Learning Multisensory Representations

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UNIVERSITY OF ROCHESTER

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Final Report
# Learning Multisensory Representations

People's everyday experiences are multisensory. For example, while eating breakfast, we both see and grasp our coffee cup. Moreover, multisensory perception is critical in some highly important situations, as when a TSA agent searches a passenger’s bag by both looking inside the bag and touching its contents or when a police officer frisks a person using both visual and tactile inspection. In brief, our research program uses experimental and computational methodologies to study how people acquire multisensory representations and how the use of these representations influences perceptual judgements and decision making. The program focuses on people’s performances in visual-haptic and visual-auditory environments. Funding from this grant supported research reported in 7 journal publications and 3 conference publications (manuscripts based on 2 of the conference publications are currently being prepared for journal submission).

## Subject Terms
- multisensory perception
- visual perception
- haptic perception
- auditory perception
- perceptual learning
- perceptual decision making
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People’s everyday experiences are multisensory. For example, while eating breakfast, we both see and grasp our coffee cup. Moreover, multisensory perception is critical in some highly important situations, as when a TSA agent searches a passenger’s bag by both looking inside the bag and touching its contents or when a police officer frisks a person using both visual and tactile inspection.

In brief, our research program uses experimental and computational methodologies to study how people acquire multisensory representations and how the use of these representations influences perceptual judgements and decision making. The program focuses on people’s performances in visual-haptic and visual-auditory environments. People are extraordinarily good at learning information via one sensory modality but applying the acquired knowledge when environments are perceived via a different modality, a phenomenon known as cross-modal transfer. To date, artificial intelligence systems are relatively poor at cross-modal transfer when environments are defined in a realistic manner.

People learn modality-independent, conceptual representations from modality-specific sensory signals. We hypothesize that any system that accomplishes this feat will include three components: (i) a representational language for characterizing modality-independent representations, (ii) a set of sensory-specific forward models for mapping from modality-independent representations to sensory signals, and (iii) an inference algorithm for inverting forward models—that is, an algorithm for using sensory signals to infer modality-independent representations. We have instantiated this hypothesis in computational systems in which the modality-independent representations are based on a probabilistic approach (distributed representations over latent variables) and in systems in which these representations are based on a probabilistic/symbolic hybrid approach (probabilistic grammars). We have also collected experimental data from people, and used our computational models to account for the experimental findings.

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LRIR Title

Reporting Period

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Program Officer

Research Objectives

Technical Summary

Funding Summary by Cost Category (by FY, $K)

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