

M.Sc. LST

Speech Science

Speech Perception

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Bernd Möbius & Valentin Kany

Language Science and Technology
Saarland University

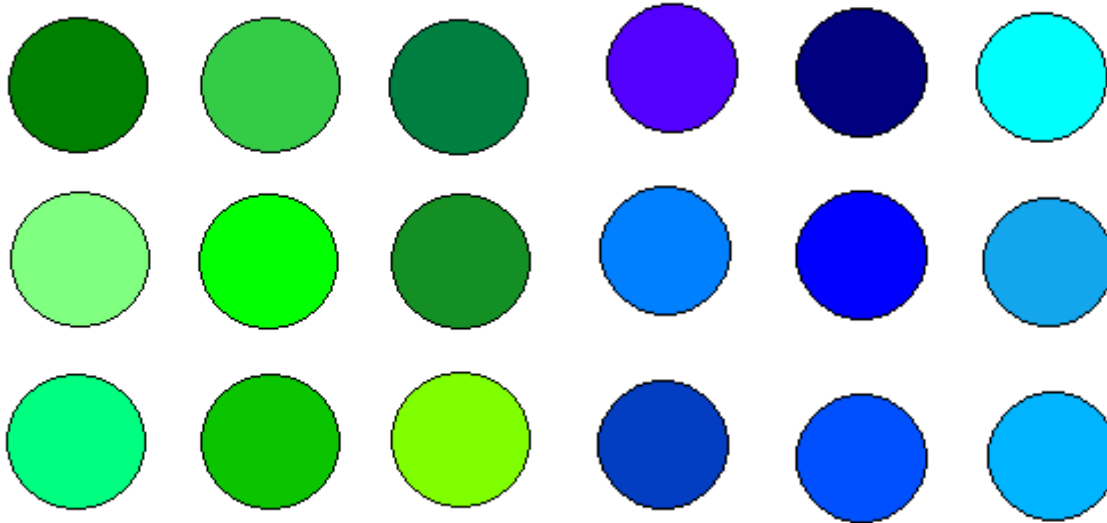


Overview

- Categorical Perception
- Perceptual Magnet Effect
- Multimodal perception

Categorical Perception

- phenomenon:
 - speech stimuli are not perceived continuously in auditory-perceptual space
 - stimuli are classified as belonging to categories



Categorical Perception

- phenomenon of (auditory) categorical perception:
 - presentation of a continuum of speech stimuli between 2 categories (e.g. phonemes: /ta/ - /da/ or /pa/ - /ba/)

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demo: : <https://www.youtube.com/watch?v=4V5pQyKsgg4>

