

# A computational model investigating Shared Sound Category Learning Mechanisms Hypothesis

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17-02-2015

## 1 Introduction

Although the brainstructures processing speech and music appear to operate independently (left hemisphere being laterized for speech, right hemisphere for music (Kolb & Whishaw, 1947; Marin & Perry, 1999; Peretz, 2006)), there are many similarities how the brain is activated while interpreting speech and music (Zatorre et al., 1994; Trehub et al., 199). Especially the learning of sound categorization appear to utilize similar mechanisms (McMullen & Saffran, 2004; Hickock & Poeppel, 2004; Patel, Peretz, et al., 1998). In this project a computational model is designed to investigate the Shared Sound Category Learning Mechanisms Hypothesis.

## 2 Desgin

First the sound input is transformed to an representation mimicking the cochlear and cortical processing of sounds. The spectrotemporal response fields (STRFs, as shown in Figure 1) of the neurons in the primary auditory cortex (A1) proposed by Taishih Chi, Powen Ru and Shihab A. Shamma (2005) are modelled. These STRF representations are then fed into a machine learning (neural network) algorithm (to be investigated). The cochlear & cortical processing and machine learning algorithms will be programmed using C++. A lot of data will have to be processed in a small amount of time and a lot of 'parallel' calculations will be made. A robust and fast program will have to be coded. The programming syntax and methods available with C++ seem to fit my way of thinking and developing. Thus C++ is an easy choice for me.

The test-trial-scheduler will be programmed in an yet to be specified programming language, possibly python, lisp, etc. Here the needed calculations are few and speed is not the main concern. An (relatively) small, easy and transparently programmed program will suffice.

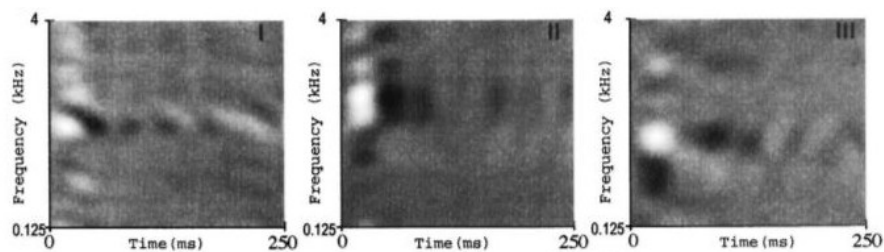


Figure 1: example STRFs from A1 of ferrets (taken from Chi, Ru & Shamma, 2005)

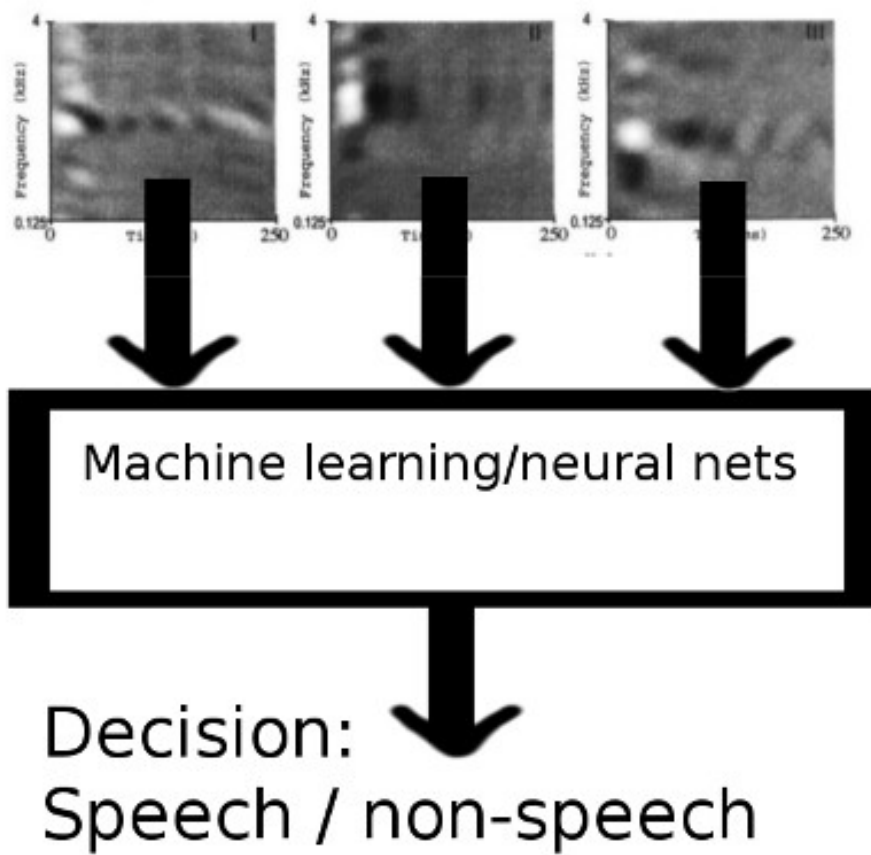


Figure 2: Processing and machine learning design

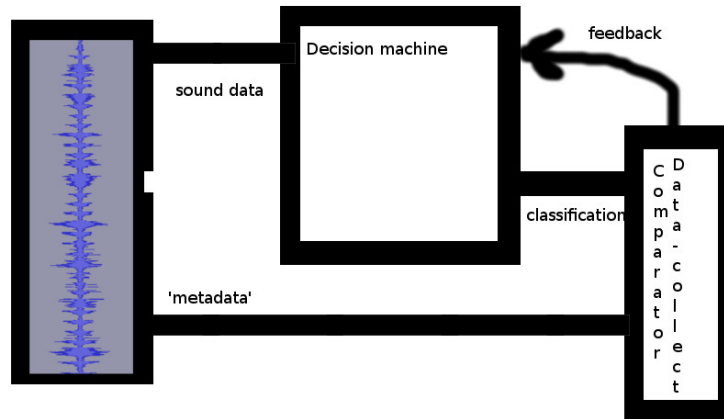


Figure 3: Scheduler design

### 3 To do

- program STRFs
- Investigate machine learning/neural network possibilities
- find a corpus of test data
- write trial scheduler
- schedule trials and collect data

### 4 Time schedule

- 24-02
  - cochlear and cortical processing stage programming
  - investigating what machine learning design will be used
- 03-03
  - cochlear and cortical processing programming
  - decision what machine learning design will be used
- 10-03
  - cochlear and cortical processing done

- machine learning programming
- designing test-trial-scheduler
- doing test trials
- 17-03
  - machine learning algorithm done
  - trail-scheduler done
  - trials done, data aquired

## 5 Goal

A computational model to investigate the plausibility of the Shared Sound Category Learning Mechanisms Hypothesis. The program wil consist of 3 major parts:

1. a input processing stage mimicking cochlear and cortical processing mechanisms;
2. a machine learning/neural network to learn sound categorization and;
3. a test-trial-scheduler which will feed sounds to the system, acquires the responses and displays them in a sensible way.