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Prosodic and Rhythmic Aspects of L2 Acquisition: The Case of Italian

Edited by

Anna De Meo and Massimo Pettorino
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“AND NEVERTHELESS THEY DO SPEAK ITALIAN”: PROSODIC EXPLORATIONS IN THE SPEECH OF DEAF IMMIGRANTS

ELISA PELLEGRINO AND VALERIA CARUSO
UNIVERSITY OF NAPLES “L’ORIENTALE”, ITALY

1. Introduction

Starting from past research on the main features of deaf speech, our study focused on the prosodic competence of foreign deaf immigrants, taking into account both the degree of deafness and the general comprehensibility of their speech productions.

We highlighted skills and strategies used to overcome their speaking impairment, and collected data on the deep influence that the pragmatic dimension of language may have even on deaf speakers, particularly during dialogical interaction.

2. Describing deaf speech: the existing medical research and perspectives for linguists

There is a rich medical literature devoted to the analysis of deaf people’s speech production. These studies clarify both the physiologic aspects of mispronunciations and the input deficiencies responsible for the voice quality of these atypical speakers. The analyses carried out have indeed identified the basic components that characterize deaf people’s speech. Referring to the Prosody-Voice Screening Profile set down by Schriberg et al. (1990) for the evaluation of pathological speech, deaf speakers’ productions can also be described in terms of their vocal and prosodic features. In particular, Schriberg and colleagues describe voice in
terms of loudness, pitch, laryngeal and resonance quality, while phrasing, rate, and stress belong to the prosodic component.

Since Calvert’s (1962) investigation, deaf peoples’ voices have been described as “tense, flat, breathy”, while the adjectives “harsh” and “throaty” are usually used to refer to what Schriberg et al. (1990) have called the “laryngeal quality” of pathologic speech. Both tension and voice constriction are considered to be articulatory consequences of the kind of input these speakers rely on, which is tactile, rather than auditory. The breathy quality instead derives mostly from the “excessive force on plosives before a vowel” that deaf speakers usually produce, as we will see in the present study. The reverberation of sounds in the pharynx is, on its side, responsible for the resonance which produces articulations that are perceived as “hollow”, while researchers point out how bad nasalization is managed by these speakers: sometimes they fail to pronounce these sounds, and some others they hyper-articulate nasal sounds in contexts where these do not occur at all.

Even more distinguishable are the prosodic traits of this atypical speech, whose main feature is the lack of fluency, described in terms of irregular phrasing, due to a general tendency to speak word by word without co-articulation, or sound blending. Fluency is also affected by the slow speech rate of deaf people, caused by prolonged vowels and long pauses between words. Stathopoulos et al. (1986) have highlighted the strategic use of pause duration for signaling sentence boundaries, which are marked by longer pauses than those used for words, instead of an adequate stress variation that should be used to control speech flow and mark the appropriate chunking. More generally, as Nickerson (1975) has pointed out, these speakers do not control stress contour, and tend to accent every single syllable they pronounce, a habit that is responsible for

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2 Ibidem.
Prosodic Explorations in Speech of Deaf Immigrants

the characteristic monotonous speech of many of the deaf. In addition, researchers have underlined how pitch control is influenced by the degree of the hearing loss itself. Bonetti et al. (2008) have analyzed prelingual mildly deaf adolescents, and found that they are able to control certain vocal features, such as speech fundamental frequency, intonation, accent, pauses and speech rate, proving that “prosody is not uniformly affected in the category of deafness, but that some prosodic features remain preserved with lower degrees of deafness.”

Nonetheless, the bulk of medical studies is not concerned with real communication, and their analysis are carried out using word lists or small phrases read aloud as test material. This methodology actually allows easy comparisons and measurements for researchers that are mainly concerned with segmental aspects and the general intelligibility of speech. On the contrary, in our study we focus on the communicative skills and competence of a special group of deaf adults, namely deaf immigrants, who are in need of, and want to improve, their Italian in order to strengthen interaction with the hearing community of the new country they live in, and thus they ask for specific training not only in the written language but also in speech production. Some of them actually have hearing children, some others work in the public services, and some simply ask to be trained in vocal communication to accomplish the basic tasks of ordinary life. In this perspective, we have investigated the prosodic competence of three deaf immigrant women, and collected data on different aspects of communicative prosodic skills.

