CATEGORICAL SPEECH PERCEPTION REVISITED
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THE HASKINS PARADIGM OF CATEGORICAL SPEECH PERCEPTION

- Based on linguists’ concept of contrastive invariance in phonemes and conditioned variability in allophones,
- Projected onto perception by psychologists: the goal of perception is the decoding of the distinctive invariance of segmental phonemes from speech variability
- Listeners categorize an acoustic continuum sharply in an identification task and differentially across category boundaries but poorly inside

The classic identification and discrimination experiments for acoustic continua of place and VOT in plosives were taken as support of a special Speech Code in perception
- Closely linked to categorial separation in production
- As against gradual acoustic modulation (Kreutzfeldt et al. 1967)
- Resulting in the Motor Theory of Speech Perception

- The experimental results were less clear for vowels than for consonants, and seemed to differ from categorial tonal perception.

CATEGORICAL PITCH PERCEPTION

(a) The Categorization of Peak Alignment
Kohler (1987) applied CSP to the perception of F0 contours in German in a peak-shift and semantic contextualization paradigm, using the sentence ‘Sie hat ja gelogen.’

- There are 3 phonological peak positions early, associated with finally (‘knowing’), coming to the end of an argument
- Medial, associated with openness (‘observing’, ‘starting a new argument’)
- Late, associated with unexpectedness (‘realising in contrast to one’s expectation’)

- A series of lost stimuli with peak shifts ranging from early to late was generated.
- A verbal context was introduced for the identification of stimuli from the early to medial part of the continuum as either matching or not matching.
- Discrimination was tested with 1-step and 2-step pairings in ascending and descending orders along the whole continuum from early to late.

(b) The Categorization of Valley Alignment
Using the same method, Niebuhr and Kohler (2004) compared identification and discrimination of a valley-shift with a peak-shift continuum across unit step frame, being mirror images in semitone steps with reference to an initial F0 of 108 Hz.

- There is the usual CSP in identification and discrimination for peak shift.
- Valley shift also categorizes against opposite ends of the shift scale.

- The psychophysical principle does not apply, but functional categorization does.

(c) The Categorization of a Phrase-final Falling-to-Rising Continuum
- Phrasing is a natural tendency of speech, determining pitch identification.
- Different phrasing was used as the stimulus basis for discrimination and identification experiments.

RESULTS

- Results show categorical changes in the identification of early vs medial peaks discrimination maximum across the category boundary
- i.e. support for the classic Haskins paradigm.

- Psychophysical principle of pitch discrimination, separate from functionally determined pitch identification.

EXPLAINING THE DATA

- The psychophysical and the functional principle can be independent, but may be linked, as in the classic Haskins paradigm, which generalised one perceptual constellation with far-reaching consequences for the theory of speech perception.

- The naturally produced sentence Alle Jungen spielen Fußball.“All boys play football” was used as the basis of stimulus generation for discrimination and identification experiments.

- It contained two peak parts, on all and Fußball with a F0 dip between them.

- The F0 curve was styked by 5 significant points, (start, first peak maximum, minimum, second peak maximum, end) with linear interpolation between them.

- The first 4 points were kept constant across the series, the last one was changed in steps of 0.7 semitone, from 70Hz to 264Hz, which resulted in 24 stimuli forming a continuum from falling via level to rising pitch on the last word (see Table 1).

- The experimental results were less clear for vowels than for consonants, and seemed to disfavour categorical tonal perception.

- There is the usual CSP in identification and discrimination for peak shift.

- Matching of early to early and late to late stimuli was not significantly different from discrimination of identical stimuli in valley shift and peak shifts.

- The psychophysical principle does not apply, but functional categorization does.

- The psychophysical and the functional principle can be independent, but may be linked, as in the classic Haskins paradigm, which generalised one perceptual constellation with far-reaching consequences for the theory of speech perception.

REFERENCES


EXPLAINING THE DATA

- F0-peak and F0-continuum differ in the way syntagmatic pitch and articulation are contrasted along the landmark of consistent vowel transition. Early and medial peaks are aligned categorially with F0 falls, with a high-low or a low-high transition across the articulatory landmark, and increased acoustic intensity heightening the pitch differences.

- In the valley shift, the decisive pitch difference between early and late final ises is confined to the vowel and thus lacks a tight link with a syntagmatic articulatory contrast. This difference may be perceived in the different discrimination patterns.

- It can be concluded that a discrimination peak is not an inherent feature in the perceptual categorization of a physical continuum but constitutes a separate psychophonetic principle, based on two features:

1. Prosodic patterns are perceived in relation to the acoustic patterns of vocal tract sequencing.

2. Prosodic patterns are perceived across vs inside early/medial categories even works with speakers of diverse languages (tone and intonation), who have no knowledge of German.

- These two features define a different Speech Code from the Haskins one: it transsects the segmental-phonemic orientation and the very specific CSP paradigm.

- The psychophysical principle may fail for lateral segments of diverse languages to perceive categorical changes in F0 peak contour synchronization, even without a knowledge of the respective language.

- In all cases where pitch patterns are not defined as syntagmatic pitch contrasts in relation to syntagmatic articulatory transitions but as pitch characteristics of syllable nucleus or phonial pattern, the psychophysical principle does not seem to operate in pitch perception, hence the negative results of discrimination tasks in valleys alignement and peak-final rising pitch, in spite of functional categorization in identification tasks.

- To this list may be added the discrimination of peak height for emphasis (Lauf & Morton, 1997).

- Sound perception, too, would only be expected to show discrimination maxima if the definition of the sound category relies on essential syntagmatic features. This would explain the differences found in the categorization of consonants and vowels.