Theories of Language Acquisition

- Innateness of Language

Humans are endowed with a genetically determined system specifically designed to facilitate language acquisition. Experience-independent learning mechanisms play a primary role in language acquisition.

(cf. Chomsky 1965, among others).

- General Learning Principles

Language acquisition is facilitated by an interaction between statistical distribution of elements in the input and general learning principles. Experience-dependent learning mechanisms play a primary role in language acquisition.

(cf. Bates and Elman, 1996; Rumelhart and McClelland 1996).

Theoretical Purpose

- The purpose of this research is to test these theories in the domain of categorical perception by investigating whether naturally occurring phonemic contrasts are easier to acquire than unnatural contrasts (i.e. contrasts that do not occur in any of the world's languages).
- The question under investigation is the following:

Given an equal amount of exposure to relevant input, will it be easier for adults to acquire a natural categorical distinction vs. an unnatural distinction?

Previous Research

- Early categorical perception studies

  Early categorical perception studies suggest that, during a very early stage in language development, infants, with no prior exposure, can perceive non-native phonemic contrasts, while adults have difficulty perceiving non-native contrasts (Eimas 1971, Werker, Gilbert, Humphrey and Tees 1981; Werker and Tees 1983 among others).

- Adult intense training studies

  Other research suggests that adults can be trained to perceive category boundaries not evidenced in the native language (Bradlow, Akahane-Yamada, Pisoni & Tohkura 1999; Lively, Pisoni, Yamada, Tohkura & Yamada 1994; MacKai, Best & Strange 1981, among others).

Maye and Gerken (2000)

- Purpose

  To investigate whether native English-speaking adults can form phonemic categories based on the statistical distribution of exemplars in the input.

- Design

  - During a 9-minute training session, native English speakers were presented with CV syllables whose formant transition frequencies varied along an eight-point continuum (ranging from voiceless unaspirated /t/ (e.g., *stay*) to voiced /d/ (e.g., *day*), which are not contrastive in English).
  - Statistical distribution of CV tokens varied between two training groups (see figure 1).

    Mono-modal distribution group: tokens from the center presented 4Xs as often as tokens from the edges.

    Bi-modal Distribution group: tokens near the endpoints were presented 4Xs as often as tokens in the middle.

Maye and Gerken (2000) Con't

- Following training, participants were presented with minimal pairs beginning with voiceless unaspirated /t/ and voiced /d/ and asked to indicate whether they were the same or different.
- Results

  Results showed that participants in the bi-modal group were more likely to distinguish tokens at the far edges of the continuum than participants in the mono-modal group.

- Relevance to current study

  Using a bi-modal statistical distribution, adults can be trained to perceive non-native phonemic contrasts.

Overview of Current Study

- While adults can perceive/learn non-native contrasts with training, it is not yet clear whether this ability is facilitated by genetically endowed language-specific acquisition capabilities, or general learning principles.
- The present study attempts to gain information about the mechanism behind adult acquisition of non-native contrasts by training adults to perceive a natural categorical distinction and an unnatural distinction (i.e. a distinction that does not occur in any of the world's languages).

Predictions

- Given an equal amount of exposure to stimuli representing natural and unnatural phonemic distinctions, the Innateness and General Learning Principles theories make different predictions.
- ➢ If perception of phonemic contrasts is primarily influenced by statistical distribution in the input, then adults should not differ in their ability to learn natural and unnatural categories.
- ➢ However, if humans are "prewired" to be sensitive to linguistically relevant information in the input, then natural categories should be easier to learn than unnatural categories.

Design

- Participants: 20 undergrads
- Task: Passive listening followed by word discrimination task
- Training Conditions

Training Type	Training Duration
Natural training group Heard tokens distributed around a category boundary corresponding to a natural distinction.	**Short training duration** Training duration: 4.3 minutes
Unnatural training group Heard tokens distributed around a category boundary corresponding to an unnatural distinction.	**Long training duration** Training duration: 8.6 minutes

- Stimuli
  - ➢ Stimuli were synthesized CV syllables varying along a uvular – pharyngeal /ʁi - ⇨i/ continuum.
  - ➢ All stimuli presented in the testing phase are underlined in figure 2.
  - ➢ Participants in the Natural Training group heard stimuli labeled U1 and P1; participants in the Unnatural Training group heard stimuli labeled P1 and P2.
- Uvular-pharyngeal fricative distinction
  Contrastive in Jordanian Arabic but not in English.
- El Halees (1985) suggests that the uvular – pharyngeal distinction is dependent on F1.
  Uvulars: F1 < 550 Hz
  Pharyngeals: F1 > 550 Hz

Procedure

1. Practice session
   Participants judged whether English word pairs were the same or different.
2. Training session
   Participants passively listened to a list of experimental stimuli randomly presented using a bi-modal frequency distribution
3. Experimental session
   Participants listened to experimental stimuli pairs and judged whether they were the same or different.

Experimental Presentation

- Bi-modal statistical distribution
  Stimuli in the center of U1, P1 and P2 were presented four times as often as stimuli at the edges.
- Training
  - ➢ Block: 20 experimental stimuli
    20 filler stimuli (/bi/ - /di/)
  - ➢ Short training duration
    5 training blocks (4.3 min)
  - ➢ Long training duration
    10 training blocks (8.6 min)

Results Con't

- The Natural Training/Long Duration group correctly responded "different" to across-category pairs significantly more often than the Unnatural Training/Long Duration group ($F(1,8) = 5.09$ $p = .05$).
- The Natural Training/Long Duration group correctly responded "different" to across-category pairs significantly more often than the Natural Training/Short Duration group ($F(1,8) = 4.88$ $p = .05$).
- A two-way ANOVA indicates that there is no interaction between the type of training (natural vs. unnatural) and amount of exposure (long duration vs. short duration) ($F(1,16) = 2.09$, $p = .17$).

Discussion

- Despite the fact that participants in the both training groups were exposed to the experimental stimuli with identical frequency, participants in the natural training group were better able to distinguish across-category pairs.
- The results fail to support the general claim that language acquisition is primarily driven by general learning principles not specific to language.
- If language learning—or more specifically categorical perception—were dependent only on general learning principles, then there should have been no difference between participants trained to perceive the natural category distinction vs. the unnatural category distinction, since frequency in the input was held constant.
- Amount of exposure matters: for the Natural Training group, "different" responses to across-category pairs increased from 15% to 48% when training duration increased from 4.3 to 8.6 minutes.

Conclusions

- The results suggest that acquisition of phonemic categories is not solely dependent on general learning principles and is facilitated by principles specific to natural language.
- The results of the current study also indicate that adults' ability to distinguish non-native phonemic contrasts is influenced by the amount of exposure to the contrast.

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