



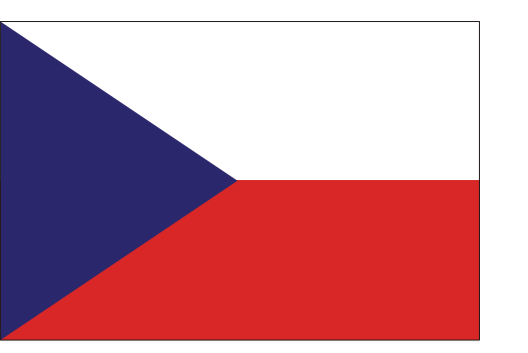
# Visual contrast sensitivity changes during orthostatic load

Petr DOŠEL, Jan PETŘÍČEK, Jan HANOUSEK, Ludvík CETTL

Institute of Aviation Medicine – Prague

Czech Republic

e-mail: [petrdosel@atlas.cz](mailto:petrdosel@atlas.cz)



## ABSTRACT

Vision provides the pilot with approximately 80% of information concerning his motion and position in space. Contrast sensitivity is very important for the ability to recognize details in visual field. Changes in blood distribution caused by +Gz acceleration lead to typical changes in vision quality and therefore to changes in contrast sensitivity.

LBNP method was used to simulate acceleration-induced changes in the blood supply of the human body. The test was done on 28 military pilots. The LBNP examination was accomplished as