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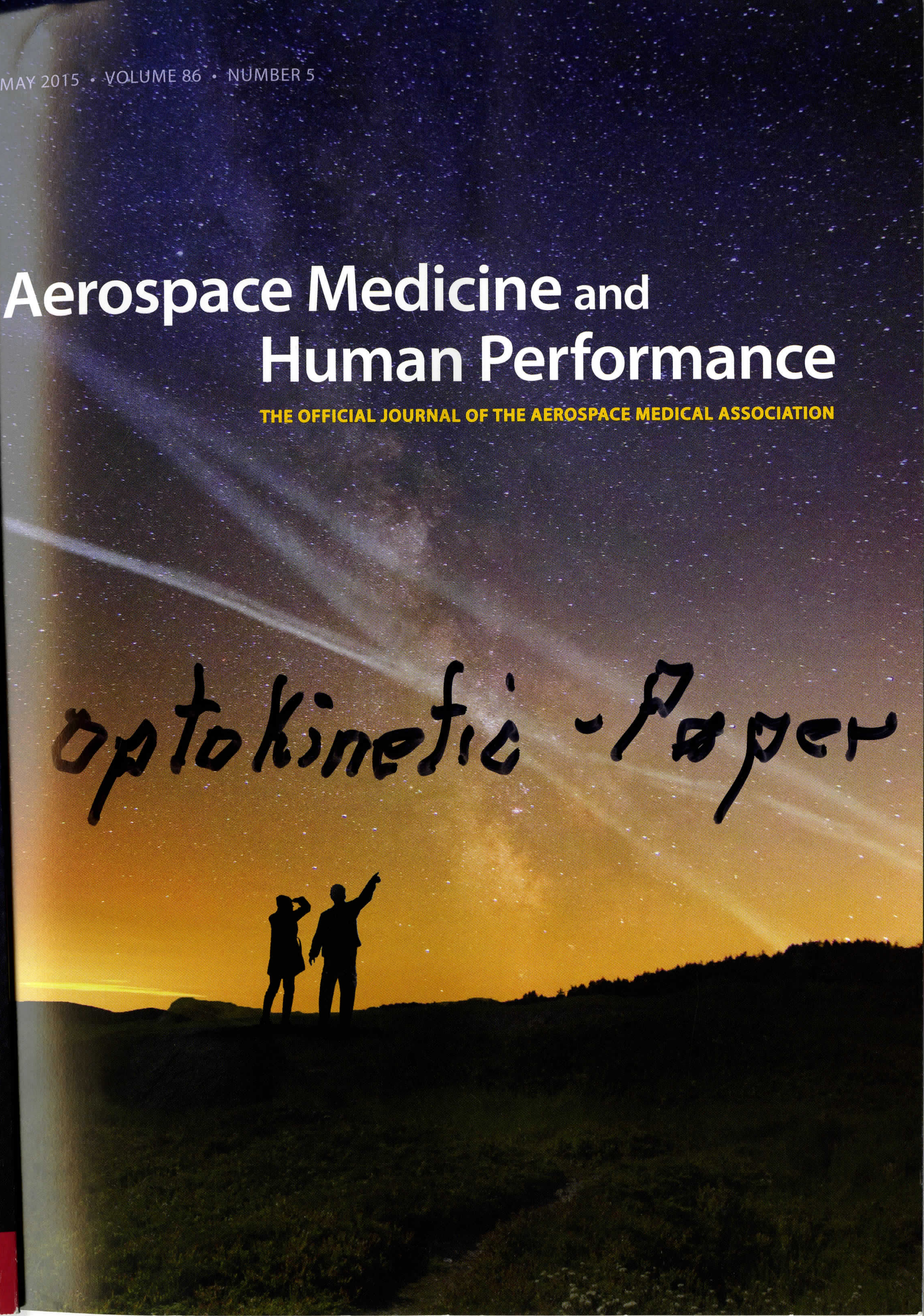

Visual Blur and Motion Sickness in an Optokinetic Drum

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BACKGROUND: The most commonly cited hypotheses for motion sickness (MS) focus on inconsistent sensory inputs. Visual/vestibular conflicts may lead to MS, but visual input from retinal regions/neural pathways that are sensitive to motion might bear more weight in MS etiology. We hypothesized that inducing blurred vision in an optokinetic drum would attenuate the influence of foveal (parvocellular) input, but not peripheral (magnocellular) input that is sensitive to motion. Increased relative influence of peripheral visual input was predicted to subsequently lead to more visual/vestibular conflict and subsequently more severe MS symptoms.

METHODS: Through goggles that were either clear or frosted, 15 subjects (5 men, 10 women, mean age = 24.9 yr, range = 18-49) viewed the interior of a rotating ($60° \cdot s^{-1}$) optokinetic drum for 10 min. Subjects completed the Simulator Sickness Questionnaire (SSQ) before and after viewing. Overall subjective sickness ratings (0-10) and visually induced self-motion perception (vection) ratings (0-10) were also recorded.

RESULTS: Postexposure SSQ scores obtained in the blur condition (total - 52.9, oculomotor - 38.9, disorientation - 69.6) were significantly higher than those obtained in the control condition (total - 30.4, oculomotor - 21.7, disorientation - 37.8). Overall sickness ratings and vection ratings were also significantly higher in the blur condition.

CONCLUSIONS: These results suggest that visual blur can exacerbate MS, perhaps because of differential influences of visual pathways. Although these results were obtained with an optokinetic drum, possible effects of visual blurring in motion provocative environments such aircraft, watercraft, spacecraft, and land vehicles should be considered.

KEYWORDS: sensory conflict, vision, vestibular, vection.

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The best known theories of motion sickness (MS) are based on sensory conflict.[17] These theories assert that when afferent signals regarding self-motion are not consistent, MS can result. Such inconsistencies often involve the visual and vestibular systems. Hence, the navigator of an aircraft, who looks mostly at instruments, may be more susceptible to MS than the pilot who often receives consistent visual and vestibular inputs regarding self-motion. Sensory conflict does not require actual self-motion relative to Earth. Visual input alone such as that which can occur in a flight simulator can lead to compelling self-motion perception that is entirely visually induced. This phenomenon, known as vection,[3,23] is associated with simulator sickness.[8] Even if one accepts sensory conflict as a possible cause of MS, the explanation is incomplete. The question about "why" sensory conflict should lead to MS needs to be addressed.

Some investigators and theorists have proposed that MS is part of our genetic endowment and the product of evolution.[6,13,14] A large survey study of monozygotic and dizygotic twins yielded results suggesting a strong and significant genetic contribution to MS susceptibility.[18] One set of theories asserts that sensory conflict can 'trick' the brain into reacting as if poisoning has occurred.[15,22] Such theories treat MS as a mistakenly engaged mechanism aimed at eliminating toxins from the body. Another explanation for MS is that sensory conflict both within a sense (vestibular) and between senses (visual/vestibular) can falsely trigger a protective mechanism aimed at inhibiting mobility during

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