

EFFECT OF MICROGRAVITY ON SEVERAL VISUAL FUNCTIONS DURING STS SHUTTLE MISSIONS

VISUAL FUNCTION TESTER - MODEL 1
(VFT-1)

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PURPOSE (VFT-1)

- **Previous visual acuity studies at different test distances and may be affected by age and lighting**
- **Determine effect of microgravity on distance visual acuity over mission duration**
- **Use high contrast acuity targets in small size increments under set lighting conditions**
- **Expand assessment to several other visual functions**

METHODS (VFT-1)

SUBJECTS

- **26 STS Astronauts**
 - **5 subjects with only 1 pre- and 1 on-orbit eliminated**
 - **1 Toric-SCL with on-orbit problem eliminated**
 - **n = 20; 1 HGP CL, 1 SCL, 1 Toric-SCL included**
 - **Repeat data on 2 subjects**

APPARATUS

- **Visual Function Tester - Model 1 (VFT-1)**
 - **Small, hand-held, battery powered**
 - **Seven vision tests:**
 - **Acuity in small steps to 20/7.7**
 - **Stereopsis to 10 sec-of-arc**
 - **Lateral phoria, Vertical phoria, Cyclophoria**
 - **Critical flicker fusion**
 - **Retinal rivalry**

METHODS

PROCEDURE

- **Pre-mission briefing and tester familiarization**
- **Vision assessed**
 - **2x pre-flight at 14 days (L-14) and 7 days (L-7)**
 - **Daily after wake-up on-orbit**
 - **3x post flight at landing, 3 days (L+3) and 7 days (L+7)**

DATA ANALYSIS

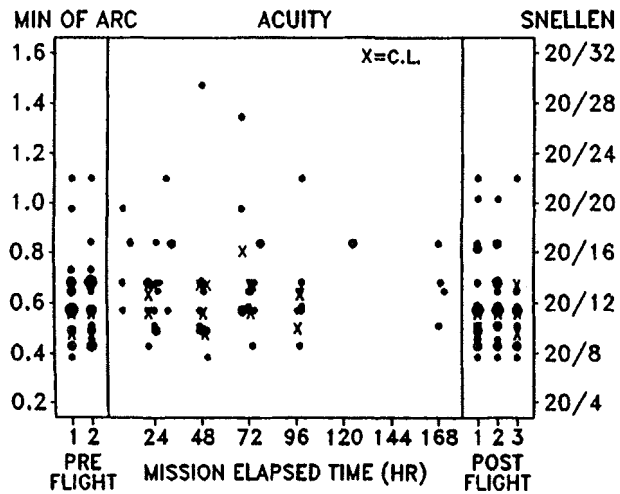
- **Calculated difference between mean of two pre-flight sessions (taken as baseline) and each subsequent measurement for each subject**
- **Non-parametric statistical analysis (Wilcoxon signed-rank)**

RESULTS

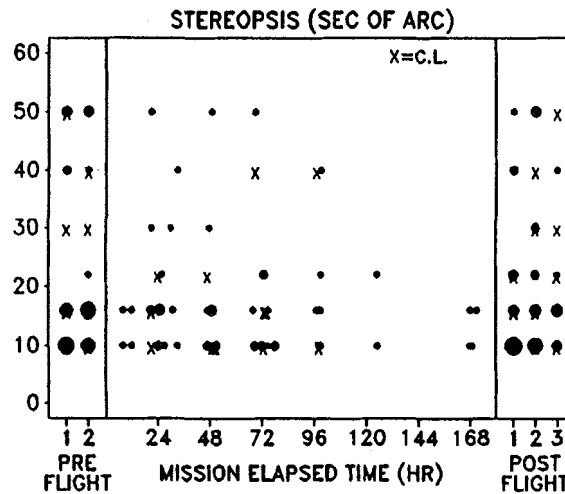
GROUP DATA

- **Corresponding data days are:**
 - **L-14 days = Pre-flight 1**
 - **L-7 days = Pre-flight 2**
 - **On-orbit = Hours of mission elapsed time (MET)**
 - **Landing = Post-Flight 1**
 - **L+3 days = Post-flight 2**
 - **L+7 days = Post-flight 3**
- **Size of dots represent number of subjects with same performance**
- **Variability between subjects in baseline pre-flight data is typical of psychophysical vision data**