an exposure to the negative pressure level of -70 mmHg with achievement of this value in one second. The pilots were examined in sitting position.

Contrast sensitivity was tested twice: Before the load, and after the first minute of LBNP load.

Statistically significant results of contrast sensitivity changes in the first minute of LBNP load were obtained and the deterioration of vision was proved.

## Introduction

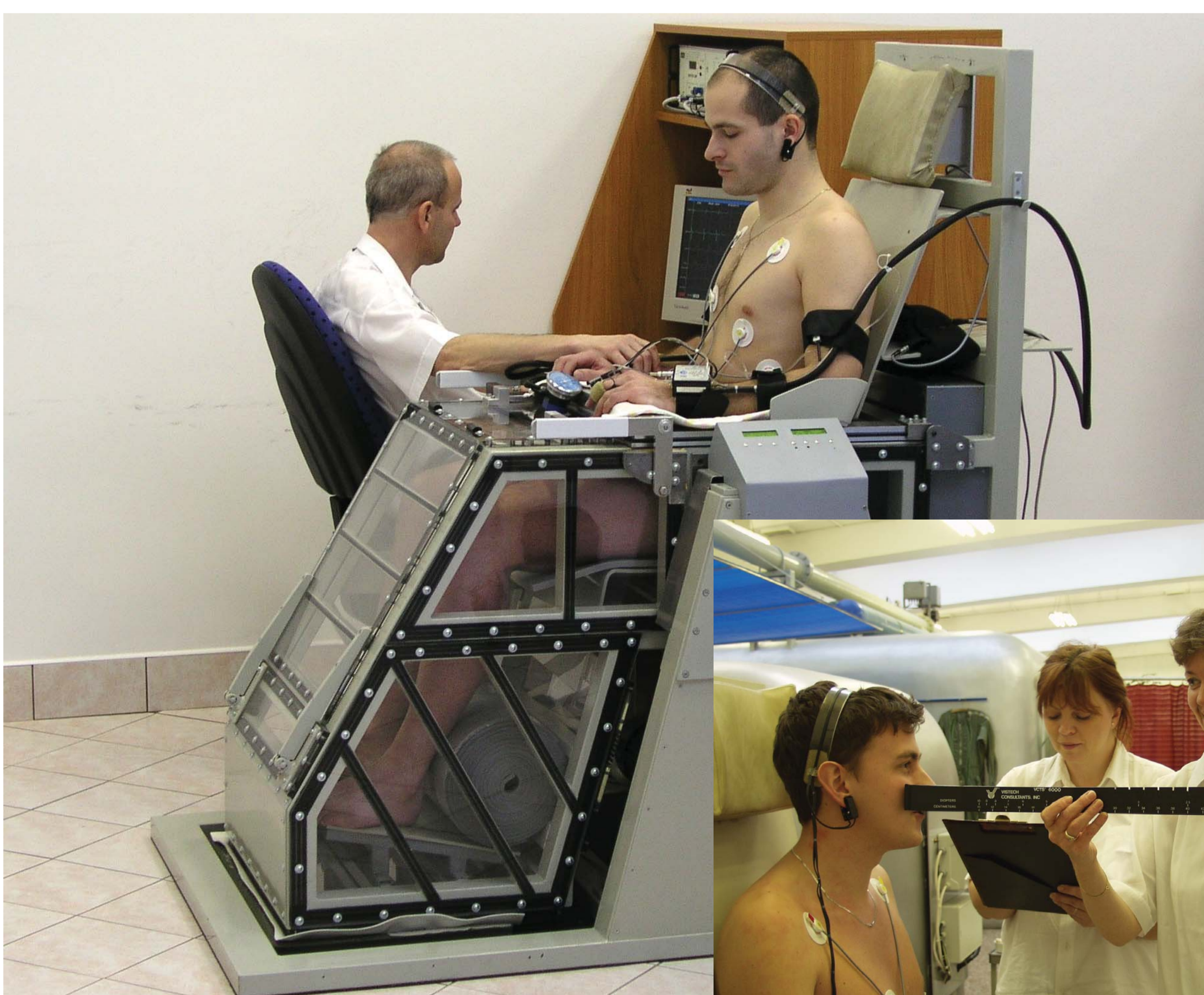
High level of the long lasting acceleration with an extensive gradient of the acceleration onset belongs to the flight specificity of modern agile aircrafts. Changes in blood distribution caused by +Gz acceleration lead to typical changes in contrast sensitivity. An objective assessment of contrast sensitivity deterioration under Gz load is of great importance.

