Syllabus: **Perceptual Dynamics S17** (Special topics in Neural Science)

This is a dynamic syllabus. Last update: 26feb2017

Course Description

NEURL-UA 302/NEURL-GA 3042
3 points. Spring term, 2017.
Wednesday, 1:00-3:00pm, Meyer Rm 760. J. Rinzel. 1st class: Jan 25, 2017
Prerequisite: Calculus I-II. (seek consent of instructor if in doubt).

This is a seminar course to develop familiarity with dynamics, behavioral and neuronal, associated with a range of perceptual phenomena. The format will be mixed: lectures, journal-club-like presentation of papers, and exploration with computer-driven stimuli. We will discuss neuronal mechanistic models and computational models to go with the behavior. Our approach will be case-study; relevant background will be presented. We will emphasize auditory perception (spatial hearing, pitch, auditory scene analysis) but we will likely include case studies from vision (e.g., binocular rivalry) and we may touch on time perception. Computer codes will be with Matlab, likely pre-written and modifiable by students; Matlab expertise is not a pre-requisite.

Book and supporting materials:
Auditory Neuroscience by J Schnupp, I Nelken, A King. MIT Press 2011.
See demos (under topics) on the book's web page:
https://mustelid.physiol.ox.ac.uk/drupal/

Syllabus:

The Course will involve case studies of psychophysical experiments, neurophysiological experiments, and conceptual/computational models. We will also implement some protocols, demos, models with Matlab.

Most of the course will be on auditory perception; the final segment will likely be on time perception/production.

The abbreviation **SNK** refers to the book by Schnupp, Nelken & King: Auditory Neuroscience. Making sense of sound. We will use this book together with research articles in the course.

I will post pdf files from presentations and summaries of presentations in NYU Classes

Research articles and resource files can be found on DropBox in the folder Perceptual Dynamics F14
https://www.dropbox.com/sh/z6ua96ch1oikr7i/AABoCwxBagvzGNqc6RLkYeSma?dl=0

Look to the upcoming week for the *READ* assignment and reminder to send your *ToDo* item.

RED font: items in preparation.

Jan 25: Introduction with demos

JR

- Introduction to some topics in auditory perception (pitch, spatial hearing, scene analysis) and time production. Matlab Session 1 – maybe today: single sound, sound train, inputting parameters, subject's response; An additional session soon?

Feb 01: Perceptual bistability

READ and ToDo: Pressnitzer & Hupe (2006) and Supplemental Material (SM) – see Dropbox. Supplemental reading: SNK: 6.1, 6.4, 6.6; Denham & Winkler (2006),secs 1-3;

JR

- van Noorden 'diagram' (Denham & Winkler, 2006) - staircasing triplets w/ attention (more on attention, later)
- Perceptual bistability and alternations: visual & auditory, experiments and models
- Buildup. Steele etal (2015) – stat model.
- A simple math model of bistability – x'= x(1-x)(x-a). Matlab for ODEs ?
- Matlab Session 1 or Session 2 (ODEs)?

Feb 08: Periodicity pitch and models

READ and ToDo: SNK Chapt 3 (except 3.4 & 3.7) - Supplemental: Denham2012-PitchPerception.pptx (Dropbox);

Mohammed Butt

- Additional background on Periodicity Pitch
  - Supplement, as needed, from Plack&Oxenham (2005)
  - Supplement with additional ppt slides (ask JR)

READ and ToDo: Bender & Wang (2005) (Dropbox) - Supplemental: Denham2012-Sounds.pptx (Dropbox);

JR

- Bender & Wang (2005) on pitch sensitive neurons
- JR intro to phasic model
- a temporal model: Huang & Rinzel (2016)
- Other models:
  - Cariani & Delgutte (1996a,b) & SNK 3.7
  - Harmonic template model: Shamma & Klein (JASA, 2000) & SNK 3.6

Feb 15: Pitch and music

READ and ToDo: SNK 3.4 and McDermott & Oxenham (2008)

Jonathon Gornet

- SNK, section: 3.4 together with McDermott & Oxenham: (CurrentOpinNeurobiol, 2008)

