Use of Phonetic Detail in the Acquisition of Word-Object Associations: Turkish Children’s Sensitivity to Vowel Harmony in Word Learning Tasks

COGS 690 Graduate Seminar
Gözde BAHADIR
18.05.2007
OUTLINE

- Early perceptual sensitivities
- Use of early perceptual sensitivities in word-object association
- Different roles for vowels and consonants in early lexical acquisition?
- METU Babylab studies on Turkish vowel-harmony
- Present research proposal
Early Perceptual Sensitivities

- Developmental studies in cross-linguistic speech perception are important as they can inform us about the universal and language-specific aspects of speech perception (Werker, 1993).
- Much of the research in speech perception has been designed to resolve the theoretical controversy: Speech processing via a “specialized linguistic” or “generalized auditory” mechanism?
Early Perceptual Sensitivities

- **Discrimination** of speech stimuli from contrasting phonetic categories (categorical-like perception) by young infants:
  - Infants are exposed to a repeated auditory stimulus ([ba] changed to [pa]) and their sensitivity to this change is measured in terms of sucking rate/amplitude (for neonates) or gaze and head-turns (for 4-6 month-olds)

- Young infants’ ability to discriminate speech sounds extend to non-native contrasts, as well.
Early Perceptual Sensitivities

- Although young infants can discriminate many of the phonetic distinctions across natural languages without relevant experience, by 10-12 months of age, they can only discriminate the consonant and vowels distinctions that have “phonemic significance” in their native language (same with older children and adults)
- Decline (or tuning in) as a result of language experience
- **Perceptual reorganization** during the first year of life (Werker & Tees, 1984)
Early Perceptual Sensitivities: 1st Reorganization

Kuhl, 2004
Use of Early Perceptual Sensitivities in Word-Object Association

- For 1 year, infants perceive and segment phonemes and words purely in terms of their formal properties. However, words are used intentionally to convey meaning. Different sounding words are used to refer to different objects.

- Do infants use the perceptual formal knowledge they have acquired during the first year of their life in word-learning tasks?
Use of Early Perceptual Sensitivities in Word-Object Association

- Comprehension:
  - Recognitory comprehension: mere associative link between a word and an object, “goes together” relation: “association” low-level processes “contiguity”
  - Symbolic comprehension: not mere co-occurrence; “stands for”, “refers to” relation: cognitive “surplus”

- Recognitory comprehension imposes less cognitive demands than either symbolic comprehension or word production.

- Does the additional symbolic comprehension increase the computational demand on the child?

- Do these processes involved in learning to recognize words are different in younger infants than in older children?
Use of Early Perceptual Sensitivities in Word-Object Association

- When can infants first readily learn word-object pairings?
- Standard view: a number of abilities (e.g. some heuristics to facilitate fast mapping) come online by around 18 months that make learning much easier.
- Infants of 15 months can learn the association between new words and objects if they are taught the words in a contextually rich, interactive setting.
Use of Early Perceptual Sensitivities in Word-Object Association: The “Switch Task”

- To understand at what age infants can learn word-object pairings with only minimal exposure and without social or contextual support, Werker et al. 1998 developed the “switch procedure”.

- In this design, infants are first habituated to two objects, one paired with Word A, and one paired with Word B. After familiarization, two critical test trials are presented: the “switch” trial (e.g. Object A now paired with word B) and the “same” trial (e.g. Object B still paired with Word B). If the infants link the word with the object, they should notice when that pairing has been violated, and thus should show greater looking time to the display during the switch trial than during the same trial.
Use of Early Perceptual Sensitivities in Word-Object Association

Werker et al., 1998:

Auditory stimuli: Phonetically dissimilar, isolated, nonsense, CVC words recorded in infant-directed speech by a fluent female speaker: neem /nim/ and lif /lif/ (and pok /pok/ for pre- and post-trials)

Visual stimuli: two attractive toys, video-taped:
Use of Early Perceptual Sensitivities in Word-Object Association

- RESULT: “Infants aged 14, but not 8-12 months can readily learn new word-object pairings in a brief, controlled laboratory procedure.”

