size change on priming in the two modalities. However, the differentiable effects persisted with a 5-h delay. This suggests that object processing that subserves identification priming maintains modality specificity, even though cross-modal haptic–visual identification priming has been demonstrated.

(3008)

Change Blindness as a Multisensory Phenomenon: Evidence From Tactile Change Detection. ALBERTO GALLACE, *University of Oxford and Università degli Studi di Milano-Bicocca*, HONG Z. TAN, *Purdue University*, & CHARLES SPENCE, *University of Oxford*—Given the evolutionary importance of successful environmental change detection, it is surprising that people are so poor at detecting changes to successively presented visual scenes (the phenomenon of "change blindness"). We explored people's ability to detect tactile change by sequentially presenting two vibrotactile arrays consisting of one to three stimuli over the body surface. We investigated the detection of changes to the number of stimuli presented and changes to the location of the stimuli, using a tactile analogue of the flicker paradigm. Change detection performance was good when the patterns alternated continuously, but poor when they were separated by a 110-msec gap. We also compared performance under conditions of unimodal (visual or tactile) versus bimodal (visual and tactile) change. Our results demonstrate the existence of tactile change blindness and are discussed in relation to other recent findings (e.g., on tactile numerosity judgments) that also highlight severe limits on tactile information processing.

(3009)

Dissociation of Egocentered Reference Frames Alters Auditory–Visual Fusion in Space. DAVID HARTNAGEL, *IMASSA and Université Paris 8*, & ALAIN BICHOT & CORINNE ROUMES, *IMASSA* (sponsored by Muriel Boucart)—Auditory–visual (AV) fusion studies permit us to investigate space perception without localization response bias; they have shown that perception of unity varies across space in azimuth. Humans make numbers of gaze movements that induce dissociation between auditory and visual reference frames. Question arises as to the effect of this dissociation on variation of AV fusion in the 2-D frontal space. Two psychophysical experiments were performed to determine fusion thresholds (in darkness and in light). Gaze position was controlled by an eye tracker in order to guarantee the dissociation between reference frames at stimulus onset. The 500-msec bimodal stimulation consisted of a 1° spot of light (or a laser beam in darkness) displayed on an acoustically transparent screen in synchrony with a 49-dB (A) broadband pink noise provided by one of 35 loudspeakers. Results showed that the reference frame of AV fusion is neither head nor eye centered, but results from cross-modal dynamic interaction.

(3010)

Learned Cross-Modal Integration of Novel Visual Cues With Auditory Speech. JOSEPH D. W. STEPHENS & LORI L. HOLT, *Carnegie Mellon University and Center for the Neural Basis of Cognition*—The integration of information across modalities is a key component of behavior in everyday settings. However, little is known about the extent to which experience affects mechanisms of multimodal integration. In the present study, participants were trained for more than 10 sessions on audiovisual combinations of speech sounds and corresponding movements of an animated robot, whose features bore no resemblance to speech articulators. Participants' use of auditory and visual information was tested periodically throughout the experiment. During training, identification of acoustically presented consonants began to be influenced by simultaneous presentation of trained visual stimuli. The nature of this influence changed by the end of training, suggesting that further experience altered perceptual mechanisms for combining information. A subsequent experiment manipulated relations between the trained visual stimuli, such that they were more incompatible with the structure of natural visual speech. The findings are relevant to theories of speech perception and multimodal integration.

(3011)

Eyes, Ears, and Cars: Errors and Illusions in Motion Perception. TAMARA L. BOND & RANDOLPH D. EASTON, *Boston College* (sponsored by Randolph D. Easton)—The present research examines the ability of individuals to identify the direction of motion and the location of vehicles, using auditory, visual, and bimodal stimulus cues. Vehicles were presented using surround sound audio, video, and bimodal audiovisual tracks. Participants pressed a button to indicate the direction of motion when they perceived each vehicle crossing their midline. Individuals were also presented with a directional conflict paradigm, where visual and auditory information flowed in opposite directions. Preferential attention to auditory and visual information was also manipulated. Approximately one third of the individuals detected the presence of the directionally conflicting stimuli, and this predicted accuracy in auditory tasks. Accuracy for directional information was better for visual and bimodal trials than for audio trials, indicating directional ambiguity for auditory motion. Differences in localization ability were exhibited for auditory, visual, and bimodal stimuli.

(3012)

Cybersickness and Vection Induced by an Expanding and Contracting Optical Flow Pattern. ANDREA BUBKA & FREDERICK BONATO, *Saint Peter's College*, & STEPHEN A. PALMISANO, *University of Wollongong*—Cybersickness (or simulator sickness) often occurs in vehicle simulators and other virtual environments. Unlike typical motion sickness, cybersickness does not depend on physical motion. It is often accompanied by visually induced self-motion perception (vection). In the present study, the effects of an expanding and contracting optical flow pattern on cybersickness and vection were measured. Observers viewed a pattern on an LCD computer monitor that alternately expanded and contracted, flow direction changing every 5 sec, or that steadily expanded (control condition). Cybersickness and vection were assessed after 5 min using established subjective scales. The results were that the contracting and expanding pattern yielded significantly more severe cybersickness and vection was perceived as an oscillating forward and backward self-motion. These results suggest that cybersickness is associated more with vection that changes in direction and not with vection magnitude per se. Results will be discussed in the context of several motion sickness theories.

(3013)

What Is the Provocative Stimulus for Motion Sickness? FREDERICK BONATO & ANDREA BUBKA, *Saint Peter's College*—The most well-known theories of motion sickness (MS) are based on sensory conflict, but what kinds of conflicts lead to MS? The subjective vertical mismatch theory asserts that MS results only when the sensed vertical conflicts with the expected gravitational vertical (based on past experience). We propose a rival theory that asserts that the sensed and the expected effects of motion alone can lead to MS; a vertical mismatch is not necessary. In two experiments using an optokinetic drum, a subjective vertical mismatch was avoided, since rotation direction and velocity were manipulated. MS onset was fastest and symptoms more severe when rotation direction or velocity changed. Under these conditions, visual input leads to self-rotation perception that also changes direction and velocity, but the vestibular system indicates that the observer is stationary. These results support a theory based on sensed and expected motion and seriously undermine the general applicability of the subjective vertical mismatch theory.

• Timing and Counting •

(3014)

Developmental Differences in Individuation: Containment and Connection. ELIZABETH F. SHIPLEY & BARBARA SHEPPERSON, *University of Pennsylvania*—Individuation by 4-year-olds and adults was examined in tasks requiring a count of the "things" in arrays of 3-D objects. Participants were asked to count arrays (1) that included