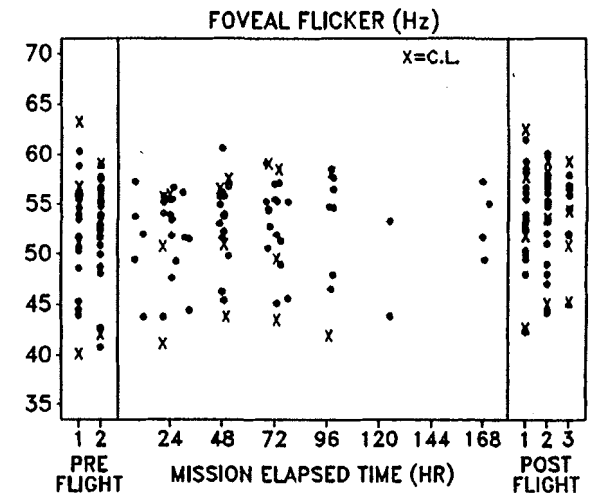
VFT-1 (GROUP DATA)



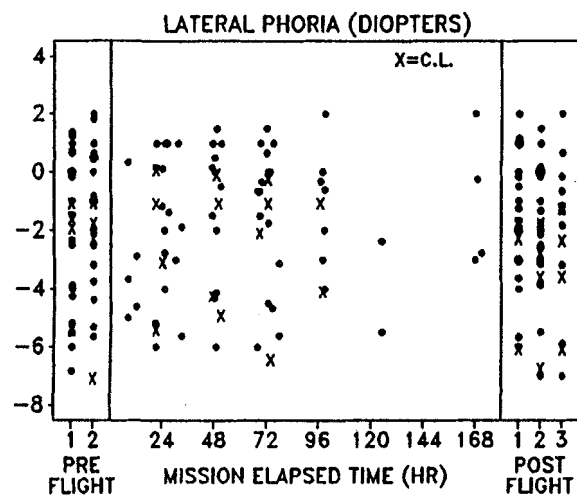
VFT-1 (GROUP DATA)



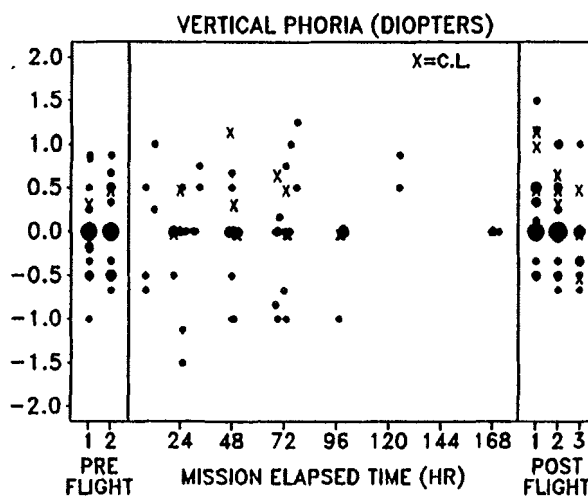
VFT-1 (GROUP DATA)



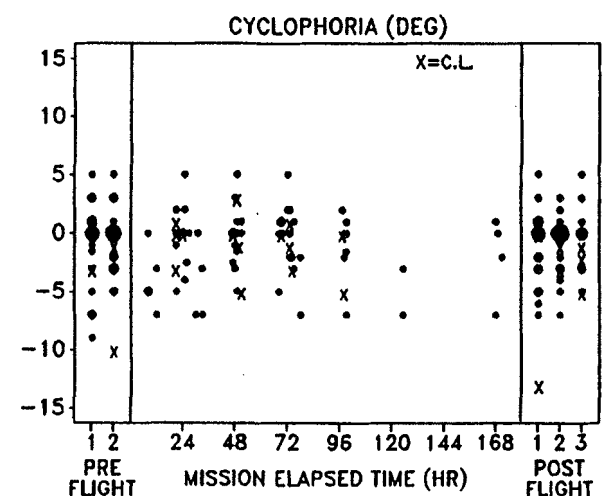
VFT-1 (GROUP DATA)



VFT-1 (GROUP DATA)



VFT-1 (GROUP DATA)