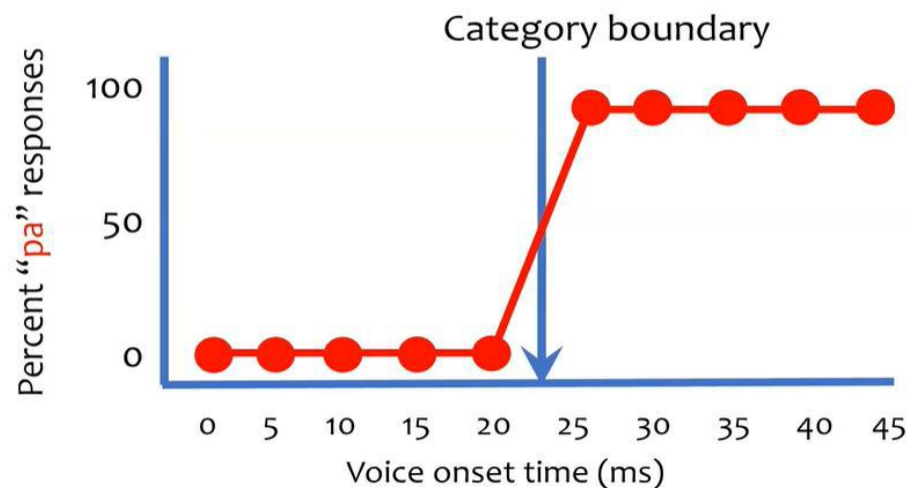
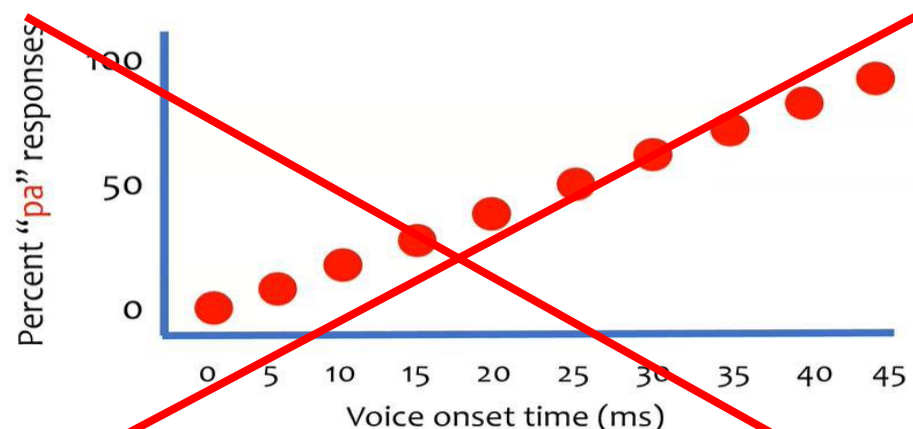
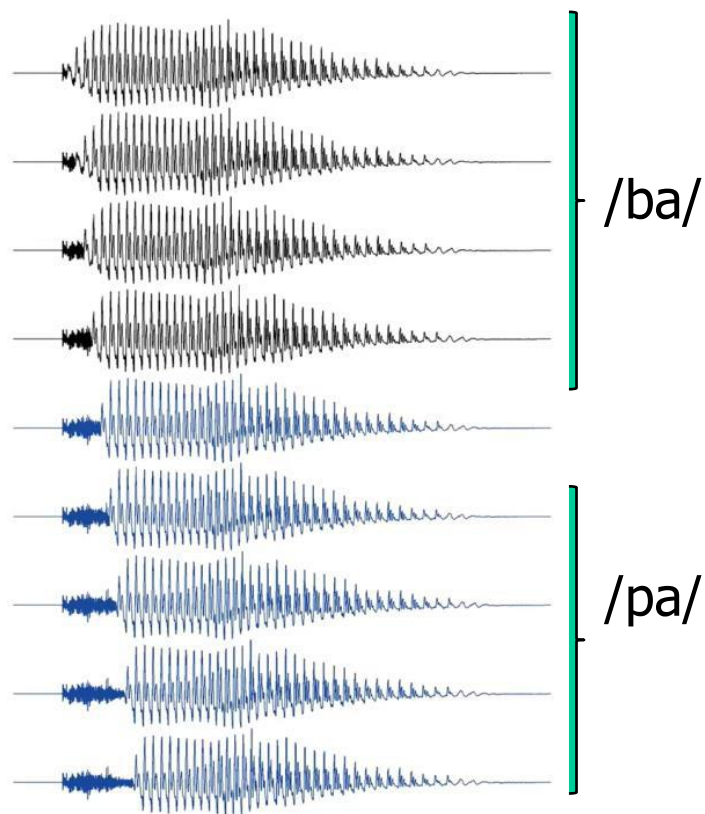
→ find the factual mistake w.r.t. VOT in the video!

Categorical Perception

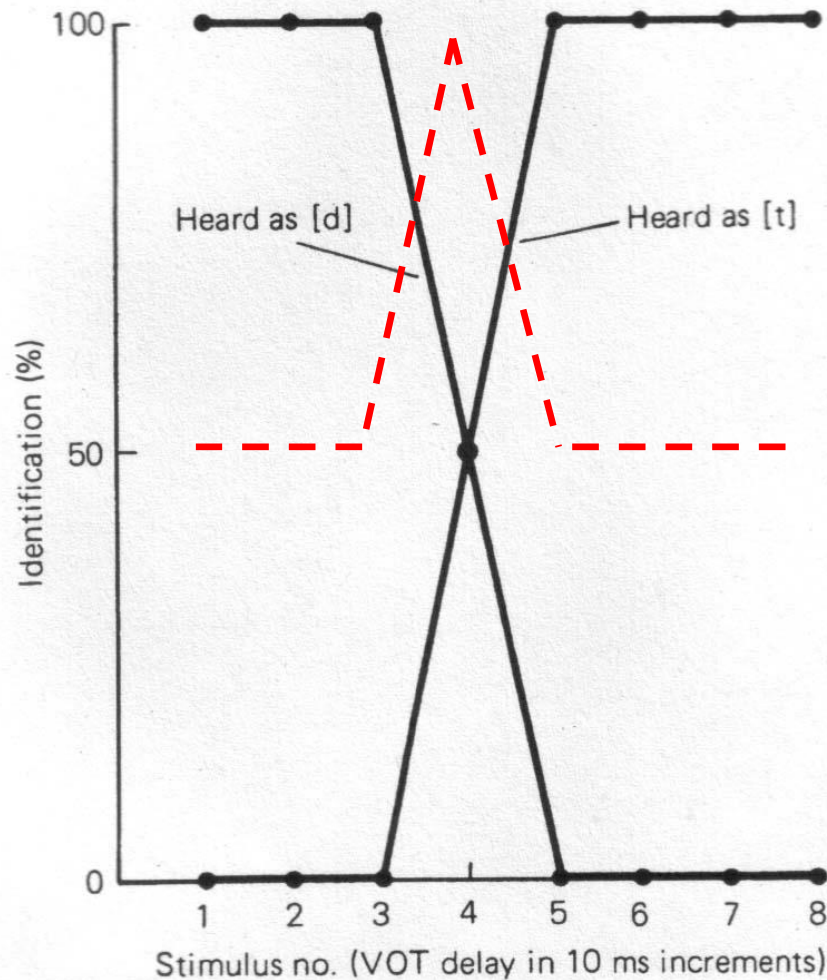
- phenomenon of (auditory) categorical perception:
 - presentation of a continuum of speech stimuli between 2 categories (e.g. phonemes: /ta/ - /da/ or /pa/ - /ba/)
 - stimulus construction by editing natural speech or by speech synthesis
 - combination of 2 tasks
 - identification: 1 stimulus
 - discrimination: pair of stimuli

