

CATEGORIES AND CATEGORICAL PERCEPTION

Categories in sensation/perception (non-semantic)

LOGIC OF CATEGORICAL PERCEPTION

- **Categorical perception:** the phenomenon in which people perceive stimuli from different categories as more different from each other than stimuli from within the same category.
- Why useful? Introduces invariance in response with respect to a functionally defined category.
 - In speech: adjusts for different ways in which a speaker utters sounds.
 - Rapid prediction; efficient memory; compression

LOGIC OF CATEGORICAL PERCEPTION

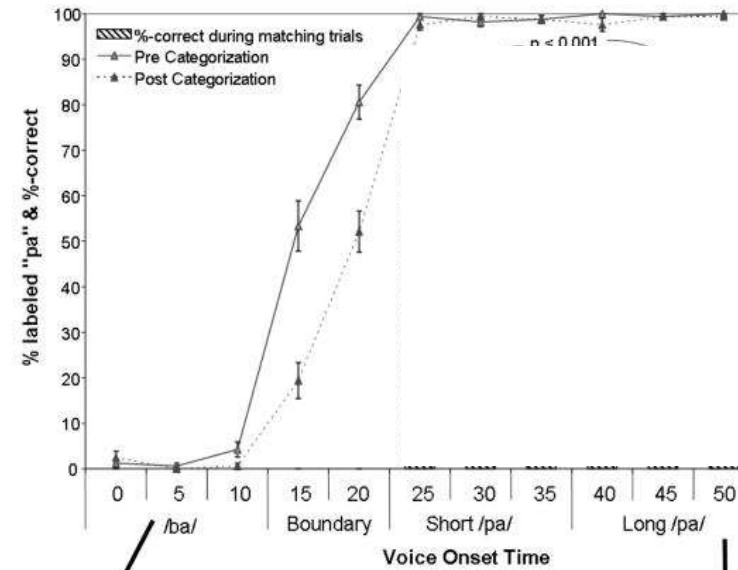
- Demonstrating:
 - Select a set of stimuli that uniformly covers a certain physical domain (e.g., sound freq 100Hz – 8000Hz)
 - Select an objective distance measure; e.g., distance in frequency space (applicable to both sounds and colors)
 - Select a method for operationalizing human similarity (e.g., similarity judgments, generalization, confusion [same/different])
 - In one procedure: assign all stimuli to categories;
 - In a second, obtain similarity judgments for within-category vs. between-category pairs, or ask for categorization, and evaluate if the boundary is fuzzy or not.

IN AUDITION

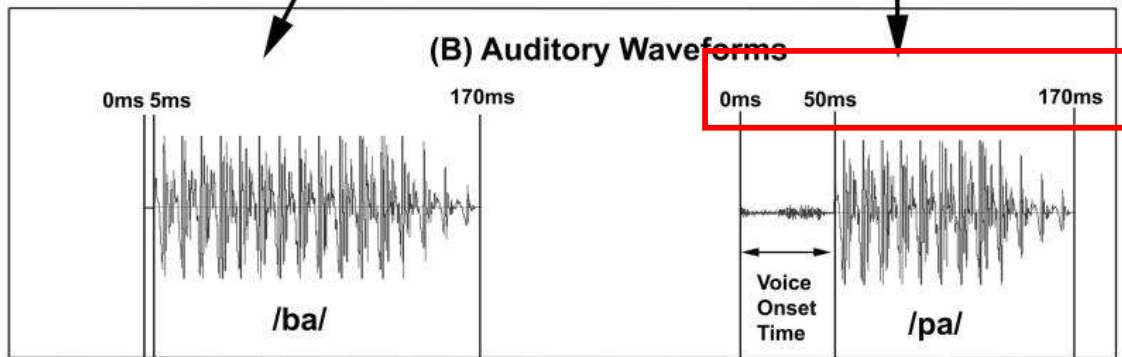
- In auditory stimuli, discrimination between speech sounds: People have a sharper discrimination boundary between sounds that are perceived as belonging to different phonetic categories than between sounds that are perceived as belonging to the same category.
 - The objective dimension: Voice Onset Time of consonants
 - Discrimination performance: Same/different judgment.
 - Present consonants such as /b/ and /p/. A fixed-size physical difference in VOT that was easily discriminated when it straddled the boundary between two categories (labeled as /b/ or /p/), produced *chance* discrimination performance when both tokens came from the same category (either both /b/ or both /p/).

