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Seeing with Sound: is it Vision?



The vOICe

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Seeing with Sound: is it Vision?




Overview

- Seeing with sound for the blind
 - *How does it work?*
 - *User experiences*
- Questions for Neuroscience, Psychology, Philosophy, ...
 - *Is it vision?*
- Conclusions

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The vOICe: Seeing with Sound




Basic facts:

- Blind people cannot see... but usually they can hear
- Multimedia computing allows audio-visual transformations

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The vOICe: Seeing with Sound



Basic facts:

- Blind people cannot see... but usually they can hear
- Multimedia computing allows audio-visual transformations

So translate video to audio!?


Video

↓ *The vOICe*

Audio

↓ *Human brain*



Mental Video



Wearing The vOICe

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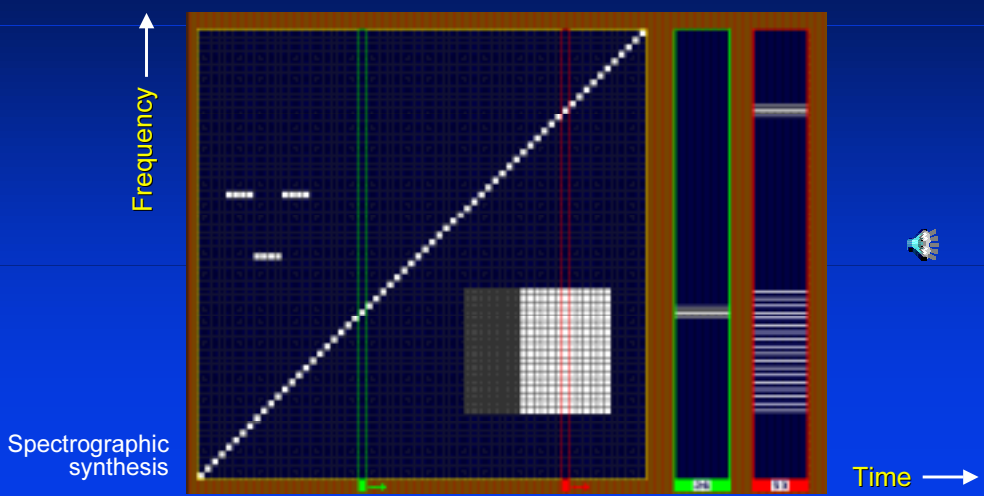
Mental video?



- Video:** Hidden camera
- Processing:** Notebook PC
- Audio:** Stereo headphones