## Method

The study was done on 28 healthy volunteers-active pilots of the Army of Czech Republic.

## Simulation of +Gz

LBNP method was used to simulate acceleration-induced changes in the blood supply of the human body. The LBNP examination was accomplished as an exposure to the negative pressure level of -70 mmHg with achievement of this value within one second.



LBNP device developed in IAM



Contrast sensitivity test

## Contrast sensitivity examination

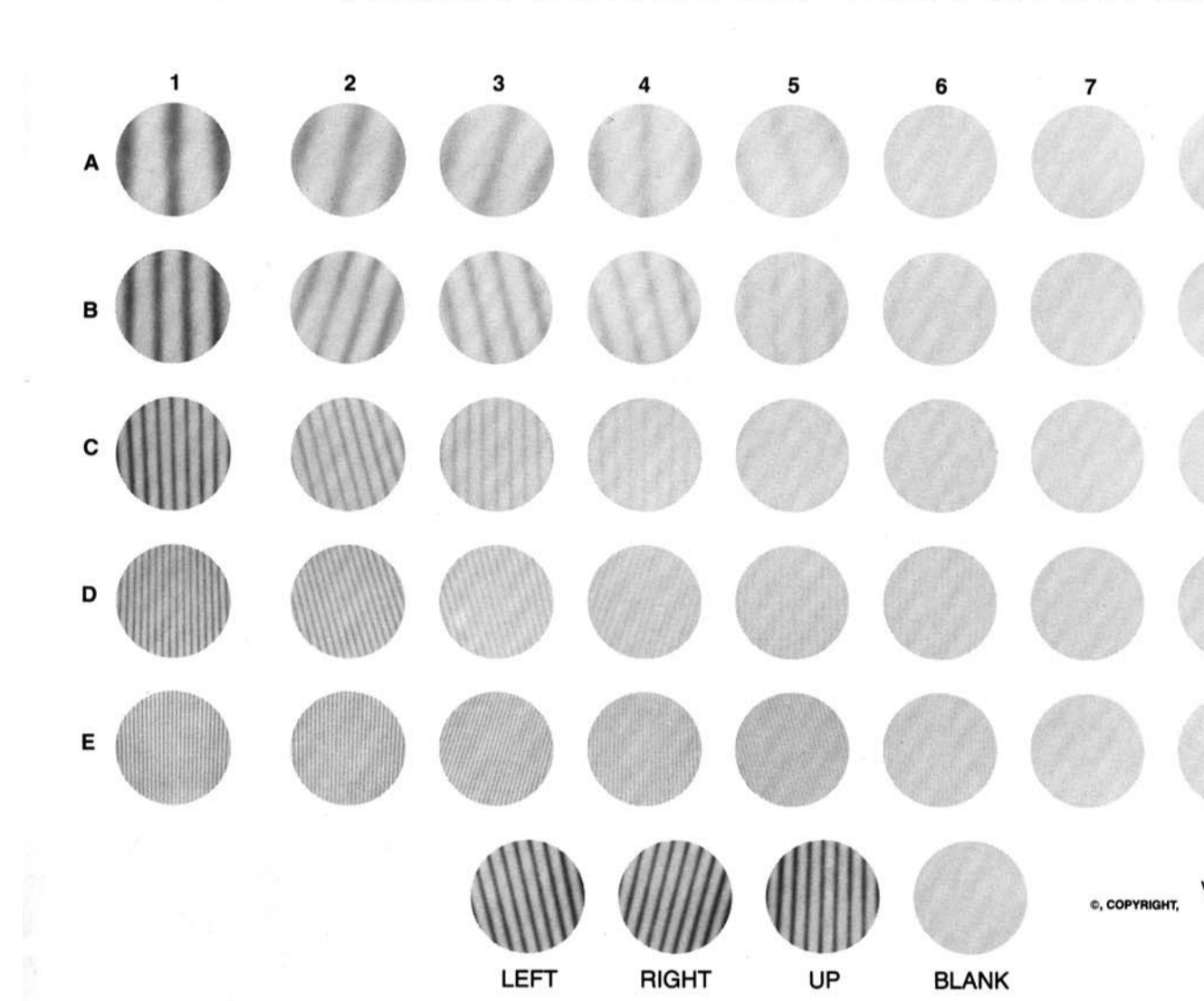
Contrast sensitivity was tested by means of Vistech Consultants (USA) VCTS (visual contrast test system) charts. Each subject was tested twice.

The first test was taken prior to LBNP exposition, and the second one after one-minute LBNP load.