READ and ToDo: Pressnitzer et al. ASA music ambiguity (FrontHumNeurosci, 2011) and McKenna TM, Weinberger NM, Diamond DM (Brain Res, 1989); supplemental reading: Weinberger NM - Chapt 3, esp pp67=73, of Psychology of Music, edited by D

Deutsch, 1999:
https://books.google.com/books?hl=en&lr=&id=A3jkobk4yMMC&oi=fnd&pg=PA47&dq=weinberger+music+and+auditory+system&ots=muSzPAiaZH&sig=mfoUX2xzXx370TNZlnj4Qbtx8NQ#v=onepage&q=weinberger%20music%20and%20auditory%20system&f=false

Link Tejavibulya

- bistability
- Music ambiguity
- Coherence model
- Neurons and sound sequences

Feb 22: Rhythms: sound, brain, speech – attention
Read and ToDo: Riecke, Sack, Schroeder (Current Biol, 2015) & "CB-Disbatch" by Snyder); Supplemental on transcranial stimul'n.

Leana King

- Entraining brain rhythms can accelerate buildup
- Use of tACS… transcranial Alternating Current Stimulation

Read and ToDo: ZionGolumbic etal (Neuron, 2013) & "Spotlight" (TrendsCogSci, 2012); Supplemental ZionGolumbic Poeppel Schroeder (Brain&Language, 2012)

Jasmin Multani

- Attended and ignored speech in 'cocktail party'
- Role of neuronal oscillations for decoding
- Selective entrainment hypothesis
- Active listening

JR

- Matlab Session 2 on ODEs – the cubic case: go over the Warmup for HW2 especially periodic stimulus, with random ampl. Warmup due 23feb. Preview HW#2; due 05mar.

Mar 01: Binocular rivalry: neurophysiology, psychophysics and modeling; effects of attention
READ and ToDo: Leopold & Logothetis (1996); Review paper: Alais & Blake (2015);

Rachel Denison

READ and ToDo: Wilson (PNAS, 2003); Chong, Tadin, Blake (J Vision, 2005);

Hsin-Hung Li

Include demo of PsychToolBox and sample code.

Mar 08: Music Perception: Rhythm, tonality, sensory-motor interactions, nonlinear dynamics model – resonance.

Ed Large *(Univ Conn)*

READ and ToDo: Rhythm – beat – meter. Large, Herrara &Velasco (FrontSysNeuro, 2015); Large & Gray (J CompPsychol, 2015)
READ and ToDo: Tonality – intervals & mode-locking – consonance/dissonance. Lerud, Almonte, Kim & Large (Hearing Res, 2014); Large, Kim, Bharucha & Krumhansl (MusicPerception, 2016)

Mar 15: NYU Spring Break

Mar 22: Neurophysiology, psychophysics and modeling of auditory streaming w/ alternations.

READ and ToDo: Micheyl et al (Neuron, 2005)

Supplemental reading: Pressnitzer et al (Current Biology, 2008)

Julia Greenberg

- Neurophysiology (awake macaque) and psychophysics: Micheyl et al (Neuron, 2005) including signal detection model for buildup function.
- Streaming in auditory brain stem? Pressnitzer et al (Current Biology, 2008)

READ and ToDo: Rankin et al (PLoS CB, 2015)

Supplemental reading for modeling: Huguet & Rinzel (Modeling Multistable Perception in Encyclopdia CNS, 2015); Boughey on competition phase plane (Boughey, Ecology text, 1970 – 2pgs).

JR

- Review of ODEs.
- Reminder of Pressnitzer & Hupe (Current Biol, 2006)
- Sensory-based network model for auditory streaming
  - bistability and alternations
  - effects of attention
- Other models: Barniv & Nelken (PLoS One, 2015); Mill etal (PLoS CB, 2013)

JR

Matlab Session 3… back to HW #1: randomize deviant position, Ntrials, 3x2 data matrix.

Mar 29: Effects of pauses & perturbations on streaming/segregation; prediction, novelty detection.