The vOICe image-to-sound mapping

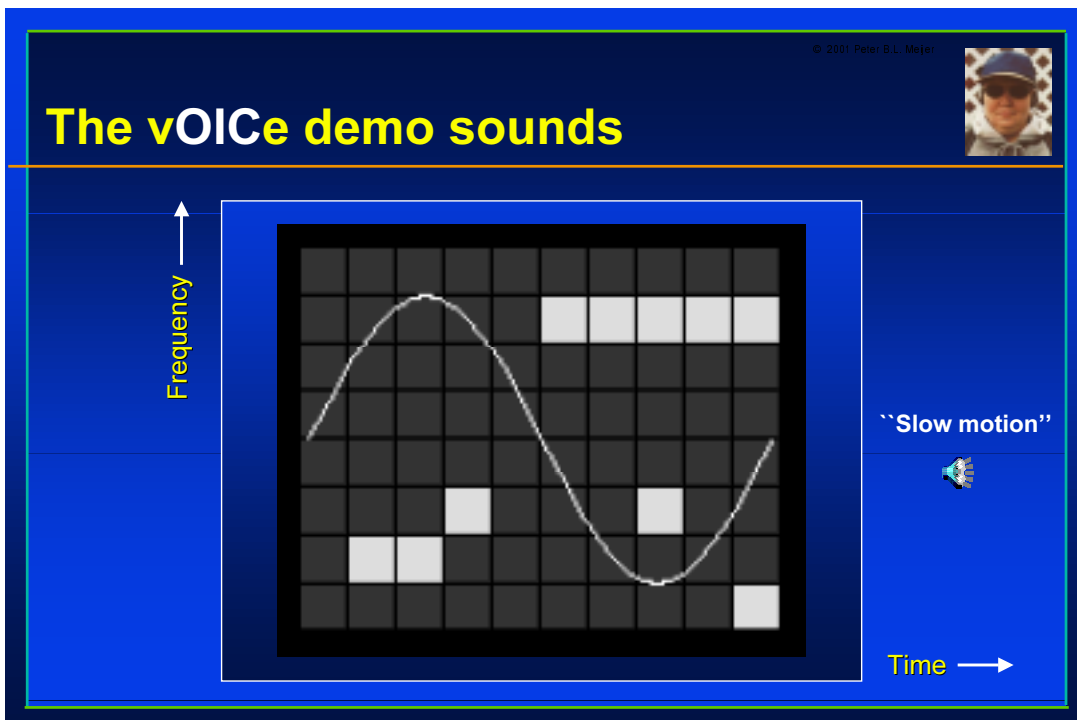
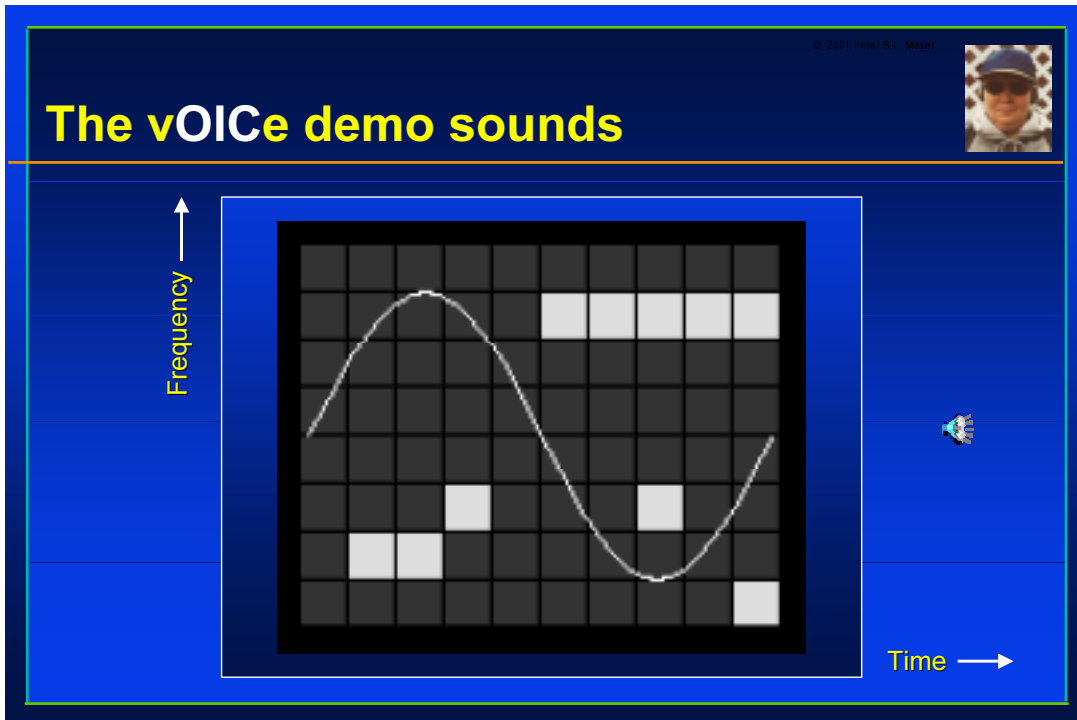
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Frequency


Spectrographic synthesis

Time




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The vOICe demo sounds




Frequency ↑




Time →

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The vOICe image reconstruction




64 x 64 pixel view



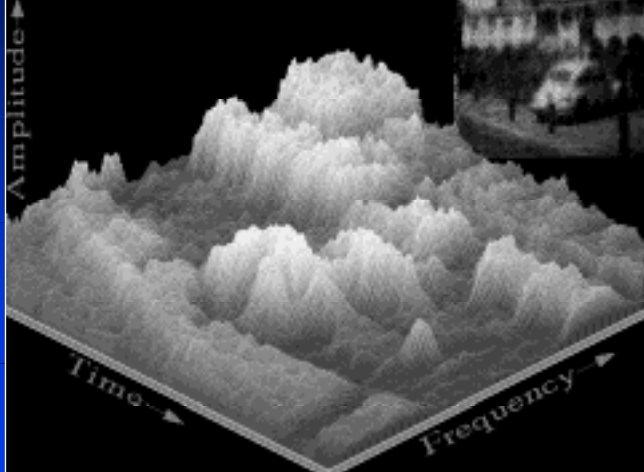
Original (left) and reconstruction from soundscapes (right)

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The vOICe mental imagery?

