



Multimodal interaction: A review.

Turk, M. (2014). Multimodal
interaction: A review. *Pattern
recognition letters*, 36, 189-195.



Agenda

1. Advantages of Multi-model interaction
2. Input and Output Modalities
3. Biological Sensory Integration
4. Designing and Building Multi-model Interaction Systems
5. Multi-model Integration
6. Challenges in Multi-model HCI

Advantages of Multi-model Interaction

- ◆ It offers interaction alternatives to better meet the needs of diverse users with a range of usage patterns and preferences.
- ◆ Humans may process information faster and better when it is presented in multiple modalities (e.g. dual processing models).
- ◆ They can support shorter and simpler speech utterances than a speech-only interface, which results in fewer disfluencies and more robust speech recognition.
- ◆ They can support greater precision of spatial information than a speech-only interface, since pen input can be quite precise.

Input and Output Modalities

Table 1

Human sensory modalities relevant to multimodal human-computer interaction, after Blattner and Glinert (1996).

| Modality | Example |
|---------------|--|
| Visual | Face location Gaze Facial expression Lipreading Face-based identity (and other user characteristics such as age, sex, race, etc.) Gesture (head/face, hands, body) Sign language |
| Auditory | Speech input Non-speech audio |
| Touch | Pressure Location and selection Gesture |
| Other sensors | Sensor-based motion capture |

Biological Sensory Integration

- ◆ Activity in the V1 Visual Cortex show that auditory and visual stimuli are combined.
- ◆ This is supported by the McGurk effect i.e. where speech sounds are mis-categorised when auditory and visual cues conflict.



Designing and Building Multi-model Interaction Systems

- ◇ Reeves et al. (2014) guidelines for multi-model interaction design:
 - ◇ Multimodal systems should be designed for the broadest range of users and contexts of use.
 - ◇ Designers should take care to address privacy and security issues in multimodal systems.
 - ◇ Maximize human cognitive and physical abilities, based on an understanding of users' human information processing abilities and limitations.
 - ◇ Modalities should be integrated in a manner compatible with user preferences, context, and system functionality.
 - ◇ Multi-modal interfaces should adapt to the varied users and contexts.
 - ◇ Be consistent.
 - ◇ Provide good error prevention and error handling.

Table 2

A classification of multimodal interfaces types, after Nigay and Coutaz (1993).

| | | Use of modalities | |
|----------------------|----------------|-------------------|-------------|
| | | Sequential | Parallel |
| Fusion of modalities | Integrated | Alternative | Synergistic |
| | Not integrated | Exclusive | Concurrent |

4 Types of Multi-model Interfaces

Challenges in Multi-model HCI

- ◇ Multimodal integration methods and architectures need to explore a wider range of methods and modality combinations e.g. more than two modalities.
- ◇ Cognitive load in multimodal systems
 - ◇ What multimodal systems can indicate about a user's cognitive load
 - ◇ How people naturally interact multimodally
 - ◇ How alternative modalities may reduce or increase the cognitive load.
- ◇ Integrating recognition technologies rather than just building a sum of parts.