VFT-1 GROUP DATA

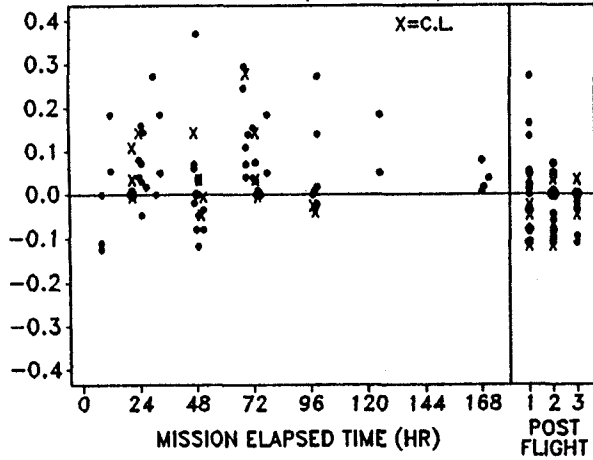
	MEAN PRE-FLIGHT	MEAN CHANGE
VISUAL ACUITY	0.61 min arc (20/12.2)	+0.06 min arc (to 20/13.4)
STEREOPSIS	19.8 arc sec	-4.9 arc sec
LATERAL PHORIA	-2.08 Δ (ESO)	+0.36 Δ
VERTICAL PHORIA	0.04 Δ	-0.07 Δ
CYCLOPHORIA	-1.14 (ENCYCLO)	-0.02
FOVEAL FLICKER	52.43 Hz	-0.06 Hz

RESULTS

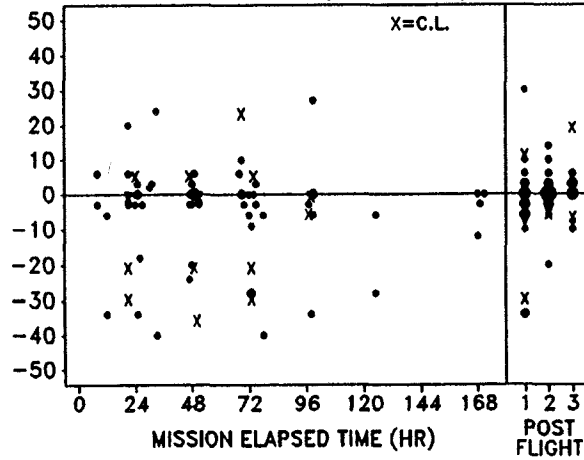
CHANGE DATA

- **Difference between mean of two pre-flight sessions (baseline) and each subsequent measurement for each subject was calculated**
- **Size of dots represent number of subjects with same amount of change**
- **No apparent trend in change for lateral and vertical phorias, cyclophoria, and critical flicker fusion; nor retinal rivalry (no figure)**

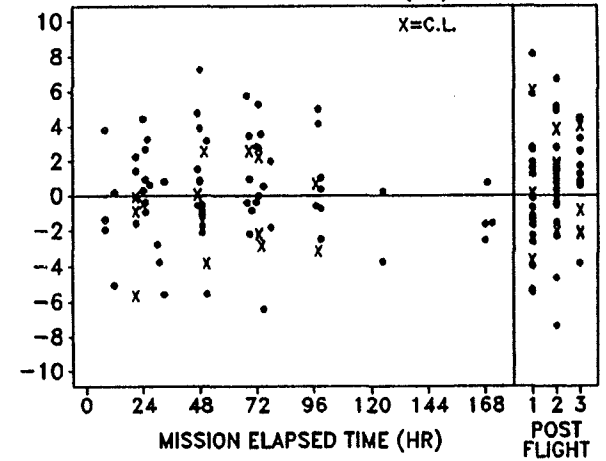
VFT-1 (CHANGE FROM PRE MEAN)
ACUITY (MIN OF ARC)



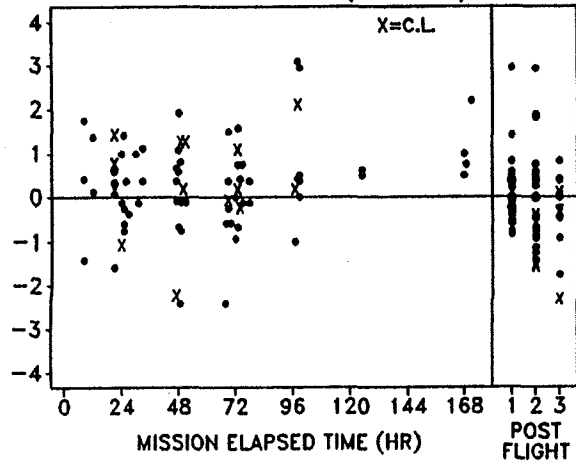
VFT-1 (CHANGE FROM PRE MEAN)
STEREOPSIS (SEC OF ARC)



