Obstruent production by Greek-speaking children with atypical phonological development

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Phonological development

Children’s production patterns are influenced by several parameters including:

- Universal constraints on perception and production
  - Sounds that are more difficult to produce are acquired later
  - For example, fricatives vs stops
- Phoneme and phoneme sequence frequency
  - Frequency of sound in ambient language facilitates early acquisition

Common error patterns

- Substitution
  - Stopping ['tupa] for /'supa/
  - Fronting ['tola] for /kola/
  - Liquid deviation [ne'lo] for /ne'ro/
- Affecting syllable structure
  - weak syllable deletion [pa'to] for /pago'to/
  - final consonant deletion ['kokora] for /kokoras/
  - Reduplication [ma'mame] for /ki'mame/
  - Reduction of consonant clusters ['piti] for /spiti/
- Assimilation
  - Consonant harmony ['da'daki] for /tsa'daki/
  - Prevocalic voicing ['bodi] for /'podi/

Aims

- investigate error patterns in obstruent production and s, $sp$ & stop $s$ consonantal sequences produced by children with atypical phonological development
- examine the effect of word frequency in production
- look into the influence of the ambient language in the error patterns observed

Atypical phonological development

- persisting error patterns
  - patterns continue after a certain age, e.g. consonant harmony after 4
  - chronological mismatch
  - advanced patterns co-occur with early ones, e.g. consonant harmony co-occurs with consonant clusters
- variable error patterns
  - different errors for the same structures, e.g. final consonant deletion or substitution of final consonant by glottal stop
  - systematic sound preference
    - e.g. [t] for /θ/, /f/, /s/, S/
  - atypical error patterns
    - e.g. gliding of fricatives, frication of stops, initial consonant deletion, etc.

Acquisition of Greek consonants and clusters

<table>
<thead>
<tr>
<th>75%</th>
<th>t</th>
<th>k</th>
<th>kj</th>
<th>s</th>
<th>θ</th>
<th>ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAL (1995)</td>
<td>2.6-3.0</td>
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Acquisition of Greek

(source: PAL)

2;6-3;0:
- fronting, backing, stopping, consonant harmony,
- consonant deletion, final consonant deletion,
- cluster reduction, metathesis/migration

3;0-3;6:
- consonant deletion, fronting and backing are declining

3;6-4;0:
- consonant harmony and stopping are declining

4;0-5;0:
- syllable reduction, metathesis/migration and final consonant deletion are declining

Acquisition of clusters

- follows acquisition of singletons
- /s/-stop clusters before stop /s/ clusters
- some error patterns in TD children
  - deletion of first member of the cluster
  - /s/ more often in /s/-stop clusters.
  - stop more often in stop-/s/ clusters.
- most frequent substitution for /s/-stop clusters is a stop
- most frequent substitution for /ps/ and /ks/ is a fricative or other stop-fricative sequence [ts]

Syriga et al (2007)

Speech material

- obstruents /t, k, kj, s, b, ts/
- s-stop and stop-s sequences
  - /sp, st, sk, ps, ts, ks/
  - recorded for one child only
- word-initial position
- vowel context: /i, e, a, o, u/
- real words:
  - familiar to the children
  - 2-3 syllables long
  - picturable
- nonsense words (for singleton obstruents)
  - 3-4 syllables long
  - anti-penultimate stress

Subjects

- 3 Greek-speaking children with atypical phonological development
  - one girl (3;3)
  - two boys (3;6 and 4;3)
- normal hearing
- normal IQ
- atypical phonological development:
  - based on parent and teacher report
  - based on informal observation at time of testing
  - based on opinion of a Greek speech-language pathologist who listened to the recordings

Speech material

- 12 Greek-speaking children with typical phonological development
  - three groups of 4 children matched in age with children with PD
  - normal hearing
  - normal IQ
  - age-appropriate speech and language development, based on parent and teacher report

Procedure

- picture and digitized recording of each stimulus presented simultaneously
- children repeated the word they heard
- children’s repetitions were digitally recorded
- native speaker transcription using PRAAT
- two native speakers transcribed the PD data
- initial consonant and cluster labelled
  - correct-incorrect
  - if incorrect, phonetic transcription of perceived error
  - agreement between transcribers was good, differences were resolved by discussion
Consonant production: TD children

- Production in real vs nonsense words
- More correct productions in real words for most consonants for all children groups

Consonant production: PD children

- Production in real vs nonsense words
- Variability among consonants and children
- More correct productions for [k] in real words for all children

