Phonemic Comparison, Segmentation and Blending Skills in Hearing Impaired Children

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Reading achievement among hearing impaired children has received considerable attention over the past two decades. The evidence continues to document severe reading deficits for this population.
To learn reading, the child must be able to * hear phonemes, see letters and relate them to each other. When this becomes automatic and efficient, the child can read words* (Moats, 2000).

• **Phonological awareness** is defined as the ability to abstract and manipulate segments of spoken language (Anthony et al., 2005, James et al., 2008).  

• **Phonological awareness** is the first step in teaching the child the code to read (Billard et al., 2009, Nathan et al., 2004).
• **Three distinct levels of phonological awareness are proposed:** breaking individual words into smaller units from words to syllables, then into the onset-rime level and finally into the phoneme Level (Anthony et al., 2003, Stahl & Murray, 1994).

![Diagram showing levels of phonological awareness]

• **Phonemic awareness is the highest level of phonological awareness which is focused only on the manipulation of phonemes** (Anthony & Francis, 2005, Hulme et al., 2007, Lonigan et al., 1998).

It is the most crucial level in phonological awareness skills to success in reading and spelling. (Lonigan et al., 1998, Wagner et al., 1994).
• Hearing impaired children have got many challenges to acquire phonemic awareness and subsequently reading skills as inability to access phonological information through auditory channel is a barrier to phonological processing skill acquisition.

• Accordingly, this study was designed to explore issues related to the development of auditory phonemic awareness skills in hearing impaired children.
The study group comprised of:
Fourteen children with sensorineural hearing loss ranging in age from 7-13 years.

The children were recruited from the Audiology Unit, Ain Shams University hospitals during the year 2009.
The criteria for inclusion were that all children had:

- Sensorineural hearing loss with regular binaural hearing aid use.

- Average intellectual ability as evidenced by Arabic Hiskey Nebraska test for learning aptitude.

- Good reading ability and scholastic achievement as evidenced by parent's report.

The study was conducted on fourteen children with sensorineural hearing loss with age range between 7-13 years (mean 10.3 ± 1.88).

All children had average IQ with Arabic Hiskey Nebraska test for learning aptitude (91 ± 6.992).

All the children were attached to mainstream schools and used aural-oral route for communication mainly.
• All hearing impaired children were using hearing aids binaurally and regularly with satisfactory aided response.

All children were subjected to the following:
• History taking including full medical and audiological history.

• Full audiological assessment.

• Immittancemetry was done to exclude middle ear problems.

• Psycho-social evaluation using Arabic Hiskey Nebraska test of learning aptitude to assess their intellectual ability.
All children were subjected to the following:

• Language test using standard Arabic language test (Kotby et al., 1995).

• Assessment of phonemic awareness skills.

Assessment of phonemic awareness skills (comparison, segmentation and blending):

• These abilities were assessed using informal remediation test material developed in Arabic language in Audiology Unit, Ain Shams University (Tawfik et al., 2005).

• In this study, certain material were selected to assess the phonemic comparison, segmentation and blending which is presented through auditory channel.
Phonemic comparison skill: two tasks were used:

- **Task I:** to identify the word that starts with the initial phoneme of an assigned word.

  e.g. Magazine → Cat, Monkey, Donkey, Basket.

  (Stipulated as phoneme identification or isolation in other reference [Picard, 2002].)

- **Task II:** to find three words that start with the initial phoneme of an assigned word.

  e.g. find three words that start with the first phoneme in the word Bat.

  Bat → Bag, Bad, Ball.
Phonemic segmentation skill: two tasks were used:

• Task I: to omit a phoneme from a word and mention the rest of the word.

  e.g. Dog without g → Do.
  (Stipulated as phoneme manipulation or deletion in other references.\cite{Picard, 2002, Carroll et al. 2003})*

• Task II: to count the number of phonemes in a word.

  e.g. Cat → c, a, t → 3.
**Phonemic blending skill**: to blend a number of letters in a correct order to form a word. The number of letters used ranged from two to six.

e.g. a, r, m → arm.
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All the children were attached to mainstream schools and used aural-oral route for communication mainly.

The results of the current study were divided into three sections:

- Demographic analysis of the hearing impaired children.
- Results of phonemic awareness tasks.
- Effect of different variables.
Demographic analysis of the hearing impaired children.

Table 1. Mean and Standard Deviation (SD) of hearing parameters (from history) among hearing impaired children.

<table>
<thead>
<tr>
<th>Hearing parameters</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset of hearing loss</td>
<td>2.3 years</td>
<td>1.9</td>
</tr>
<tr>
<td>Duration of hearing loss</td>
<td>7.7 years</td>
<td>2.6</td>
</tr>
<tr>
<td>Relative hearing loss duration*</td>
<td>73.9 %</td>
<td>19.8</td>
</tr>
<tr>
<td>Time in sound†</td>
<td>8.6 years</td>
<td>2.7</td>
</tr>
<tr>
<td>Relative time in sound‡</td>
<td>74.6 %</td>
<td>29.0</td>
</tr>
</tbody>
</table>

* Relative hearing loss duration is a percent ratio between the duration of hearing loss and the chronological age of the child.
† Time in sound is the sum of duration of use of amplification and the duration of auditory experience before hearing loss (25).
‡ Relative time in sound is a percent ratio between the time in sound and the chronological age of the child.
Results

Fig 1. Pie chart to show distribution of the hearing impaired children according to the onset of hearing loss.

