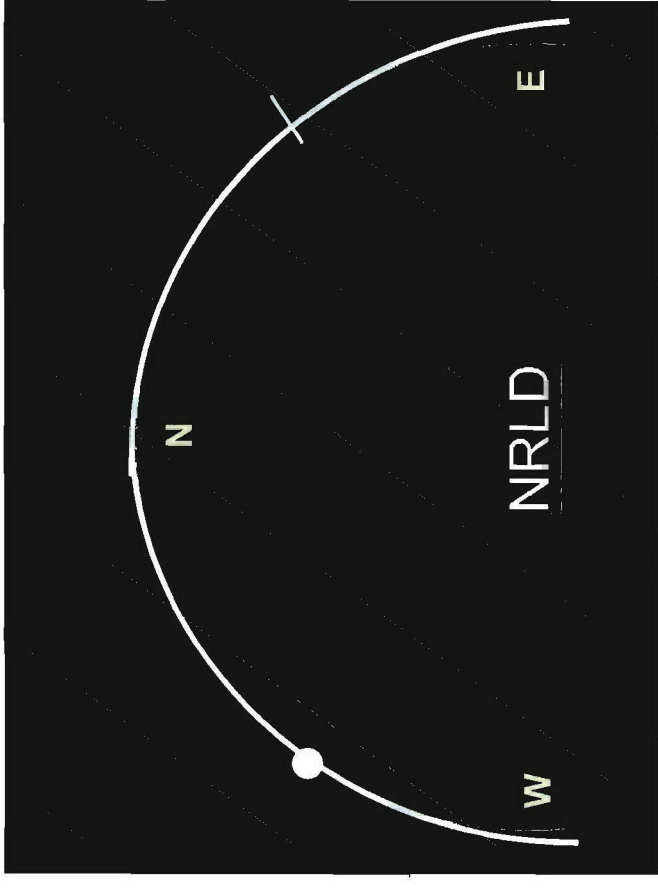




Methods



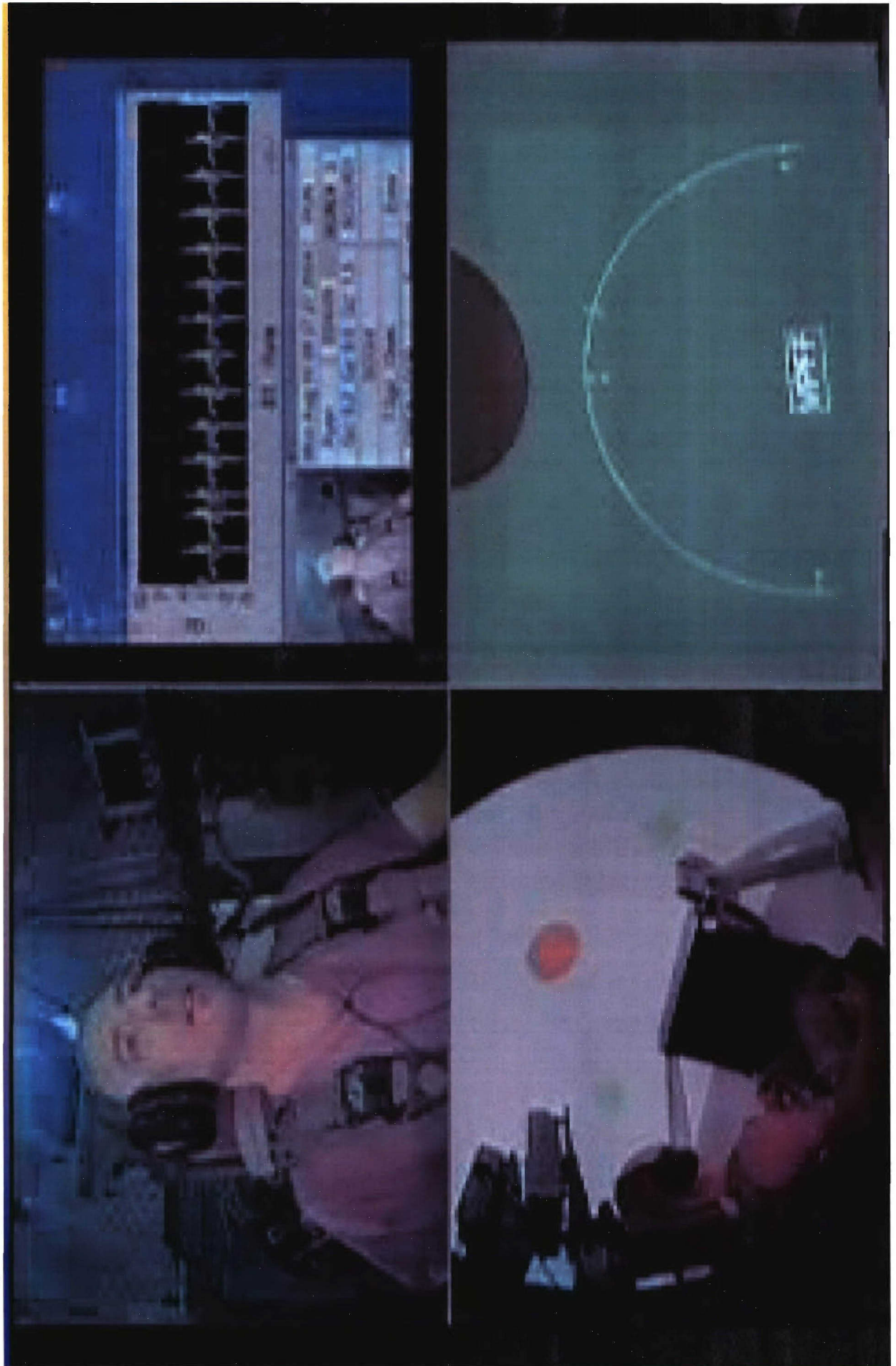
- The spot will begin to move along the designated path at a specific speed toward the stop point. The light will disappear some time before the stop point, and the subject will have to "infer" the motion and estimate the time it would take for the light to reach the stop point.
- Additionally, the subject will have to inspect four alphabet letters and determine whether any of them is a vowel. Two separate responses are therefore required: a "yes-no" response to the letters, and a "stop" response to the light.