READ and ToDo: Rankin, Osborn-Popp, Rinzel (Front Neurosci, 2017)

Pam Osborn-Popp

- Build-up and reset to Int for pauses and sudden change
- Effects of single deviant or distractor tone
- Model predicts differential processing
- Demo of Psych Toolbox in Matlab

Pawel Gucik

READ and ToDo: Winkler Denham Nelken (review in TICS, 2009); Wacongne Changeux Dehaene (J Neurosci, 2012)

Supplemental reading: Bendixen (review in Front Neurosci, 2014)

- Anticipation/prediction during streaming (Bendixen)
- Regularity representations serve as predictors (Winkler etal)
- MMN as measure of novelty detection
- Prediction based on error signals – a model for MMN (Wacongne etal)

JR ??

- Neuronal oscill'n as basis for prediction: Morillon Schroeder etal (eg rev. Curr Opin, 2015) & Arnal Giraud (rev. TICS, 2012)

Apr 05: Shepard tones, tritone paradox, auditory barberpole.
READ and ToDo: Shepard (JASA, 1964); Demany&Ramos (JASA, 2005); (on Dropbox; ToDo for each of these two papers.); supplemental reading - optional: Chambers & Pressnitzer (Atten Percept Psychophys, 2014);

Jovana Maksic

Shepard tones; the tritone comparison

- Psychophysical expts: context effects on tritone comparison
- Pitch-based hypothesis

READ and ToDo: Huang etal (2015)

Ziqi Wang

- Network model for context effects on tritone comparison
- Shift detector hypothesis

Apr 12: ASA – streaming, attention, novelty detection, EEG - MMN methodology
READ and ToDo: 2 papers: Sussman_Integrn Segregn_JASA_2005; Sussman_Newview MMN & attention_JPsychophysio_2007 (Dropbox)

Prof Elyse Sussman (Albert Einstein College of Medicine)

- Tutorial on MMN, novelty detection, attention
- research talk: Attention effects on target detection in auditory scene analysis

Apr 19: Binaural Hearing, sound localization – biophysical mechanisms.
READ and ToDo: Grothe (2003); review BINS lecture (Shapley); Ashida & Carr(2011). LocalznComplexSounds: Bernstein & Trahiotis (2002); Gai et al (2014).

TBA – JR?

- MSO biophysics for ITD detection – pure tones; slope detector; inhibition
- ITD detection of complex sounds – envelopes ?
- Perceptual phenomena: precedence & Franssen effects (Stecker & Gallun, 2012, pgs 416-418)
- MSO & LSO resonance properties (PNAS, 2014; PLoS CB, 2016)
- Matlab Session 5: SNK "ILD/ITD Practical"; preview HW3: SAM into "Practical"

Binaural hearing & perception.

- *READ and ToDo*: Stecker & Gallun (2012, pgs: 383-390, 408-415); Ihlefeld & Litovsky_ILD inadeq SpatialRelMasking for CI (PLoS One_2012)

[[excerpts from Ihlefeld lecture F14]]

Danielle Mendonca

- Foundations: acoustic cues ITD/ILD/monaural
- BMLDs, -correlation model, & Spatial Release from Masking
- Cochlear implant... spatial release from masking.

Apr 26: TBA. Open. Possibilities: more on speech streaming, cross-modal effects on perception, animals and music;
Speech streaming, rhythmicity/entrainment (stimulus/intrinsic), attention.
READ and ToDo: SNK- pgs: 142-146, 152-159; Ding & Simon (2014) – Entrainment, lecture F14—here, or Feb 22? Riecke (Feb 22) is about entrainment.

May 3: Time perception and production.
READ and ToDo: maybe Merchant et al (AnnRevNeurosci, 2013) (on Dropbox)

- Neural basis of perception & estimation of time; additional reading: Buhusi&Meck (2005).
- Bendixsen
- Morilon&Schroeder
  TBA

READ and ToDO: reading list, in preparation.
JR

- JR: model for SSA (Ulanovsky et al; SNK 6.5)
- JR: models for interval timing and deficits in PD. Additional reading: Shea-Brown et al (Brain Res, 2006) (on Dropbox)
- Matlab Session 5 ??

Classes end: May 8

May 10: Term project:
written report and oral presentation (12mins).