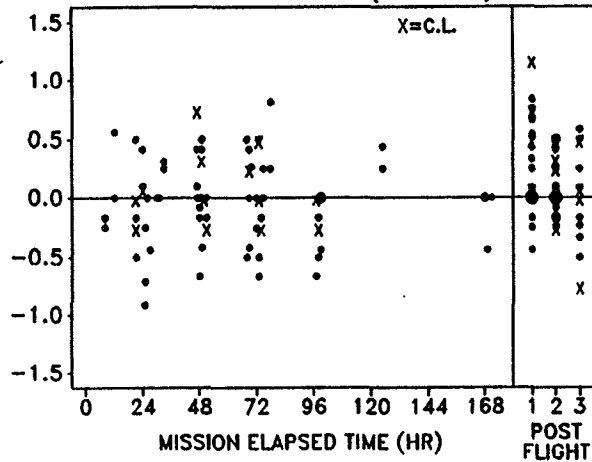
VFT-1 (CHANGE FROM PRE MEAN)
FOVEAL FLICKER (Hz)



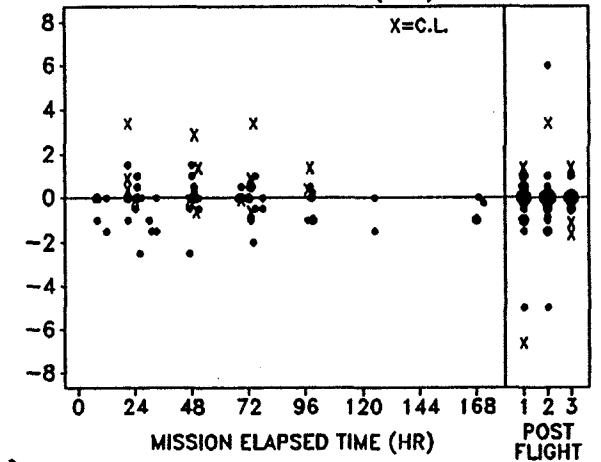
VFT-1 (CHANGE FROM PRE MEAN)
LATERAL PHORIA (DIOPTERS)



VFT-1 (CHANGE FROM PRE MEAN)
VERTICAL PHORIA (DIOPTERS)



VFT-1 (CHANGE FROM PRE MEAN)
CYCLOPHORIA (DEG)



2

RESULTS

STEREOPSIS CHANGE

- Slight trend toward smaller sec-of-arc stereopsis on-orbit (i.e., improvement), not apparent at landing or after
- On-orbit change from pre-flight baseline
 - Mean change at subject's first and last data = -5.0 arc sec
- Mean group change in stereopsis on-orbit was -4.9 arc sec from baseline; nearly significant ($p = 0.07$)
- Post-flight, change was only -0.8 arc sec at landing and was +1.1 arc sec by second post-flight (L+3 days) session