Categorical Perception: Identification

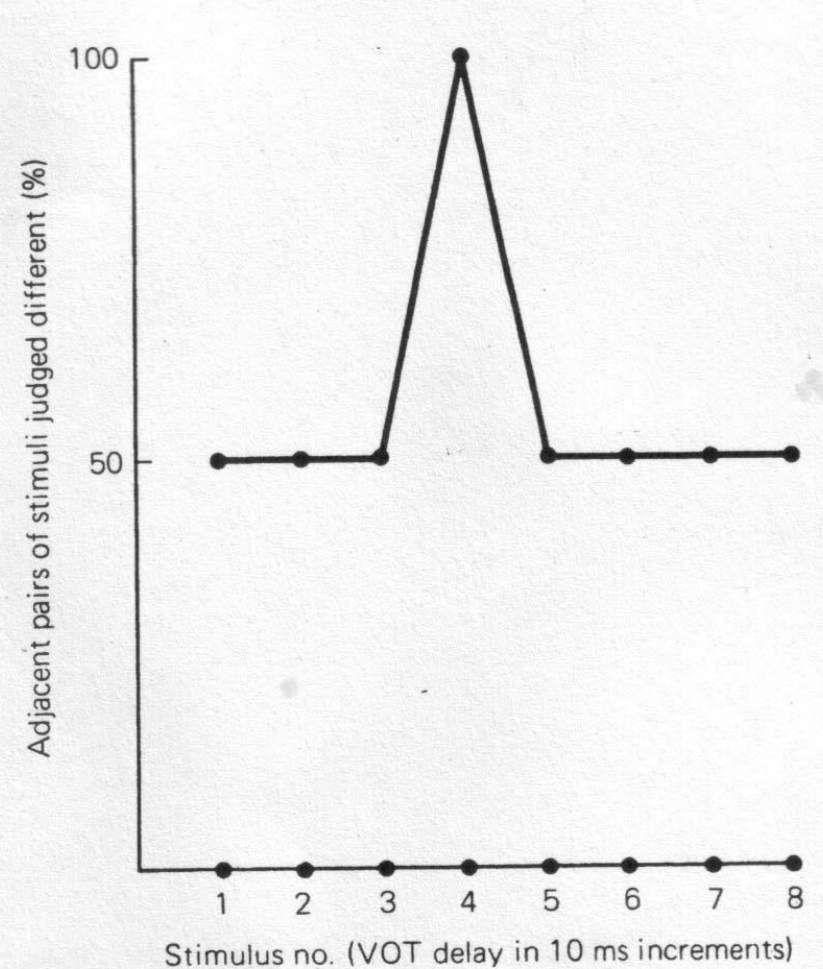
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Categorical Perception



Identification



Discrimination

[Clark and Yallop, 1995, p.314]

