Does Anybody Have Any Gravol?

Up and down: two really simple concepts on Earth. But on the Space Station, where the astronauts are in a state of free-fall, it's really hard to tell what's up! On Earth, if you close your eyes, you tell where your feet are on the ground because gravity affects your joints, muscles and inner ear (which controls your sense of balance). In space, your brain doesn't have the benefit of the clues that it gets from the effects of gravity on the body. In a free-fall state, the brain receives information from the eyes, but it's used to receiving information from several sources. It tries to compensate, but the result is motion sickness. One out of two astronauts suffers from it! Many people on Earth do too when they travel by car or plane and suddenly feel nauseous.

Scientists and astronauts have spent several years investigating the relationship between motion sickness and a small part of the inner ear structure called the vestibular system. The vestibular system is your body's main source of balance and body orientation. It is helped out by pressure sensors in your muscles and skin, and, of course, your eyes. Since it took millions of years to evolve, it's not surprising that the vestibular system hasn't yet adapted to "sudden" changes in human activity, like reading in the back seat of a car, or orbiting the planet in a free-fall state

Try the following orientation experiments.

Orientation Experiment #1

Purpose

To demonstrate how the brain uses visual cues for spatial orientation

Materials

- A swivel chair, (preferably with arms)
- Blindfold
- Pencil
- Earplugs (if possible)

Procedure

1. Have a student sit in the swivel chair, with the seat raised as high as possible, and put on the blindfold and ear plugs. If their feet touch the floor, ask them to sit cross-legged.

2. Have the person in the chair hold the pencil upright in both hands, with their arms extended straight out, level with the floor.
3. Tell the person in the chair that you are going to rotate the chair slowly, occasionally changing direction, and that they are to point the pencil in the direction that they think they are rotating.
4. Slowly rotate the chair for about 10 seconds, then stop it. Turn the chair in the opposite direction, and watch what happens to the pencil.
5. Repeat this process for three more "spins", sometimes changing the direction, sometimes turning the chair in the same direction as the previous rotation.
6. Record the direction in which the student pointed the pencil after each rotation, when the chair was stopped, and at the end of the experiment.

Explanation

Students will probably notice that the students being rotated became disoriented without their visual sense, and that the pencil was pointed in the wrong direction. Without aural or visual cues we are lost, just as a person in a silent, pitch-dark room begins to stumble, even on a level floor.

Orientation Experiment #2

Purpose

To demonstrate how the brain uses visual cues for spatial orientation

Materials

- A swivel chair
- Crumpled balls of paper
- Wastepaper basket

Procedure

1. Ask a student to sit in the swivel chair, facing forward, head erect.
2. Have the student in the chair toss a crumpled ball of paper into a wastepaper basket 1.5 meters away.
3. Rotate the chair slowly for 30 seconds. Ask other students to watch the seated student's eye movements.
4. Repeat the rotation; then immediately have the student in the chair toss the paper ball into the basket again. What happens?

Explanation

Students will probably notice that the subject is very likely to miss the basket, even if he or she was spun slowly. It takes several seconds for the eyes, overloaded with visual cues by the spin and the still-sloshing fluid in the inner ear, to give an accurate spatial reference. If you've ever spent a day on a boat and then tried to jump a metre or so to the dock, you'll experience the same effect.

Conclusion

The results of experiments conducted in a free-fall state have broadened our understanding of the neurovestibular functions. In the future, astronauts will work for weeks, months and eventually years in apparent weightlessness. Every time they make the trip into space, they will have a period of adjustment where they will experience motion sickness. Ongoing studies will be very useful for assisting astronauts in making that adjustment and for treating people on Earth who suffer from motion sickness or have difficulty with their sense of balance.

Adapted from the Canadian Space Agency / Texte modifié tiré de l'Agence spatiale canadienne
www.space.gc.ca