While medical research can help those in need of health healing, and also in the field of hearing deficit, linguists should assist everybody asking for the improvement of their language skills. For this reason, we conducted a study analyzing the spoken productions of deaf foreign immigrants attending a course of spoken Italian at the University of Naples “L’Orientale” who had explicitly asked to be trained on small speech productions. The aim was to focus on communicative awareness and competence of those more impaired in vocal communication, and our results have proved the specific that pragmatics plays in their vocal linguistic capabilities.

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7 Bonetti et al., “Prosody in Speech Produced by Deaf Person”, 1.
3. The study

The present study was intended to analyse whether foreign deaf people have any prosodic competence in L2 Italian that enables them:

- To produce a coherent phrasing of texts when reading aloud; and
- To vary the pitch contour of different speech acts similarly to native speakers.

In order to evaluate the role of the hearing loss level on the speech prosody of deaf immigrants, three deaf women who had previously attended an elementary course of vocal Italian were involved in the research:

- Albina, 43 years old, with severe level of hearing impairment. She is a health-social worker who has been living in Italy for 11 years and has 11-year old hearing son;
- Jurate and Reda, profoundly deaf women, 42-43 years old, Lithuanian, housewives, have been living in Italy for 12 years.

The study also evaluated the speech productions of an Italian native speaker for a better estimation of the deaf performances. Initially we had administered to 25 graduated native Italians, attending a training course for teaching L2 Italian in order to ascertain Albina’s, Reda’s, and Jurate’s comprehensibility. The pre-test material consisted of a short of the reading by Albina, Reda, and Jurate extracted from the first test session used for the present research (see § 3.2.). The perception test had shown that Albina, who has the lowest level of hearing impairment and the greatest practice in spoken Italian, is the most comprehensible of the three. Albina’s oral production was rated sufficiently comprehensible by 80% of the Italian listeners, and scarcely comprehensible by the others. On the contrary, Jurate was considered scarcely comprehensible by 96% of the tested native speakers, and sufficiently by the other 4%. Only Reda was unanimously (100%) considered scarcely comprehensible. However, since we are not going to analyze the segmental features of deaf speech any longer, these results provide a quick estimation of this component.

3.1. The test

The study was articulated into three phases. The first was devoted to exploring the possession of any communicative skill in reading a plain narrative text aloud. In this session we looked for evidence of any prosodic competence used for correctly conveying the meaning of a text, measuring pauses and searching for any coherent phrasing strategy. We used a 27-word extract from an article of fashion, simplified for the deaf participants:
G-Star è uno stilista famoso e fa jeans molto belli. Oggi a Milano G-Star vende i suoi jeans a solo 20 euro, un prezzo molto basso. L’attrice Laura Chiatti fa pubblicità ai jeans di G-Star nel negozio di Milano.

(G-Star is a famous stylist and produces beautiful jeans. Today in Milan he sells his jeans at only 20 euros, a very reasonable price. The actress Laura Chiatti promotes G-Star’s jeans in the shop in Milan).

The text was given for pre-reading, with images to help participants understand it. Then a multiple choice reading comprehension test followed. For the second task, participants were asked to pronounce three different speech acts, performing a set of utterances such as:

- *Che ora è?* [What time is it?] (request);
- *Esci subito!* [Go out immediately!] (command);
- *Puoi aprire la finestra?* [Could you open the window?] (request);
- *Ti ordino di aprire la finestra!* [I command you to open the window!] (command);
- *Apri la porta!* [Open the door!] (command);
- *Io vivo in Italia* [I live in Italy] (assertion).