Categorical Perception

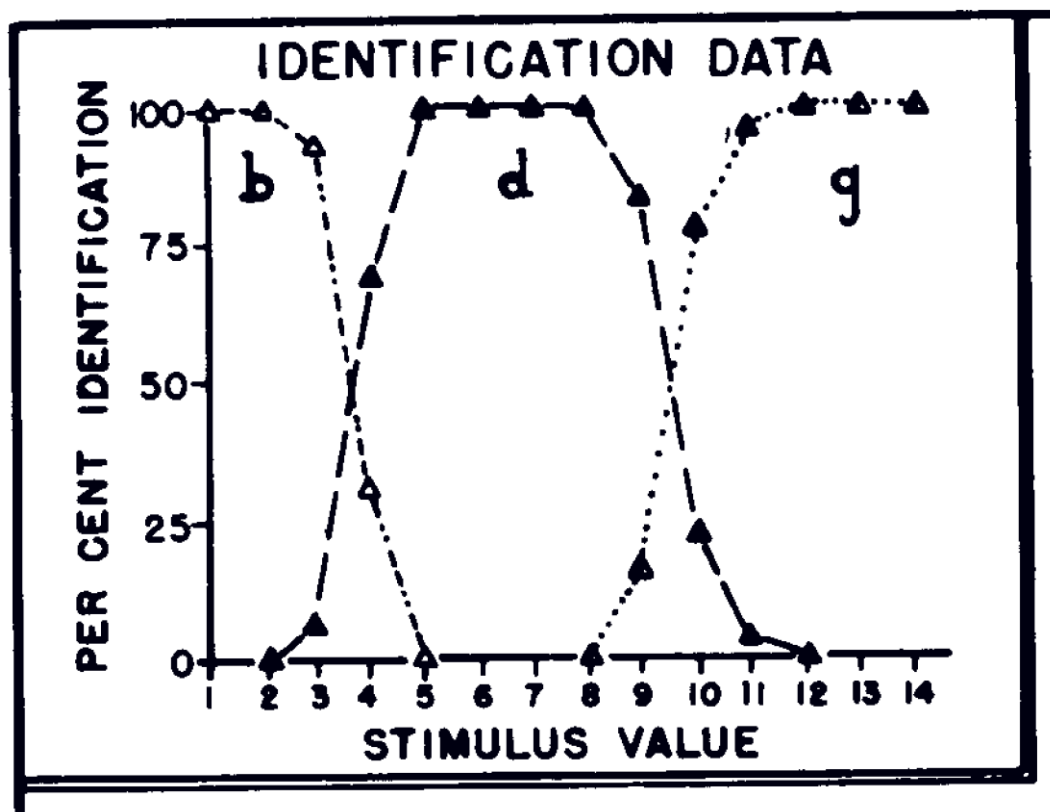
- CP is demonstrated if
 - listeners assign each stimulus to one of the offered categories and recognize categories of speech but not intermediary steps
 - identification is optimal within category boundaries but at chance level at category cross-over
 - discrimination is weaker within category boundaries
 - the maximum of the identification function coincides with the maximum of the discrimination function (category switch at same location in acoustic/auditory space)
- Categories and category boundaries are language-specific

Categorical Perception

- Examples of speech sound contrasts explored in the CP paradigm:
 - voice onset time (VOT) of stop consonants (/pa/ - /ba/)
 - place of articulation of stop consonants (/ba/ - /da/ - /ga/)

Categorical Perception

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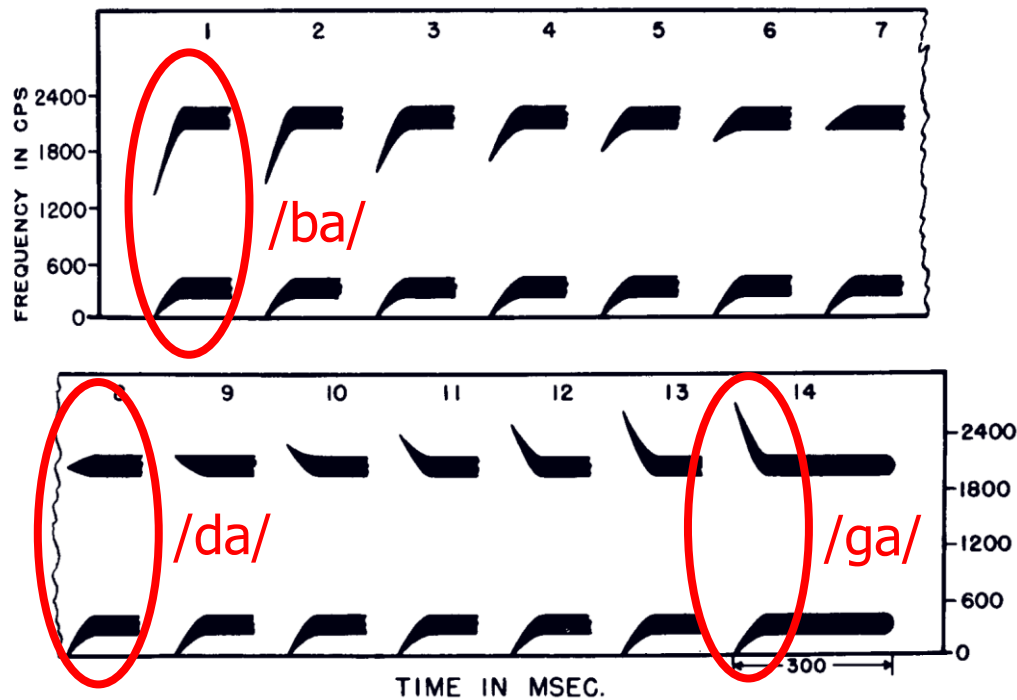


Figure 5.23. Two-formant synthetic CV pattern series: the stimuli for /ba/, /da/, and /ga/. (Reprinted with permission from A. M. Liberman *et al.*: *Journal of Experimental Psychology*. 54, © 1957, American Psychological Association.)

