

Benefits of Multisensory Learning

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Introduction

Perceptual learning has focused on **single sensory** modalities.

But the real world involves constant **multisensory** information!

Questions we will discuss:

Will learning be easier if training combined different modalities?

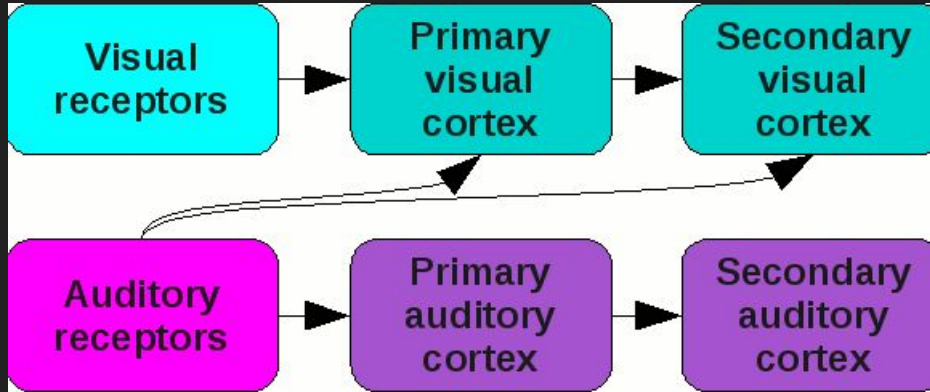
How?

Multisensory Training

- Consider learning how to discriminate between bird species.
 - Images + sounds of birds **vs** just images
- Multisensory interactions - ubiquitous & occur early in perceptual processing.
- Multisensory stimuli = natural settings → produce more efficient learning.

The Multisensory Brain

- Multisensory interactions can occur throughout processing.
 - Brainstem
 - Early sensory cortical areas
 - Association and other cortices
 - Feedforward pathway
 - Feedback pathway



Multisensory Plasticity in Development

- Neural plasticity in early stages of development.
 - When you change spatial correlation between auditory-visual inputs
 - Alters the multisensory representation in superior colliculus.
 - When you disrupt input to auditory cortex during development
 - Can lead to area being driven by visual inputs.

- Redundancy
 - 5mo infants can discriminate visually presented rhythms only when habituated with AV and not AO or VO. (Bahrick and Lickliter)

Multisensory Facilitation of Unisensory Learning

- Study comparing auditory-visual vs visual training in adults
 - AV group showed greater learning throughout experiment.

- Advantage of AV training
 - Reduced number of sessions to reach asymptote by ~60%
 - Raised maximum performance

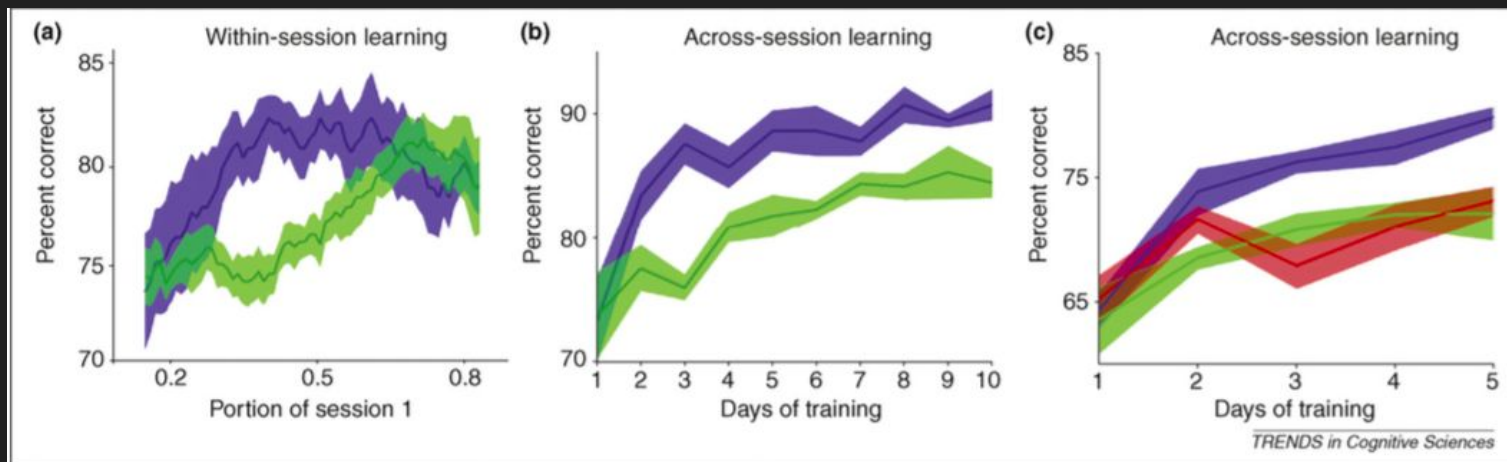
- Unisensory memory retrieval enhanced by multisensory conditions.

The Importance of Congruency

Congruency can help multisensory effects be more substantially pronounced.