- No opportunity to interact with speaker, to manipulate the object; no social or contextual cues to direct their attention to the relation between the object and the word

- The emergence of this ability in infants of 14 months marks a significant achievement that can facilitate language acquisition

- Transition from prelexical status to referential understanding
Use of Early Perceptual Sensitivities in Word-Object Association

- **Stager & Werker, 1997:**
  - Can infants use their speech-perception skills of discriminating “fine” phonetic details that they use in syllable-discrimination tasks, when first learning word-object associations?
  - 4 experiments using the switch procedure
Use of Early Perceptual Sensitivities in Word-Object Association

- **Exp. 1**: 14 month-olds fail to notice the difference (small phonetic detail)
- **Exp. 2**: single pairing, 14 month-olds fail, 8 month-olds succeed!
- **Exp. 3**: control, just 14 month-olds, they succeed
- **Exp. 4**: control, just 14 month-olds, they succeed (simple speech-discrimination task)
Use of Early Perceptual Sensitivities in Word-Object Association

Figure 2 Results showing the conditions under which infants show significant recovery on the 'switch' trials. Graphs show mean looking times on the 'same' and 'switch' trials, with standard error bars.
Use of Early Perceptual Sensitivities in Word-Object Association

- Evidence: infants use different information in word-learning than in speech perception tasks.
- When “listening for meaning” infants of 14 months fail to detect the same phonetic detail that they can easily detect in a simple syllable discrimination task.
- Infants of 8 months may be able to pass the single-word-object association task used in experiment 2, because they are not yet mapping sound onto meaning. This is still a discrimination task for them!
- It is only when infants are attempting to learn the meaning of words that they fail to attend to the fine phonetic information.
Use of Early Perceptual Sensitivities in Word-Object Association

- This “inattention” to phonetic detail may be beneficial to the child, who is at the cusp of word learning.
- Linking words with objects being computationally more demanding than just listening to words as sound, it may be necessary to limit the amount of detail in the former task.
- Expectation: at an older age, when word-learning is no longer difficult, fine phonetic detail should be accessible again.
Use of Early Perceptual Sensitivities in Word-Object Association

- “Trade-off” relation between phonetic specificity and word learning
- Semantics takes precedence over phonetics!
- More mature form of learning: semantics and not form *per se*
Use of Early Perceptual Sensitivities in Word-Object Association

- Another functional reorganization:
  
  **1st reorganization**
  decline in the infants’ ability to discriminate non-native phones
  
  **2nd reorganization**
  decrease in the amount of detail used by infants as they move from speech perception to word learning

- In both cases, an intermediate decline rather than an increase in performance is evidence of a developmental progression.

- Children never recover from either reorganization

- Form becomes down-traded under the primacy of semantics
A problem with the Stager & Werker (1997) study was that the stimuli were ill-formed as English words: monosyllables headed by lax vowels without a following coda consonant (e.g. [bı]) do not occur as English content words.

In addition, they only examined the place-of-articulation contrast ([bı]/[dı]).
Use of Early Perceptual Sensitivities in Word-Object Association: Remedy for the earlier shortcomings

- **Pater et al., 2004** show that the results of Stager & Werker, 1997 (failure of 14 month-olds to respond to [bɪ]/[dɪ] in word-learning) extend
  - to stimuli that respect English phonotactics [bɪn] vs. [dɪn],
  - to a voicing contrast [pɪn] vs. [bɪn],
  - to voicing and place combined [pɪn] vs. [dɪn]

- When a phonological contrast like place or voicing is first acquired, it remains only partially integrated and can be lost under the processing demands of word learning.
Use of Early Perceptual Sensitivities in Word-Object Association

- **Werker et al., 2002:**
  - Infants of 20 months can learn to pair two phonotically similar words to two different objects under precisely the same conditions that infants of 14 months fail. Infants of 17 months show intermediate, but still successful performance in the same task.
  - *bih* 🎧  *dih* 🎧
  - Objects: crown 🎩  molecule 🧲
Use of Early Perceptual Sensitivities in Word-Object Association

- How do these results map onto general theories of the relation between perceptual skills and word-learning abilities? What is it that is different in the older infants? Three alternatives:
  - **Discontinuity in the process** by which they encode words
  - **Discontinuity in the representation**: Infants must construct a new representation of the words they hear when they are attempting to map sound onto meaning (1. form R, 2. sem+form R)
  - **Continuity in both the learning mechanism and the perceptual representation**, but the computational demands of linking words to meaning are so great for the novice learner that she cannot attend as closely to the fine phonetic detail available, leading to incomplete information uptake (Werker *et al.*’s view)
- “**trade-off**”: “dynamical account” in terms of competition for limited computational and representational resources
Different Roles for Vowels and Consonants in Early Lexical Acquisition?