The aim of the task was to detect whether participants used different pitch contours in order to perform and differentiate between assertions, commands and requests. This kind of competence was also tested with another task consisting of semi-spontaneous conversation, in which deaf participants were asked to interact with hearing Italians never met before. The situation had elicited interaction and production of requests for the interlocutors. The questions produced in the semi-spontaneous speech production were then compared to those uttered in the acted speech task. For comparison, all the tasks were also performed by a native Italian.

### 3.2. Methods

The L1 and L2 corpora were analyzed for single speech chains. For each chain we measured the number of syllables actually uttered, their duration, the lowest and highest F0 values, the occurrence of disfluencies, the length of silent pauses between the speech chains. On the basis of these measures, the following rhythmic-prosodic parameters were calculated:

- Articulation rate (AR), the ratio between the number of syllables actually uttered and phonation time (syll/s);
• Speech rate (SR), the ratio between the number of syllables actually uttered and total time, including phonation time, empty or filled paused (syll/s). We considered empty pauses only silences that were longer than 100 ms;
• Fluency (F), the ratio between the number of syllables and the total number of speech chains;
• Tonal range in semitones.

Before examining the data from spectro-acoustic analysis, some preliminary methodological considerations are nevertheless needed. In our study, the corpus of speech produced by deaf participants was analyzed from the listener’s perception perspective, and not from that of the speaker’s production. In fact, if in speech by hearing people both the production and perception are strictly related, in deaf speakers the two perspectives do not always overlap (Fig. 4-1)

![Perceptual pauses vs. articulatory pauses.](image)

Fig. 4-1: Perceptual pauses vs. articulatory pauses.

What is perceived as silence does not necessarily correspond to physical pauses that are normally breathing or articulatory pauses. As in Fig. 4-1, the perceptual pauses (0.7-0.8 s) indeed may be the acoustic

---

correlates of compensating strategies necessary for preparing the following articulatory movements.

4. The results

In this section, we will illustrate separately the results of the two tasks our subjects were involved in. Firstly we will focus on the data of the read speech task (see § 4.1.); then we will present the results of the task of acted speech (see § 4.2.).

4.1. The read speech task

Data from the spectro-acoustic analysis of the read speech corpus show significant differences between the performance of the native speaker and those of the three deaf women. One of the prosodic features that seems to be most affected by the hearing impairment is the number of silences, which are much more frequent in the deaf, as is well known from existing literature. Jurate, Albina, and Reda pause respectively two, three and four times more often than the native Italian. (Elena 6 silences; Jurate 10; Albina 17; and Reda 24). The diverse use of silent pauses and the occurrence of disfluencies in the speech performed by deaf participants reveal significant differences among them in the composition of speech, in terms of fluency values, articulation, and speech rate. With only 6 silent pauses, lasting on average 0.450 s, the native speaker’s speech has the highest values of AR, SR, F and percentage of phonation time.

Fig. 4-2: Articulation Rate, Speech Rate and Fluency per speaker (E=Elena, A=Albina, J=Jurate, R=Reda).
Table 4-1: Composition of speech per speaker\(^{10}\).

If we move on to consider the prosodic features within the group of deaf women, data from Fig. 4-2 show that there are parameters whose diverse values cannot be attributed to the degree of deafness (fluency), and features that are more affected by the level of hearing loss (articulation rate and tonal range). Likewise, the number of silences and variations in fluency do not correspond to the difference in the level of the hearing loss. Jurate and Reda, the two profoundly deaf women, are respectively the most and the least fluent speakers, though they are less comprehensible than Albina, as we have seen in the perception test in paragraph 3. On the contrary, Albina, the most comprehensible of the three deaf participants, with a severe level of hearing impairment, has an articulation rate about one syllable higher than the profoundly deaf participants, and also a wider tonal range (Albina 14,6 st; Jurate 10,4 st; Reda 9,2 st).

In conclusion, the more profound the deficit, the longer the time to reach the articulatory targets, and the lower the tonal range. No relevant differences have been noticed instead in speech rate (about 2 syll./s).

In order to evaluate the communicative skills in reading aloud a plain narrative text, we extended the analysis to the text phrasing strategy and compared the performance of the hearing speaker with those of our deaf participants.