Warning:
Representation may dramatically affect recognition!



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The vOICe limitations?

Issues:

- ✓ Frequency-Time uncertainty
- **Physiology / Perception:**
 - ✓ just-noticeable difference (JND)
 - ✓ critical bands (human cochlea)
 - ? auditory streaming/segregation
 - ? neural pathways & bandwidth
 - ? neural processing & plasticity
- **Psychology / Education:**
 - ? sounds (too) unpleasant
 - ? minimum required results
 - ? acceptable training effort
 - ? motivation for learning
 - ? training programs

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The vOICe user experiences


So, what do blind users say?

Is it vision?

Some accounts from a late-blinded woman who started wearing The vOICe daily from mid 2000.

(No claims are made that this is representative!)

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The vOICe user experiences

User quotes:


As a person who was blinded later in life I can say that the soundscapes seem to trigger a sense of vision for me.

At first you might say I noticed only the soundscapes as they indicated changing patterns. I was not at this time actually seeing as I feel I do now. Rather just experiencing the soundscapes as I walked around.

After a few months I was not concentrating on the changing sounds rather just accepting the input as background information and translating it into images.

Vision is (and should be) a largely subconscious process

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The vOICe user experiences

User quotes:

Now to the question if what we hear is the same as seeing. I would say there is a grey area where yes indeed you are seeing using The vOICe and yet the entire information you receive using your eyes is more detailed, and complex. I do not know how far the brain can be trained to see using The vOICe program. **Still compared to the grey emptiness of blindness it is truly a light in the darkness.**

Currently I don't think about what I am hearing I just experience the program as if it was part of me. **Unless I have to really concentrate I find I don't hear the soundscapes any longer. They are there but I forget to listen and just absorb the information.**

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The vOICe user experiences

User quotes:

What is significant to realize is The vOICe allows you to experience your surroundings in a 3-dimensional form. When I am not wearing the program my contact with the world is limited to sound and touch. When wearing the program you can extend these senses to include the sight the program provides. I look across my study while using the program and see the scanning table then the small book case in back of the table with an image of the door opening on the left of the scene. Take off the program and this full, rich environment of seeing different structures is lost and I am returned to perceiving the world in a flatten 2-dimensional form. **Wearing the Seeing With Sound program is like stepping from total darkness into light.**


www.seeingwithsound.com/users.htm

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The vOICe questions...

Neuroscience / Psychology / Philosophy:

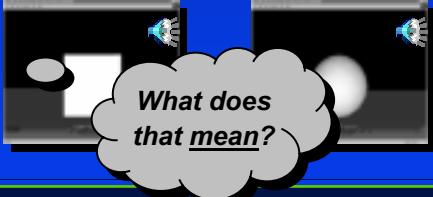
- Occipital lobe (i.e. “visual” cortex) activated by sound: Is that vision or “just” extended auditory processing?
- Measurable effects of neuroplasticity? What effects?
- Neural plasticity as a function of (critical) age?
- Is there anything truly special at all about vision?
- “Change blindness” defeated in seeing with sound?
- Relation to “Molyneux problem” ?

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The vOICe questions...

17th Century “Molyneux problem” revisited?


- **Q:** Would someone born blind, in case sight was restored, be able to **tell a cube from a sphere by sight alone**?
- **A:** “No” (according to John Locke & William Molyneux)
- **Q:** Would someone born blind, using “seeing-with-sound”, be able to **tell a cube from a sphere by “sight” alone**?
- **A:** “Yes”



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Conclusions



Seeing with Sound

- ✓ Needs more research
- ✓ Is affordable technology
- ✓ Is non-invasive
- ✓ Is available ***Now!***

<http://www.seeingwithsound.com>