- Nazzi, 2005:

- Can Werker *et al.*’s findings be generalized to contrasts other than consonantal contrasts?

- 2 different expectations w.r.t. infants’ comparative performance with consonantal & vocalic contrasts:
  - 1. It would be easier for infants to learn pairs of words contrasting on one of their vowels than one of their consonants
  - 2. Vs and Cs play different roles in language: Cs are more important at the lexical level vs. Vs at the prosodic & morphosyntactic level
Different Roles for Vowels and Consonants in Early Lexical Acquisition?

1st expectation: V>C

- Vs more salient than Cs in the speech signal
- Vs are the main carriers of prosodic information, dimensions to which infants are very sensitive during the first months of life
- Infants start learning the inventory of Vs of their native language (6 months) earlier than that of Cs (10-12 months)
Different Roles for Vowels and Consonants in Early Lexical Acquisition?

- The first adjustments infants make to the native language are related to Vs rather than Cs:
  - Neonates notice the introduction of a new syllable, only when it differs from the stimuli in the presentation set by at least its V and not C. But by 2 months: both Cs and Vs.
  - “First representation privileges Vs, but by 2 months, Vs and Cs are sufficiently well encoded to yield similar phonological representation.”
  - By 6 months, infants respond preferentially to the Vs of their native language (Cs only later, 8-10 months)
  - “When the infant goes from phonetic to phonological representations, Vs seem to be adjusted to native values before Cs” (Mehler et al., 2005)
Different Roles for Vowels and Consonants in Early Lexical Acquisition?

- 2nd expectation: “Cs and Vs have different roles”
- Linguistics:
  - Cs outnumber Vs
  - Vs tend to lose quality distinctiveness (in unstressed positions and harmony)
- Psycholinguistics:
  - “word reconstruction” studies in Eng., Dutch and Spa.: adults are better at changing a non-word into a word when it involves changing one of its Vs: Cs are more stable units for the identity of a N.
- Language Acquisition:
  - Word segmentation/learning experiment: French adults can tract TPs in a context of fixed Cs and variable Vs, but cannot do so when Cs are changing and Vs are constant: Cs matter more at lexical level!
As no developmental evidence existed regarding the different involvement of Cs and Vs in the early lexicon, Nazzi (2005) tested these hypotheses and the findings of Werker et al. 2002 with a different task:

- Name-based categorization task
Different Roles for Vowels and Consonants in Early Lexical Acquisition? A Different Method

Infants are given several trials in which three dissimilar-looking objects were introduced and named, two of these objects receiving the same name. Name based categorization was then tested by taking one of the objects of the named pair, and asking the infant to give “the one that goes with this one”.

“pide”  “pide”  “pige”
Different Roles for Vowels and Consonants in Early Lexical Acquisition? A Different Method

- Phonetically different words: [pize] vs. [moRa]
- Words differing minimally on their onset C: [pize] vs. [tize]
- Non-initial consonantal contrasts: [pide] vs. [pige]
- Vocalic contrasts: [pize] vs. [pyze]; [pize] vs. [paze]; [pize] vs. [pizu]
Different Roles for Vowels and Consonants in Early Lexical Acquisition?

- Results: words could be easily learnt in the phonetically different condition, and were learnt, though to a lesser degree, in both the initial and non-initial minimal C contrast, by 20 month-olds.

- However, infants’ global performance on all three vocalic contrasts was at chance level.

The possibility of different contributions of Vs and Cs in early word learning
Different Roles for Vowels and Consonants in Early Lexical Acquisition?

- **Nazzi and New, 2007:**
  - The C/V distinction in the previous study was confounded with another distinction: continuity of phonemes (discontinuous stop Cs vs. continuous Vs)
  - 20 month-olds’ use of phonetic specificity while simultaneously learning two words that differ by a “continuous consonant”: parallel to the results for stop consonants

Asymmetry between the roles of Cs and Vs at the lexical level
Different Roles for Vowels and Consonants in Early Lexical Acquisition?