Table 2. Mean and Standard Deviation (SD) of audiological parameters among hearing impaired children.

<table>
<thead>
<tr>
<th>Hearing parameters</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average pure tone in the better ear</td>
<td>77.9 dB HL</td>
<td>22.6</td>
</tr>
<tr>
<td>Speech discrimination in the better ear</td>
<td>44.8 %</td>
<td>28.6</td>
</tr>
<tr>
<td>Average aided pure tone</td>
<td>31.5 dB HL</td>
<td>9.8</td>
</tr>
</tbody>
</table>
Fig 2. Average pure tone threshold and aided threshold in the better ear

![Graph showing average pure tone threshold and aided threshold in the better ear](image)

Code:
- O: 0 dB
- AC: 50 dB
- No BC: 70 dB
- A: Aided 100 dB

Fig 3. Pie chart to show distribution of the hearing impaired children according to the degree of hearing loss.

- 36% < 50 dBHL
- 21% > 50 - 70 dBHL
- 7% > 70 - 90 dBHL
- 36% > 90 dBHL

Phonemic Comparison. Segmentation and Blending Skills in Hearing Impaired Children
Results
Results of phonemic awareness tasks

Fig. 4: Bar chart to show language test results in the hearing impaired children.
Fig. 5: Bar chart to show comparison between hearing impaired children performance and normative data in phonemic awareness tasks (Tawfik et al., 2005).

• Hierarchy of phonemic awareness development in normal children:
• **Hierarchy of phonemic awareness development in normal children:**

![Bar chart showing phonemic awareness tasks: Identification (age 6), Blending (age 6), Segmentation (age 6-7), Deletion (Age 7+).](chart)

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**Table 5. Correlation coefficient among phonemic awareness tasks results in hearing impaired children using Multivariate Analysis of Variances (MANOVA) test.**

<table>
<thead>
<tr>
<th>Aspects of phonemic awareness tasks</th>
<th>Comp. (I)</th>
<th>Comp. (II)</th>
<th>Segm. (I)</th>
<th>Segm. (II)</th>
<th>Blending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison (I)</td>
<td>r P 1.000</td>
<td>0.593*</td>
<td>0.740**</td>
<td>0.814***</td>
<td>0.665**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.026</td>
<td>0.003</td>
<td>0.000</td>
<td>0.009</td>
</tr>
<tr>
<td>Comparison (II)</td>
<td>r P 1.000</td>
<td>0.770**</td>
<td>0.667**</td>
<td>0.459</td>
<td>0.099</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.001</td>
<td>0.009</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Segmentation (I)</td>
<td>r P 1.000</td>
<td>0.870***</td>
<td>0.898***</td>
<td>0.727**</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.000</td>
<td>0.000</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Segmentation (II)</td>
<td>r P 1.000</td>
<td></td>
<td>1.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
<tr>
<td>Blending</td>
<td>r P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.000</td>
</tr>
</tbody>
</table>
Phonemic Comparison, Segmentation and Blending Skills in Hearing Impaired Children

Results

Effect of different variables

- Intellectual ability (IQ).
- Hearing parameters.
Table 6. Correlation coefficient between phonemic awareness results and intellectual abilities in hearing impaired children using MANOVA test.

<table>
<thead>
<tr>
<th>Aspects of phonemic awareness tasks</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
</tr>
<tr>
<td>Comparison (I) (Identification)</td>
<td>0.580*</td>
</tr>
<tr>
<td>Comparison (II)</td>
<td>0.837***</td>
</tr>
<tr>
<td>Segmentation (I) (Deletion)</td>
<td>0.820***</td>
</tr>
<tr>
<td>Segmentation (II)</td>
<td>0.652*</td>
</tr>
<tr>
<td>Blending</td>
<td>0.619*</td>
</tr>
</tbody>
</table>

Table 7. Correlation coefficient between phonemic awareness results and hearing parameters in hearing impaired children using (MANOVA) test.

<table>
<thead>
<tr>
<th>Aspects of phonemic awareness tasks</th>
<th>Onset of hearing loss</th>
<th>Relative duration of hearing loss</th>
<th>Relative time in sound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparison (I) (Identification)</td>
<td>r P</td>
<td>-0.588* 0.027</td>
<td>0.620* 0.018</td>
</tr>
<tr>
<td>Comparison (II)</td>
<td>r P</td>
<td>-0.713* 0.021</td>
<td>0.245 0.399</td>
</tr>
<tr>
<td>Segmentation (I) (Deletion)</td>
<td>r P</td>
<td>-0.374 0.188</td>
<td>0.185 0.528</td>
</tr>
<tr>
<td>Segmentation (II)</td>
<td>r P</td>
<td>-0.225 0.438</td>
<td>0.320 0.264</td>
</tr>
<tr>
<td>Blending</td>
<td>r P</td>
<td>-0.236 0.307</td>
<td>0.102 0.727</td>
</tr>
</tbody>
</table>
Conclusions

• Hearing impaired children performance in phonemic awareness tasks is characterized by a longer and more protracted learning phase than hearing counterparts.

• Early, proper and regular amplification will fasten the phonemic awareness acquisition.
To test phonemic awareness skills in hearing impaired children.

Training on phonemic awareness skills should be routinely enrolled hand in hand with auditory training for hearing impaired children which in turn enhance their reading skills.
THANK YOU