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COMPARATIVE MEASUREMENT OF VISUAL STABILITY IN EARTH AND COSMIC SPACE

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Purpose of the Research

The frequency and the intensity of space motion sickness has been reviewed and investigated (Treisman, 1977). Unusual induced-gravity situations, such as rotation, linear acceleration, parallel swinging (Guedry, 1966; Lackner, 1976; Melvill Jones, 1970), etc. have been investigated as well. Visually-induced motion sensation or distorted perception have been evaluated with respect to visual stability by many investigators (Rock, 1966; Grabiel, 1974; Howard, 1966, 1974, 1988; Snyder & Pronko, 1952; Dichgans & Brandt, 1973; Dolezal, 1982; Gibson, 1958, 1966, 1979). These studies are all concerned with the effect of gravity and the induction of motion sickness through human visual perception. Direct investigation under the microgravity situation, such as parabolic flight, Skylab, and Spacelab, have been carried out (von Baumgarten, 1986; Vogel, 1986; Young, 1986, Koga, 1988, 1989). These studies focused on how human visual stability is established through various sensory afferents in specfic gravity conditions. Results from these investigations indicate that sensory mismatch probably plays an important role in space motion sickness.

The interaction of visual, vestibular, and somatosensory perception is smoothly coordinated under normal gravitational conditions on the Earth in our daily life. When the cooperation is destroyed or a mismatch occurs among them, motion sickness may develop not only on the

Earth but also in microgravity. The latter case may be the cause of space motion sickness or space adaptation syndrome.

How human beings obtain visual stability even with posture changes on the ground has been investigated. Visual stability can be categorized as static or dynamic. Static visual stability is concerned with orientation and dynamic stability is concerned with object motion perception. The perception of visual stability is modified by many other sensations, such as somatosensory, vestibular, and muscle tension. We will mainly focus on modifications by vestibular inputs to visual perception produced by eye movements in microgravity. The Vestibular-Ocular Reflex (VOR) is a well-known characteristic which results from the relationship between eye mobility and vestibular afferent inputs. Eye movements also modify dynamic visual perception, such as perceived object motion velocity. The VOR is constantly stimulated under 1-g conditions here on Earth. In fact, human beings have been habituated and "programmed" for orientation (visual stability) in their everyday, 1-g environment. When humans are exposed to a different gravity situation, this programmed behavior must change; that is, it is reprogrammed. This is called habituation or familiarization. We hope to examine how object motion perception is perturbed and subsequently adapted in the microgravity environment.

Expected Results

This experiment is focused on the cooperation of visual, vestibular, and somatosensory perception coordination and how it is changed or reduced in space compared to 1-g environment. We will obtain information on the coordination between eye movement and neck muscle activity by using EOG and EMG. We will also collect data from Payload Specialists using a self-diagnostic questionnaire concerned with perceptual abnormality. When each sensory input function and its integration in the higher nervous system are well-characterized, then more effective techniques to control SAS may be developed.