PHYSICS OF AUDITORY CATEGORICAL PERCEPTION

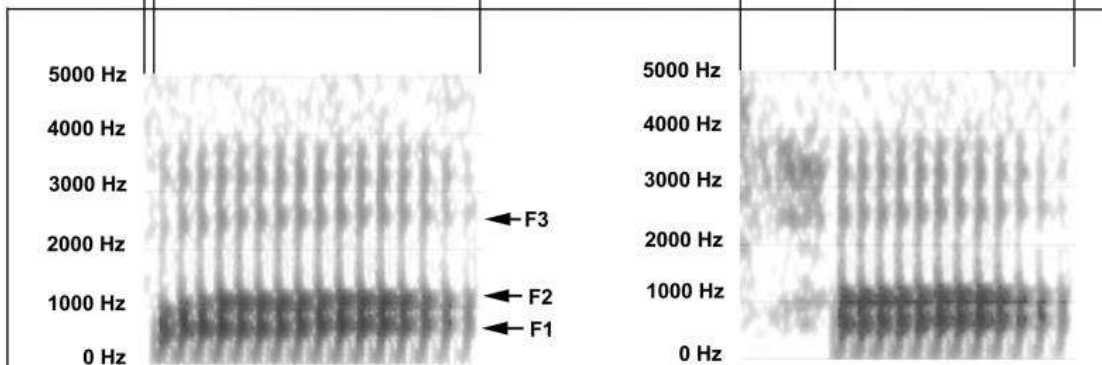
(A) Psychophysical Properties of the /ba/ to /pa/ Syllable Voice Onset Time Continuum