Error analysis

- Errors: greater variability across places of articulation
- More errors at dental-alveolar place (except for /t, s/)
- Preference for dental-alveolar place

Variability in production

- Interesting variability for correct and incorrect productions
  - [t], [tʰ], [tˢ], [tˢʰ]
  - [k], [kʰ], [kˢ], [kˢʰ]
  - [c], [cʰ]
  - [s], [sʰ], [ʃ]
  - [ts], [tsʰ], [ʃ], [ʃʰ]

- Coarticulatory effects:
  - Retracted /s/ in back vowel environment
  - Palatalised /s/ in front vowel environment
Error patterns – child PD3-a

Incorrect production (100%) of [θ], [s, ts], and [k] (real words)
- /θ/:
  - backing [kj], [k]
- /s/:
  - backing [t, s, t, k, kj]
- /ts/:
  - stopping, backing [t, s, t, k, kj]
- /t/:
  - backing [k, kj], [k]
  - backing [h]
- /k/:
  - stopping [t]
- /kj/:
  - fronting [t]
  - backing [k, h]
- /θ/:
  - stopping, backing [t, s, t, k, kj]
- /s/:
  - stopping [k, kj, h, t]
  - backing [h]
- /ts/:
  - stopping, backing [t, s, t, k, kj]
- Consonant harmony: [papuzi] for [karpuzi], [kjakja] for [kialja]
- Migration: [puta] for [supa]
- Loss of contrasts: [kjalja] for [salja]

Error patterns – child PD3-b

Incorrect production (100%) of [θ], [s, ts] (real words)
- /t/:
  - backing [k, kj]
- /k/:
  - fronting [t] (nons words, one error)
  - fronting [t] (nons words)
- /kj/:
  - fronting [t]
  - backing [k, h]
- /θ/:
  - stopping [t]
  - stopping [t, ts]
  - backing [h]
- /s/:
  - Stopping, backing [t, k, kj]
- Consonant harmony: [dadaki] for [tsadaki], [Dido] for [siDiero], [dedo] for [Dendo]

Error patterns – child PD4

Incorrect production (100%) of [θ] and [kj] (except for one token in nonsense words)
- /θ/:
  - backing [k] (nonsense words, one token)
  - fronting [p, k]
  - metathesis, epenthesis
- /kj/:
  - fronting [t]
- /θ/:
  - stopping, backing [t, ts, s]
  - stopping [t]
- /s/:
  - Stopping [t, ts]
  - backing [t]
- /ts/:
  - Stopping [t] (nonsense words, one token)
  - Stopping [t]
  - Backing [s]
  - Stopping [t]
Consonant harmony: [tsatsi] for [tsaksi], [tsotso] for [tokso], [teto] for [kendro], [tsulitsa] for [turistas]

Cluster production – PD4

Correct production of [ts]
Incorrect production of [ps, ks, st]
Preference for affricate production
Correct production of [ts]
Incorrect production of [ps, ks, st]
Preference for affricate production

Cluster production

- no ps, ks, st clusters at 4;3 (0%)
- [ts] acquired (100%)
- [ts] substitutes for
  - [ps], [ks], [st]
  - [sk] in front vowel environment
- [p] and [kj] (in certain contexts) correct in s-stop clusters [sp, sk]
- not in target stop-s clusters [ps, ks] (produced [ts])
- /θ/ more correct in target [ps, ts, ks] (all produced [ts]) than s-stop clusters

Summary

The PD children of this study show instances of:
- persisting error patterns,
  - e.g. consonant harmony after 4 (PD4)
- chronological mismatch,
  - e.g. production of affricate but not [kj] after 4 (PD4)
- variable error patterns,
  - e.g. fronting and backing of [k], [k] or [t] for /ts/ (PD3a)
- sound preference,
  - /t/ for [θ, s, ts, k] (PD3-b), /t/ for [θ, s, ts, k] (PD4), [ts] for [ps, ks, st sk (certain contexts)] (PD4)
- atypical error patterns,
  - e.g. glottal replacement (PD3-a, PD3-b)
Conclusions

Children show some error patterns that are:
- common across languages (e.g. English, German, Cantonese, Turkish, etc)
- fronting, stopping, consonant harmony
- not common across languages
- backing, glottal replacement
- glottal replacement can be considered a simplification error
- backing characterizes atypical phonological development in some languages such as English, but
- has been observed for other languages with rich systems of velars and high frequency of occurrence, e.g. Vietnamese, Japanese
- Effect of word frequency (real vs nonsense words) on accuracy is not systematic
- Results point towards the importance of cross-linguistic work in typical and atypical phonological development