Categorical Perception

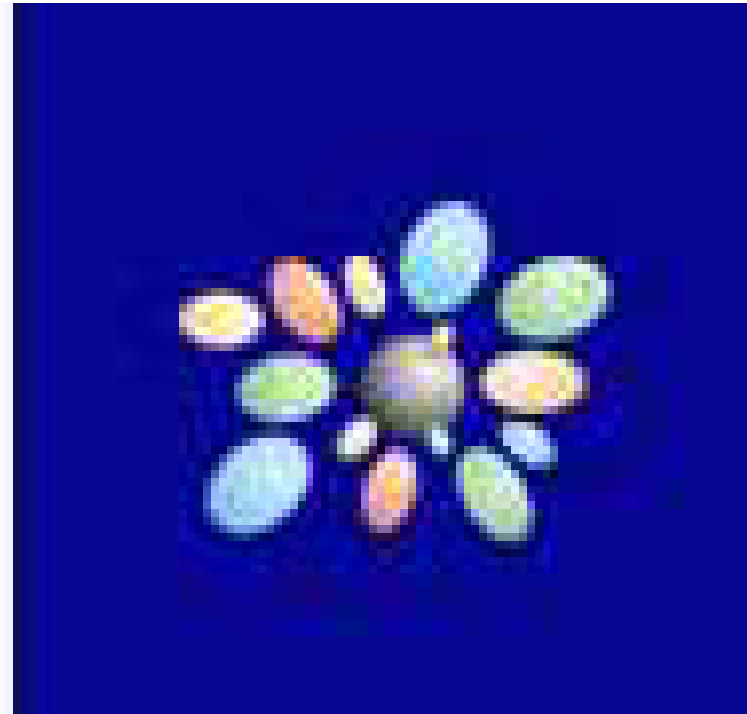
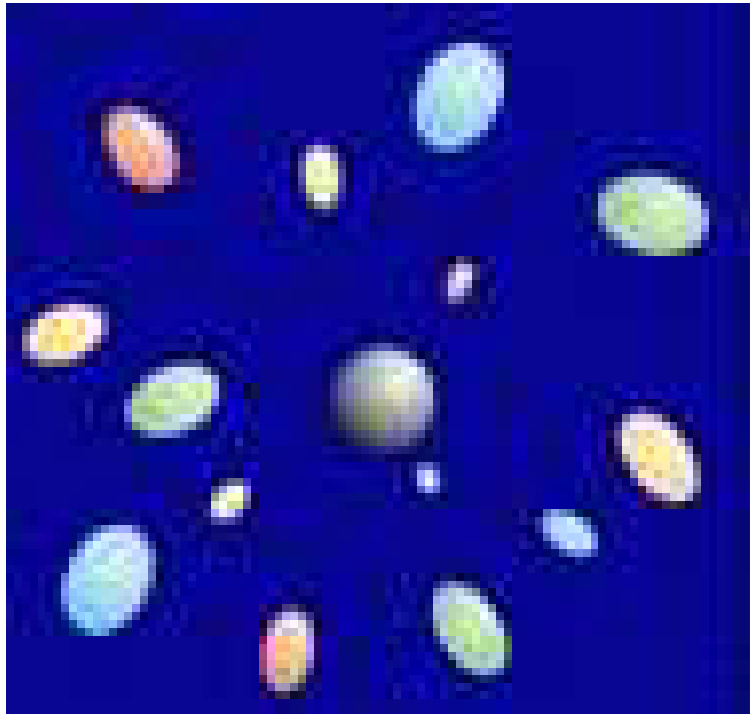
- Examples of speech sound contrasts explored in the CP paradigm:
 - voice onset time (VOT) of stop consonants (/pa/ - /ba/)
 - place of articulation of stop consonants (/ba/ - /da/ - /ga/)
 - fricatives vs. affricates (/sa/ - /tsa/)
 - manner of articulation (/ba/ - /wa/, /la/ - /ra/)
 - vowel quality: less clear categoriality, hints of continuous perception
 - prosodic features: categoriality doubtful, mainly continuous perception
 - most experiments done for English
- Review paper: Repp (1984)

