Asia-ARVO 2013: The vOICe system to help the blind

The vOICe system to help the blind

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Seeing with Sound – The vOICe

Overview

• sensory substitution
  – image-to-sound
  – visual acuity
• neuroscience
  – brain plasticity
• conclusions

blind user of The vOICe in the US
thinking of non-invasive approaches

1. use mature mass-market technology to encode live camera views in sound
2. leave it to the human brain to decode for functional vision & mental images

sensory substitution
with auditory display

functional vision: “see” with sound

The vOICe?
Oh, I see…!
current setups for The vOICe cost < $500 when using a netbook PC

The vOICe image-to-sound mapping
sensory substitution with auditory display

blind user hears rising tone

rising line!

The vOICe demo sounds (1 of 4)
The vOICe demo sounds (2 of 4)

The vOICe demo sounds (3 of 4)
thinking of non-invasive approaches

how far does it go for complex images?

first perform a technical validation of image information preservation
The vOICe image reconstruction

thinking of non-invasive approaches

*technical resolution* between 30 x 30 and 60 x 60 proven by reconstruction

what about *perceptual* resolution?
perceptual resolution (visual acuity)

“Group performance differed statistically from chance level at all visual acuities up to 20/320”

“The visual acuity of the individual participants varied between 20/200 and 20/600”

“Interestingly, 5 of the 9 participants (55%) had visual acuity that exceeded the visual acuity threshold for blindness as defined by the WHO” (20/400)

neuroscience research

✓ sound activates visual cortex of blind

✓ The vOICe sounds also activate LOtv shape recognition area of blind users (natural sounds do not activate LOtv)

Harvard Medical School, 2007
The vOICe in Nature Neuroscience: Cross-modal plasticity & visual sounds

Amedi et al., Nature Neuroscience, June 2007:
Shape conveyed by visual-to-auditory sensory substitution activates the lateral occipital complex

LOtv acts as a metamodal operator for shape

Late-blind expert user of The vOICe (Talairach normalized inflated cortex reconstruction)

Percent signal change analysis of LOtv

still unclear: attainable functional vision for use in daily living

not easy: like learning a foreign language

✓ need training programs
✓ need research partners

training & motivation...

http://www.nibib.nih.gov/Research/Highlights/Connectome
conclusions

Pranav Lal, a blind user of The vOICe in New Delhi

✓ R&D ongoing
✓ affordable
✓ non-invasive
✓ available worldwide
✓ must learn to see!

thank you!