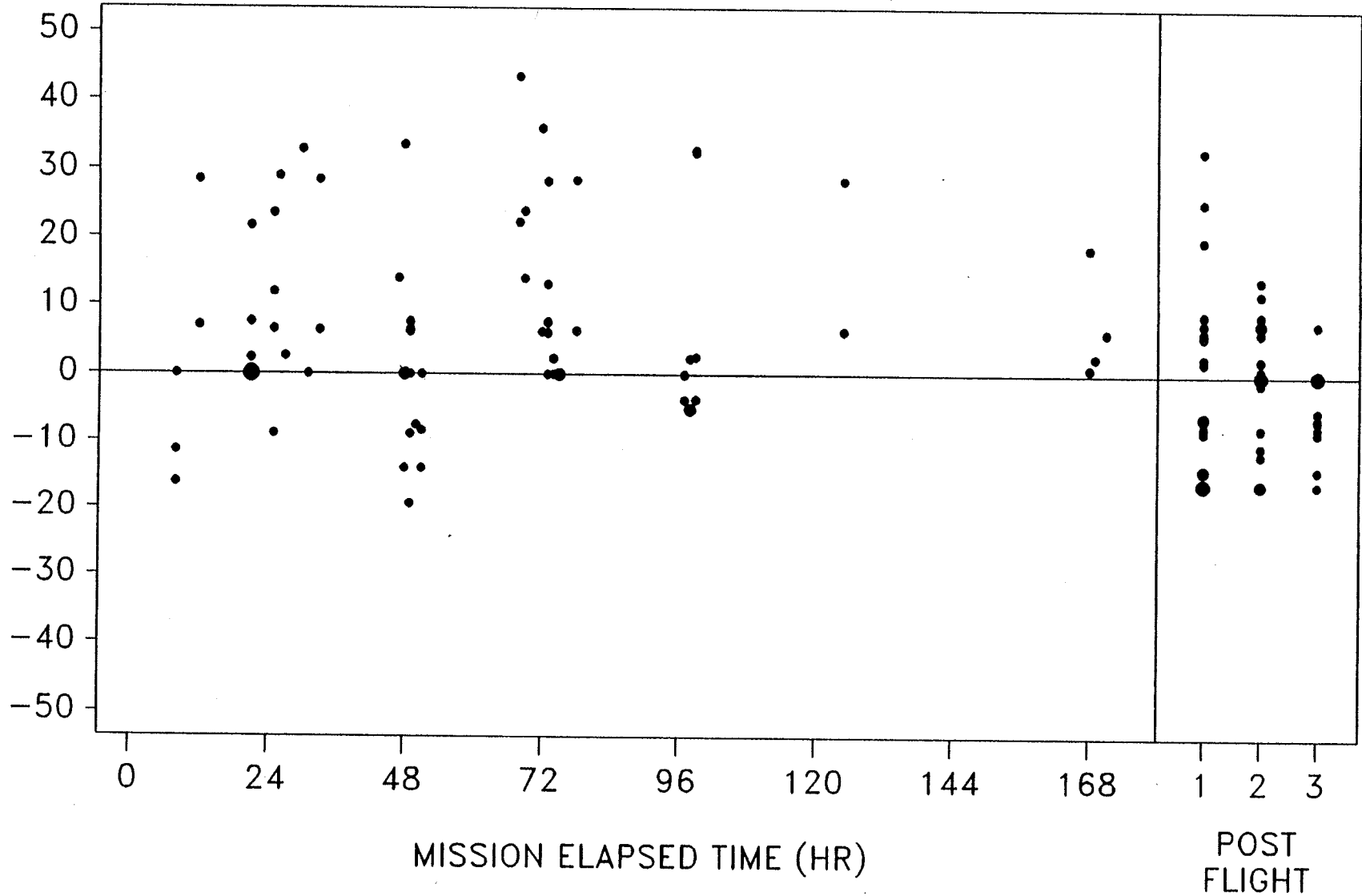
RESULTS

VISUAL ACUITY CHANGE

- **Definite trend toward larger min-of-arc resolution on-orbit (i.e., decreased acuity), not apparent at landing or after**
- **On-orbit change from pre-flight baseline**
 - **Mean change at first on-orbit data = +0.04 min arc (p = 0.13)**
 - **Mean change at last on-orbit data = +0.07 min arc (p = 0.001)**
 - **No significant difference between first and last data (p = 0.15)**
- **Significant mean group change of 0.06 min arc in visual acuity on-orbit from baseline (p = 0.005)**
- **No change from pre-flight baseline at landing or after (p=0.90)**

VFT-1 (PERCENT CHANGE FROM PRE MEAN)

ACUITY (MIN OF ARC)



DISCUSSION

- **No group changes on-orbit in lateral and vertical phorias, cyclophoria, critical flicker fusion, and retinal rivalry**
- **Mean group visual acuity loss on-orbit of only +0.06 min arc; corresponds to only slight change in Snellen acuity from 20/12.2 at baseline to 20/13.4 on-orbit**
- **Mean percent loss in acuity on-orbit = 7.5%; single data points ranged from 40% loss to 20% improvement**

DISCUSSION (Con't)

- **Mean group stereopsis improvement on-orbit of only 4.9 arc sec. Some subjects with marked improvement**
- **Two repeat subjects, in general, confirmed their initial results. Both subjects had large improvements in stereopsis on-orbit. Also found at the second mission (although one on-orbit data point varied for each)**