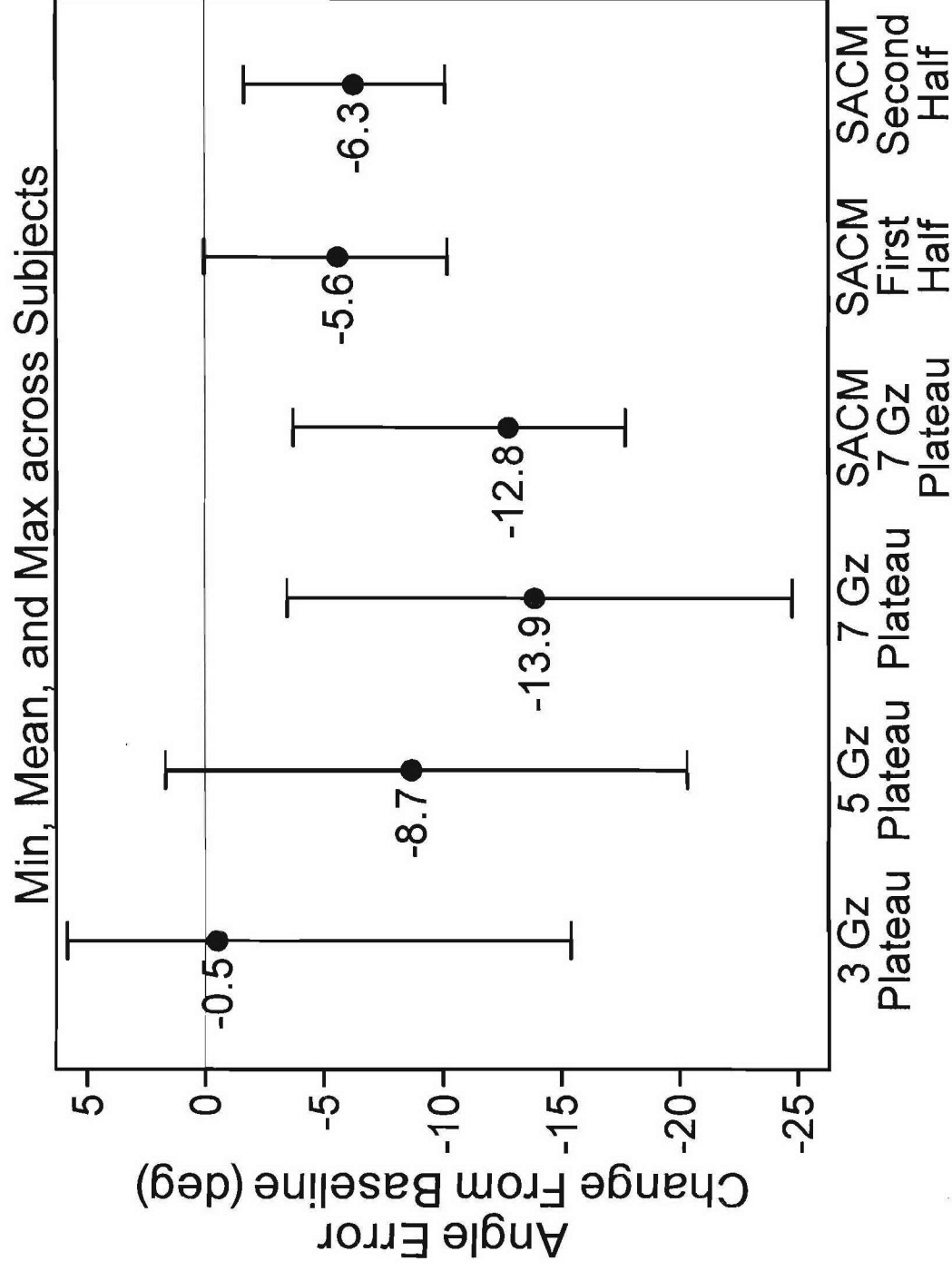
Methods

Subject Performing Task at G





Results





Results



- Repeated measures analyses of variance were performed with the mean angle error change from baseline for each subject as the dependent variable.
- A significant difference among the 3 Gz, 5 Gz, and 7 Gz plateaus, and SACM 7 Gz plateau ($p = 0.0013$: Greenhouse-Geisser epsilon = 0.69, adjusted $p = 0.0053$).
- No significant difference between the first half and second half of the SACM ($p = 0.5305$). Two-tailed t-tests using the subject means (no pooling) found the mean for the first half ($p = 0.0141$) and second half ($p = 0.0046$) of the SACM to be significantly different from 0.