Categorical Perception

- CP has also been observed in
 - infants → preceding language and speech acquisition
 - apes, monkeys, rabbits, chinchillas, some birds → without phoneme-based, linguistic communication
 - experiments involving non-speech signals → subjects not in linguistic perception mode
- CP appears to be a generic auditory or even generic perceptual phenomenon, rather than a specifically language-based one

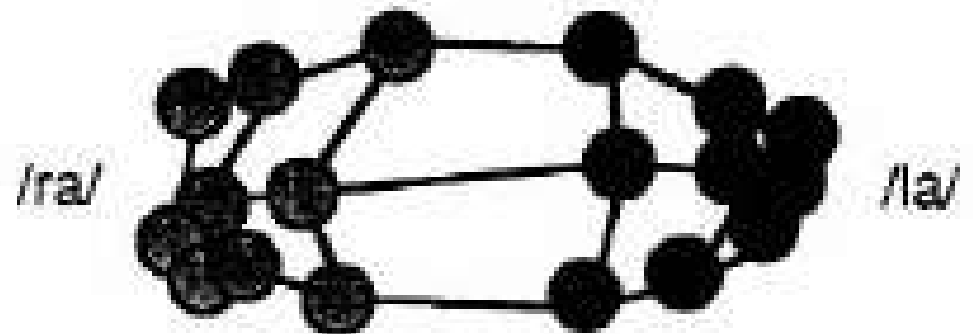
Perceptual Magnet Effect

- Infants can discriminate speech sounds of all languages, but with advancing L1 acquisition some of the contrasts lose their discriminability
- Sound categories become established around the most typical, i.e. prototypical, exemplar
- Prototype functions like a magnet
 - perceptual space is warped by shrinking the auditory distance between exemplars in the vicinity of the prototype – a magnet effect
 - reduced discrimination sensitivity between prototypes and similar exemplars
 - effective within categories

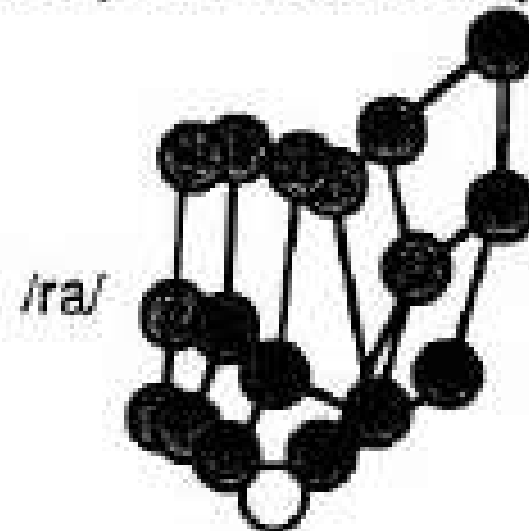


[Kuhl 1991]