(B) Auditory Waveforms



(C) Spectrograms

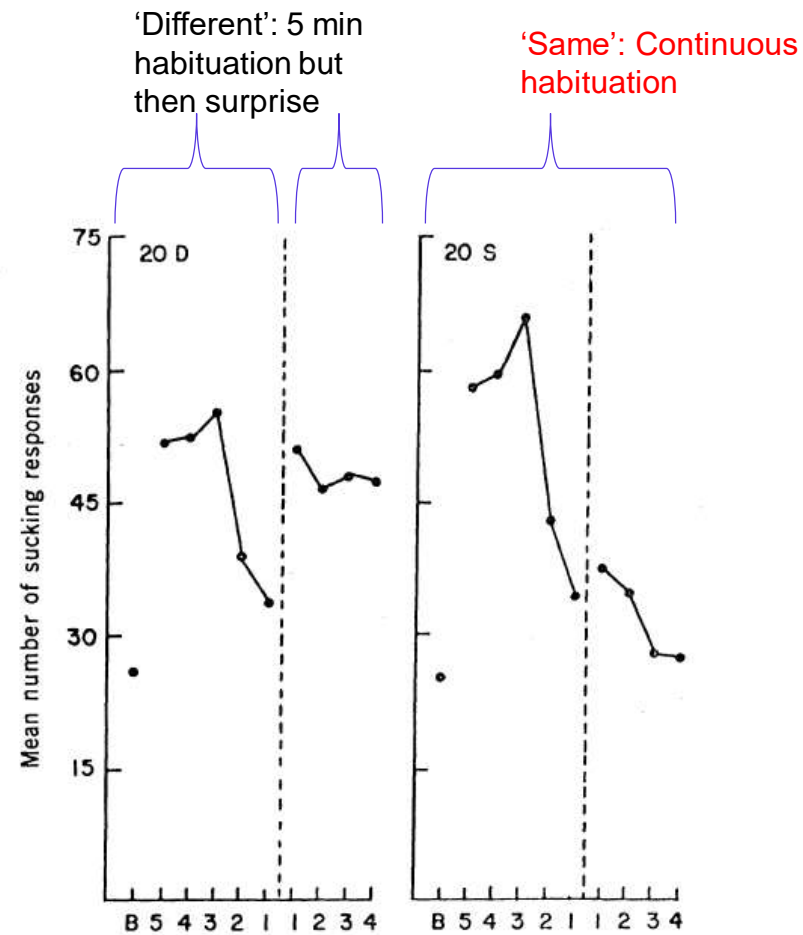


WITHIN PHONETIC CATEGORY, TWO DIFFERENT STIMULI SOUND THE SAME. EVEN FOR BABIES.

- When a functional contrast does exist, the phonetic categories are learned VERY quickly.
 - Eimas et al. 1971: observed 4-month old sucking rate on pacifier.
 - Higher rate = more 'surprise' / interest
 - Examined rate as function of relation between current and previously heard stimuli
 - They presented two stimuli with VOT differing by 20ms.
 - In one condition (labeled 'D') the difference straddled (on two sides of) the border of a phonetic boundary (stimuli perceived as 'b' and 'p' by adults)
 - In another condition 'S' the belonged to the same phonetic category.

IF A PHONETIC CATEGORY BOUNDARY DOES NOT EXIST, THE TWO STIMULI WILL CONTINUE SOUNDING THE SAME

- 5 minute of habituation precede a 20ms vot change, either within the same or across phonetic category (20S vs 20D)



RELATED PHENOMENON IN AUDITION

- Categorical perception is one way in which prior categories aid online processing, and demonstrates a basic sort of experience-dependent learning. Related phenomenon
- Change Deafness. Vitevitch 2003: had participants repeat words presented in a stream. Halfway through study, the voice changed. Only 40% of participants noticed the change in speaker
- Sine-wave speech: phonetic categories can be considered a priors on sounds that may be heard as speech. A very simple demonstration that expectations (via learning/fine-tuning) can impact whether a stimulus is perceived as speech
 - <https://users.sussex.ac.uk/~cjd/SWS/>
- McGurk Effect: multimodal inputs to “auditory” categorical perception.
<https://www.youtube.com/watch?v=PWGeUztTkRA&t=49s>

CATEGORICAL PERCEPTION IN COLOR

- CP for color: discrimination of items that cross category boundaries is better (faster, more accurate) than when the items are within the same color category. NOTE: color category is LINGUISTIC
- For example: easier to distinguish between a green stimulus and a blue stimulus than between two stimuli within the same category (two shades of green), who are spaced at the same distance.
- In other words: better cross-category (vs. within-category) discrimination is found when the physical distance between within-category items are equivalent.
- (Practical) Note: Color differences in terms of discriminability *can be equated* across between-category and within-category comparisons by using the Commission Internationale de L'Eclairage (CIE) values.

VISUAL CATEGORICAL PERCEPTION IN DIFFERENT LANGUAGE

- Roberson, D., Davies, I., Davidoff, J.: Color categories are not universal: replications and new evidence from a stone-age culture. J. Exp. Psychol. Gen. 129, 369–398 (2000)
 - A stone-age tribe Berinmo
 - Uses “NOL” as the color name that in English fall under both green and blue.
 - Berinmo: No CP at the boundary between green and blue (no boundary in their language)
 - They also have category boundary between ‘nol’ and ‘wor’ that doesn’t exist in English as both sides are Green.
 - Berinmo: better discrimination of 32 cross-category items than 32 within-category items at the boundary between nol and wor. English speakers did not show CP at this boundary.