- Nazzi (2005) and Nazzi and New (2007): evidence for a greater reliance on Cs at the lexical level at infancy.
- “More evidence will be needed to strengthen this interpretation, by exploring how this pattern replicated when using other tasks, and how it extends both developmentally and cross-linguistically (both studies conducted with French infants)... Such extensions will evaluate whether the processing differences observed here are general or determined by phonological properties of the language in acquisition...”: Motivations for the present proposal
METU Babylab Studies on Turkish vowel-harmony

- **METU Babylab**: intended as a research platform for Cognitive Science students and staff, dedicated to the study of cognitive and language development of Turkish infants and children

- First Project: “Early Language Acquisition of Turkish infants: The processing of vowel harmony and word stress”

- At what point in time do Turkish infants become sensitive to the features (+/- high, palatal, labial) in the phonological system of their target language? What functions do those features have in language acquisition and language processing? (Primary domain of application: word segmentation)
Vowel-harmony is a pertinent characteristic of the Turkish morpho-phonological system.

It may constitute a powerful cue for word segmentation together with word stress.

Turkish with its elaborate two-way vowel harmony system, offers an excellent opportunity to study both cues separately and also their joint contribution to word segmentation.

Target age range: 6-10 months (when infants tune in on the language-particular features of their mother tongue)
METU Babylab Studies on Turkish vowel-harmony

- Experiment 1: Vowel-harmony in stem+suffix sequences
- Experiments 2+3: Vowel harmony and word stress in a word segmentation task (Çağdaş Tülek’s MS. research)
Present Research Proposal

- Word learning + exploiting phonetic detail that is characteristic in the target language; e.g. Vowel harmony in Turkish
- Are Turkish children of 14 and 20 months sensitive to small phonetic detail, if this detail is “systematically” exploited in the language, as is a phonological process such as V-harmony?
- Only back-front harmony
Present Research Proposal

- Procedure: the switch task (with two pairings)
- Left to right → : assimilation changing 2nd Vowel

  - Familiarization
    - pîte
    - kipa
  - Test
    - pîta
    - kipe

Switch task
From –harmonic to +harmonic

- Familiarization
  - pîte
  - kipa
- Test
  - pîta
  - kipe

Same task
From –harmonic to –harmonic
Present Research Proposal

- The other direction: from right to left ⟷ : changing the 1st Vowel

- **Switch task**
  From –harmonic to +harmonic
  \[ p̄t̄e \ k̄īp̄a \Rightarrow p̄t̄e \ k̄īp̄a \]

- **Same task**
  From –harmonic to –harmonic
  \[ p̄t̄e \ k̄īp̄a \Rightarrow p̄t̄e \ k̄īp̄a \]
Present Research Proposal

- Procedure: the switch task (with two pairings)
- Left to right → : assimilation changing 2nd Vowel
  - Familiarization
    - pıta
    - kipe
  - Test
    - pıte
    - kipa

**Switch task**
From +harmonic to –harmonic

- Familiarization
  - pıta
  - kipe
- Test
  - pıte
  - kipa

**Same task**
From +harmonic to +harmonic
Present Research Proposal

- The other direction: from right to left ←: changing the 1st Vowel
- **Switch task**
  - From +harmonic to –harmonic
    - pıta kipe ⇒ pıta kıpe
- **Same task**
  - From +harmonic to +harmonic
    - pıta kipe ⇒ pıta kipe
Present Research Proposal

- Experimental Design:
  - 1. age: 2 levels, 14 and 20 month old infants
  - 2. back-front harmony: 2 levels, +/- harmonic
  - 3. direction of value:
    - from –harmonic to +harmonic
    - from +harmonic to –harmonic
  - 4. change of linear direction
    - from left to right (→)
    - from right to left (←)
Present Research Proposal

- Control Study 1: Consonants
- Consonant changes in Turkish as in previous studies
  - Familiarization
    - pıta
    - kipe
  
  **Switch task 1**
  initial consonant

  - Test
    - şıta
    - çipe

- Familiarization
  - pıta
  - kipe

  **Switch task 2**
  non-initial consonant

  - Test
    - pıka
    - kite
Control Study 2: Vowels

A vowel change that is not relevant for a phonological process in Turkish (e.g. [+/- nasal]) This should be a mere phonetic difference that does not figure prominently in any characteristic process.
Present Research Proposal

- Another possible control: testing adults
- “Word reconstruction” study: listeners turn non-words into real words by changing single sounds
  - **linearity**: changing disharmonic words into harmonic words, which direction?
  - niga => nige
    - nıga (attention to possible neighbor real words!)
- Or a preference task of a similar design
The End

- **ACKNOWLEDGEMENT:** Many thanks to Annette Hohenberger for her guidance!
- **THANK YOU VERY MUCH FOR LISTENING!**
- **ANY QUESTIONS AND/OR COMMENTS?**