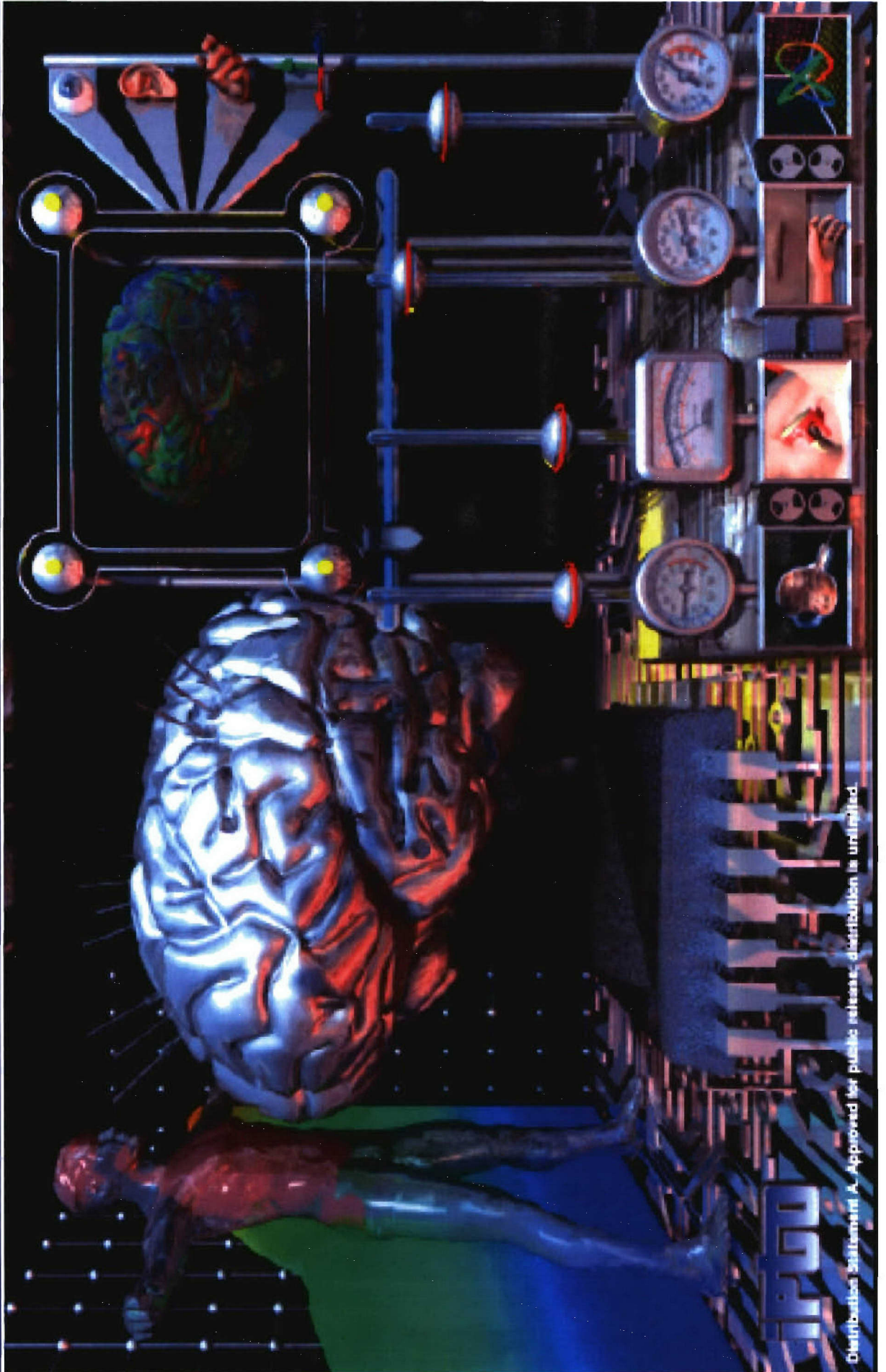
Summary



- The ability to make inferences about the speed and location of an object is compromised during exposure to 5 and 7 +Gz.
- Task performance in both the first and second half of the SACM was significantly different from baseline.
- In the operational setting, tasks which require the pilot to make inferences about the position of a moving target may be compromised as a result of moderate to high +Gz acceleration exposure.



Questions



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