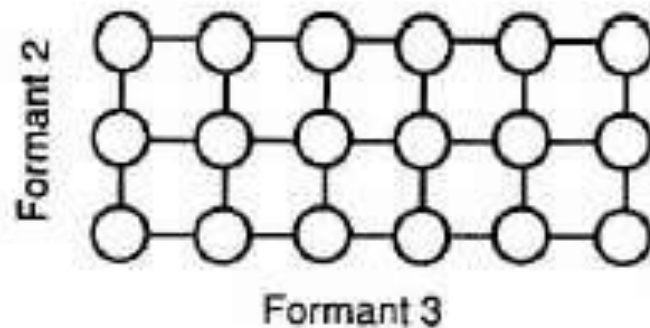
B. Perceptual World: Americans



C. Perceptual World: Japanese



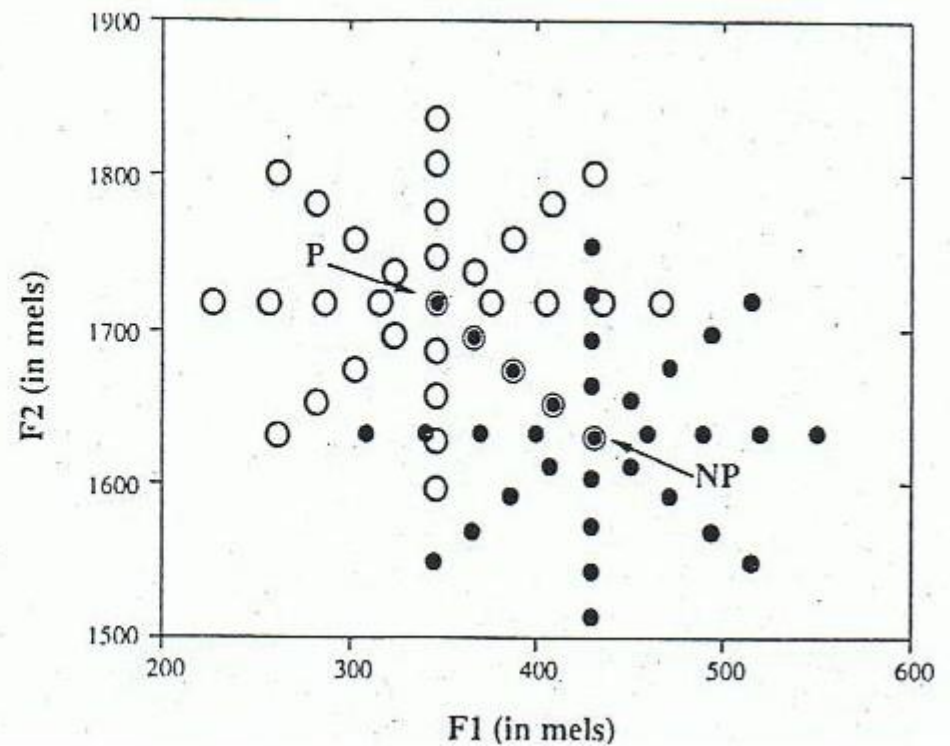
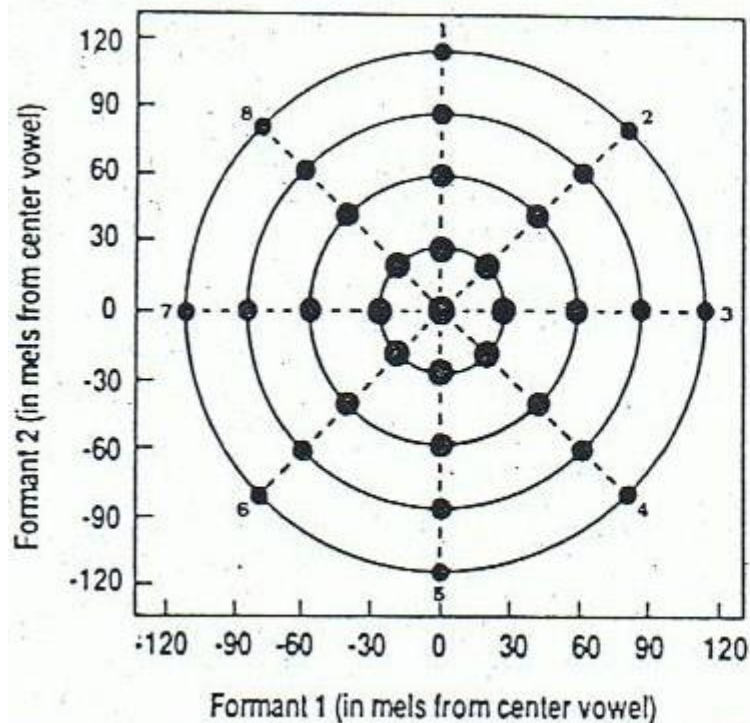
A. Physical World



