

# Prelims

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# 1. Abstract

[abstract itself]

[summary of intellectual merit, broader impacts?]

## 2. Introduction

### 2.1 Phonemes are Language Games

“Consider for example the proceedings that we call ”games“. [...] For if you look at them you will not see something that is common to all, but similarities, relationships, and a whole series of them at that. [...] Are they all ’amusing’? Compare chess with noughts and crosses. Or is there always winning and losing, or competition between players? Think of patience. [...] Look at the parts played by skill and luck; and at the difference between skill in chess and skill in tennis.

And the result of this examination is: we see a complicated network of similarities overlapping and criss-crossing: sometimes overall similarities, sometimes similarities of detail. [...] And we extend our concept as in spinning a thread we twist fibre on fibre. And the strength of the thread does not reside in the fact that some one fibre runs through its whole length, but in the overlapping of many fibres.”

-Wittgenstein, *Philosophical Investigations*: 66-67[29]

- Short description of phonetic acoustics, why they’re games
- General statement on importance of understanding neural implementation of a game-recognition system

### 2.2 Learning to play a Language Game

- Cognitive categorization learning mostly operates as family resemblances that have incomplete/nonplatonic feature sets that unite them ([23][22] [4])
- tversky talked about this in terms of set theory and resemblance [26] [27]
- The notion of what even constitutes a “features” is ill-defined (history of phonetics stuff about how we’ve just been basically trying to reverse-engineer these)
- The learning problem is one where the listener needs to learn \*both\* what constitutes a category \*and\* the features that are useful for determining category. (review some of caitlin’s infant speech learning stuff)

### 2.3 paradoxes

levels of analysis:

phonetic perception has paradoxes at several levels of analysis that are not mutually discrete.

**ontic/algorithmic:** what *are* phonemes? are they positive descriptions of combinations of features, or negative descriptions of forbidden spectrotemporal state transitions?

**implementation:** to some degree the methodological and theoretical disagreements between the feature-detection and population-computation models of phonetic perception mirror the single-cell/multicellular computation dichotomy described in the introduction of [5].

- speed of processing vs. variability within category
- neurons that process auditory information at phonetic timescales are relatively insensitive to spectral quality [18]

### 2.4 <some of that neural theories of phonetic processing

- auditory processing as domain-general and domain-specific across multiple timescales [18]
- why are auditory neurons potentially sensitive to multiple stimulus features/how does that contribute to generalizable ill-defined categories? [15]
- abrupt transitions, at least in neural data [6]
- other reward-learning regions like RSC [17]
- multimodal representations and preserved neural manifold dynamics across inference tasks in M1 [7]
- timescales of processing expand across auditory hierarchy (and more generally have different timescales of integration and lags) [18] and are lateralized [13]

## 2.5 scraps

- theoretical problems with simplified stimuli - low-dimensional and linearly-separable stimulus spaces are

fundamentally different than the high complexity of naturalistic stimuli... for all we know the computations are just straight up not comparable! [25]

## 3. Methods

### 3.1 Scraps

- Segmenting strategies [1]
- Scrambled vs. unscrambled sounds? (cites 12, 18, and

25 in [18])

- inferring perception-action loops from data [21]
- complementary roles of cell types and manifold dynamics [5]

## 4. Specific Aims

## 5. Significance & Broader Impacts

## 6. meta

### 6.1 to-read

- revisit the tversky lit and check Danielle's cites for more
- the long-term imaging/ephys papres
- [15]
- [6]
- [20]
- [21]
- [24]
- [7]
- [16]
- [11]
- [3]
- [9]
- [19]
- [28]

- [14]
- [2]
- [10]
- [8] - methods
- [12] - methods
- [1] - methods

## 6.2 bookmarks

- [5] - p6

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