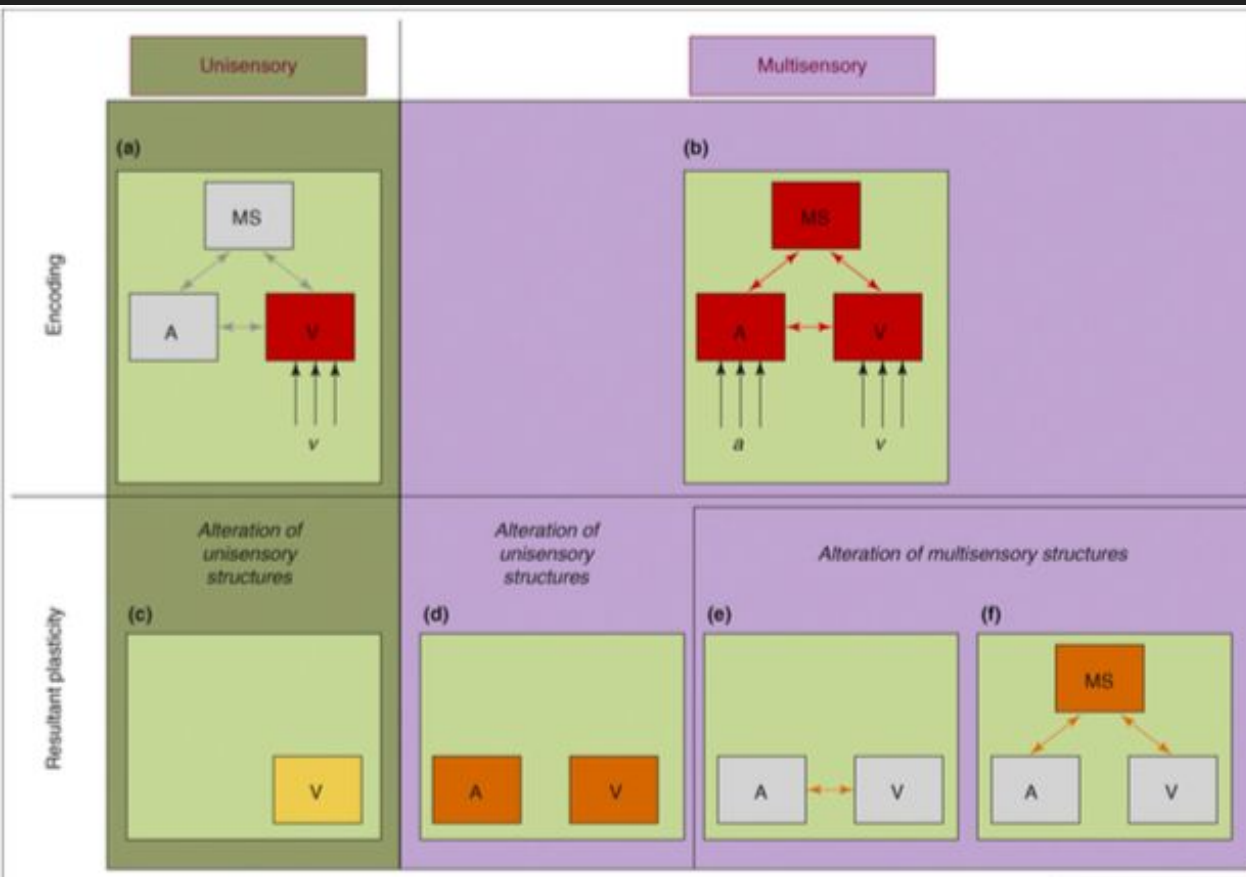
- Results

- Facilitation was specific to the congruent condition.
- Facilitation involves multisensory interactions.



A and B blue: congruent visual-audio stimuli used in training. c): blue: congruent, green: incongruent. Red: unisensory.

Mechanisms of Multisensory Facilitation of Unisensory Learning



Dichotomy: is unisensory representation improved or new multisensory representation formed?

Acquisition of New Multisensory Associations

Primates can learn multisensory associations, Anterior Rhinal Cortex are necessary (Gibson and Maunsell & Guo and Guo).

Multisensory learning also alters responses in unisensory brain areas (Gibson and Maunsell)

Novel multisensory associations can develop very rapidly

Two Mechanisms?

Example for 1: auditory facilitation of visual motion learning

Example for 2: functional connectivity increase between face and voice area increase after voice-face training. (Figure 2. e) Connection helps unisensory recognition.

Memory task, see next.

Multisensory Facilitation of Memory

Multisensory exposure can result in superior recognition of objects

Recognition Task

Images provided with sound were recognized better

Redintegration: a state of mind is restored by a part of the whole

Example: visual stimuli also activate olfactory cortex, if image was presented with odor.

Multisensory Educational Methods

Benefits both visual learners and auditory learners.

On an average we remember...



20% of what we read



30% of what we hear



40% of what we see



50% of what we say



60% of what we do

90% of what we see, hear, say and do

Multisensory Structural Language Education

Dual Coding: more information processed if split up into several channels.

Reduce cognitive load.

Conclusions

Multisensory learning :

Makes learning effective and more efficient.

Provides redundancy.

Enhances reinforcement learning.

Involves more Brain areas.