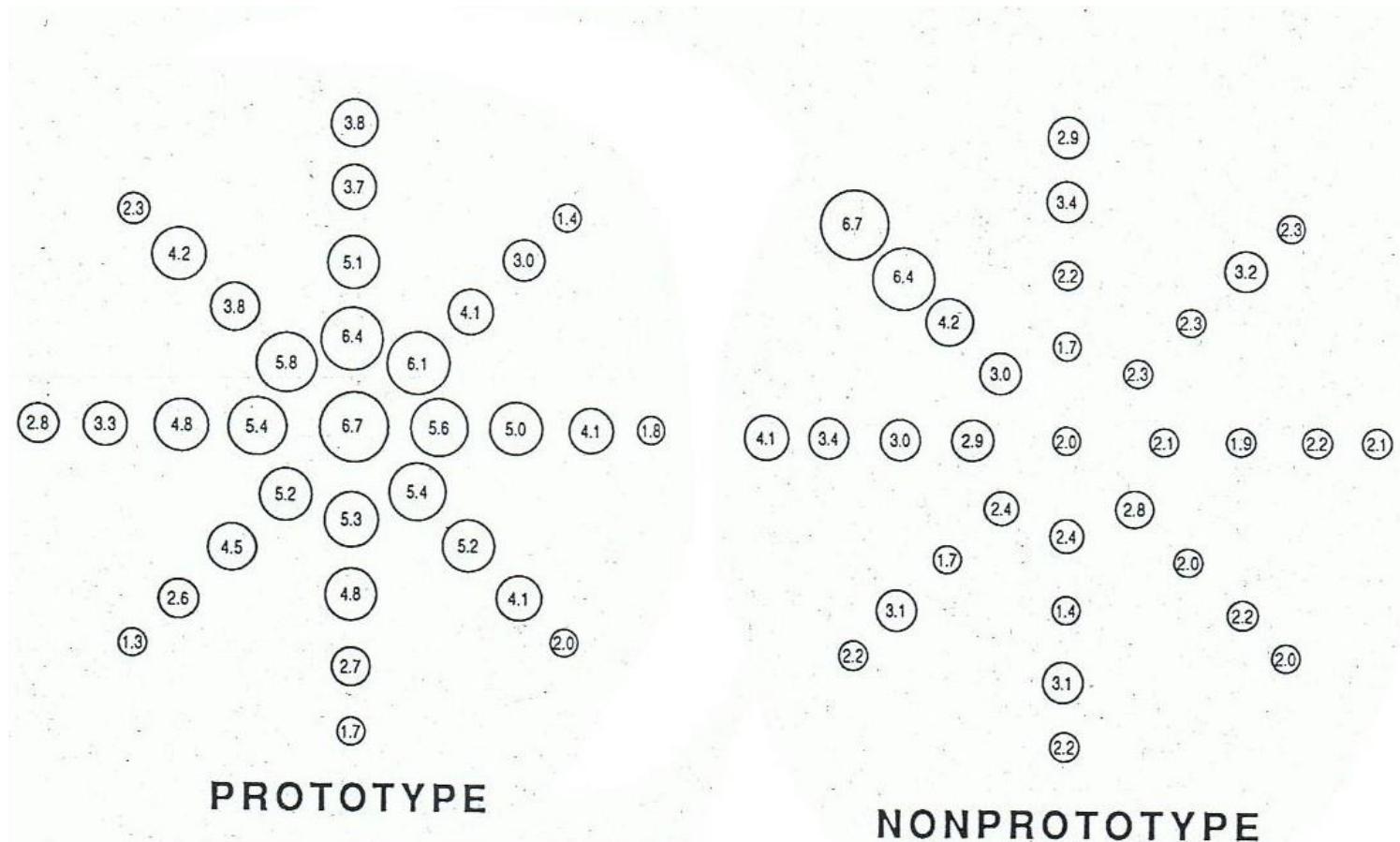
[Kuhl 1991]

- available evidence
 - /i/ - /e/ contrast
 - /r/ - /l/ contrast
 - English, Japanese
 - adults, infants, monkeys
 - German boundary tones [Schneider et al., 2005, 2006, 2009]

- test – 3 tasks
 - identification - cf. CP – stimulus construction:



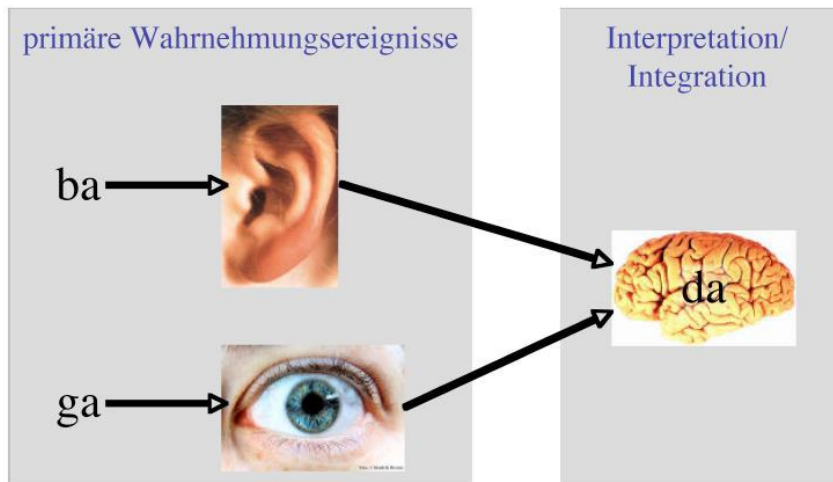
- test – 3 tasks
 - identification - cf. CP
 - goodness rating – for P and NP exemplars of target category:



- test – 3 tasks
 - identification - cf. CP
 - goodness rating
 - discrimination - cf. CP, except that stimulus pairs are
 - P + neighbor(s)
 - NP + neighbor(s)
- expected result (see above)
 - discrimination sensitivity reduced around P but not NP

Multimodal Perception

- Perceptual fusion of multimodal stimuli
- e.g., McGurk effect [McGurk and MacDonald, 1978]:
 - visual stimulus: [ga]
 - acoustic stimulus: [ba]
 - → multimodal perception: [da] !!
- Demo 1: <https://www.youtube.com/watch?v=aFPtc8BVdJk>
- Demo 2: <https://www.youtube.com/watch?v=jtsfidRq2tw>



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Thanks!