Chart Configuration A

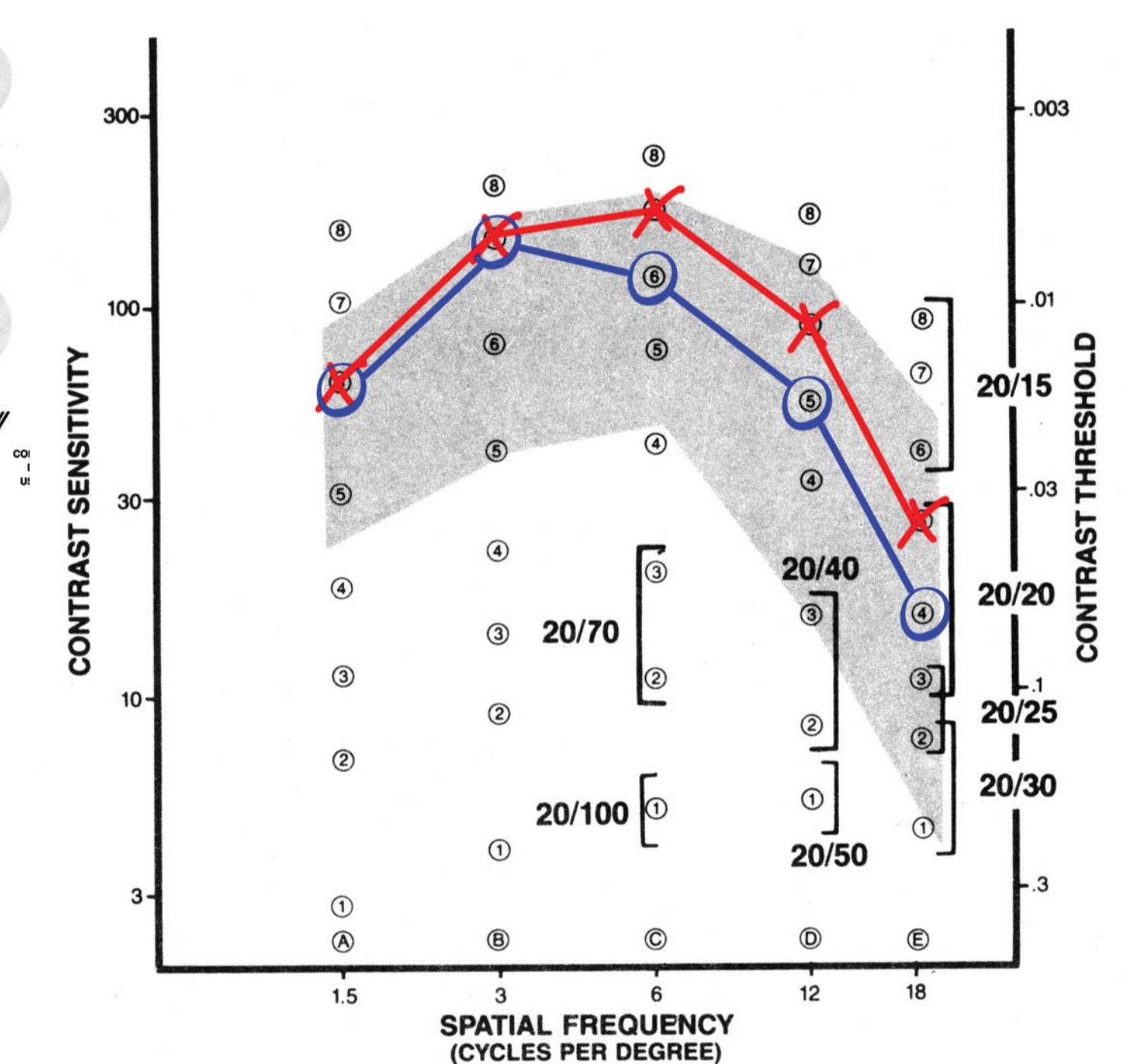
	1	2	3	4	5	6	7	8	9
<b>A (1.5)</b>	U 3	U 7	R 12	R 20	L 35	<del>L</del> 71	L 120	R 170	B
<b>B (3)</b>	U 4	L 9	R 15	U 24	U 44	L 85	<del>R</del> 170	U 220	B
<b>C (6)</b>	U 5	R 11	L 21	L 45	R 70	<del>U</del> 125	U 188	L 260	B
<b>D (12)</b>	U 5	U 8	R 15	U 32	<del>U</del> 55	L 88	U 125	R 170	B
<b>E (18)</b>	U 4	L 7	U 10	<del>R</del> 15	R 26	U 40	R 65	U 90	B

VISION CONTRAST TEST SYSTEM



VCTS chart

VCTS standard form



Sample data in graphical form

## Results

The Wilcoxon test was performed for each spatial frequency. Results are shown in table.

Spatial frequency	N	T	Z	p-level
1.5	28	27.50	0.49	0.624835
3	28	49.00	0.22	0.826091
6	28	0.00	3.62	<b>0.000293</b>
12	28	15.00	2.74	<b>0.006134</b>
18	27	8.00	2.79	<b>0.005214</b>

## Conclusions

Results from our testing demonstrated the significant impairment of contrast sensitivity on higher spatial frequencies during the orthostatic load. Our study confirmed substantial similarity of LBNP load influence on blood pressure regulation to +Gz acceleration load. It is possible to use LBNP as a method of visual changes evaluation during +Gz load.

## REFERENCES

- Došel P., Hanousek J., Petříček J., Cettl L.: Pilots' examination in a rapid LBNP exposure. Journal of Gravitational Physiology, 12, 2005, 1: 87 – 88.
- Hanousek J., Došel P., Cmíral J., Petříček J.: Physiological Response of Pilots to the Load of Lower Body Negative Pressure. Journal of Gravitational Physiology, 4, 1997, 2: 33 – 34.