The chunking strategy used by the native speaker highlights the proper use of pauses, which reproduces the pragmatic organization of text information in topics and comments. All silent pauses last from around 300 to 600 milliseconds, and mark the boundaries between the theme introduced (e.g. *G-star è uno stilista famoso*) and what it is said about it (e.g. *e fa jeans molto belli*). The only remarkable exception is represented by a longer pause of ca 900 milliseconds at the end of the second paragraph (after *un prezzo molto basso*). This silence occurs when the

\(^{10}\) The mismatch between the number of silent pauses and the percentage of silence between the profoundly deaf Jurate and the hearing Elena depends on the fact that Jurate’s performance last longer (35 s) than Elena’s (13 s).
primary concept\textsuperscript{11} of the text, corresponding to the introduction of a new, not previously mentioned character, the actress Laura Chiatti. According to De Beaugrande and Dressler (1981) primary concepts are:

“…points from which [text] accessing and processing can be strategically done”, since “concepts are […] steps in the construction of a continuity of sense”.\textsuperscript{12}

The prolonged pause of 900 ms in the read speech of the native Italian signals a delay in the text processing, due to the radical shift in the conceptual architecture of the short text.

\begin{tabular}{|c|c|c|}
\hline
Nr & Text chunks/Speech chains & Silence (s) \\
\hline
1 & G-star è uno stilista famoso & 0.308 \\
2 & e fa jeans molto belli. & 0.573 \\
3 & Oggi a Milano G-star  & 0.410 \\
4 & vende i suoi jeans a soli 20 euro & 0.438 \\
5 & un prezzo molto basso. & 0.882 \\
6 & L’attrice Laura Chiatti & 0.345 \\
7 & fa pubblicità ai jeans di G star nel negozio di Milano & \\
\hline
\end{tabular}

Table 4-2: Text phrasing in the reading aloud task performed by the native speaker.

On the contrary, the text read by Albina has an impressive number of pauses that present at least one overt marking strategy: the long silence introduced at the end of each paragraph. In this perspective, Albina seems unable to produce any other coherent phrasing, and her performance looks as if as she was aware only of the typographic aspect of the text.


\textsuperscript{12} De Beaugrande and Dressler, \textit{Introduction to Text Linguistics}, 95.
However, by ordering the chunks according to pauses duration, a reading strategy is clearly recognizable. In fact, Albina tends to preserve syntactic boundaries, since shorter silences are used inside phrase units: 

\[
\text{[[[L’attrice]NP (0.153 s pause) Laura Chiatti]]NP (0.588 s pause) [fa pubblicità]VP (0.384 s pause) [[[ai jeans (0.175 s pause) [di G-Star]PP ]PP (0.771 s pause) [[nel negozio di [di Milano]PP]PP]PP VP].}
\]

In this respect she meets the vocal identikit offered by the medical literature, according to which deaf speakers pronounce word by word without co-articulations and sound blends. However, the presence and length of the pauses indicate the use of a reading strategy.
Table 4-4: Text phrasing by Albina: chunks ordered on the basis of their duration.

Jurate’s reading has a more extended phrasing and significantly longer pauses, especially that of 940 milliseconds after the word euro. She tries to organize her reading in clear informative chunks, separating the argument—which functions as the main concept around which all other information is grouped—from its predicates. This becomes particularly evident in the second paragraph, after the word euro, when she produces the longest silence (940 ms) trying to make a reparation (repeating the verb vende), to preserve the text intelligibility, since she had interrupted her reading in many points before the interruptions being caused essentially by articulatory difficulties. Instead, in the first paragraph she had been almost successful in producing only two different chunks, a perfect separation between the topic (G-Star) and its comment (è uno
stilista famoso e fa jeans molto belli). Unsurprisingly, the perfect division was interrupted only before the word *belli*, which starts with the sequence of a plosive plus a vowel, one of the crucial deficiencies in deaf people’s productions already highlighted in literature.\(^{13}\) Even if the third paragraph doesn’t show a similar clear phrasing, Jurate has proved to be aware of the pragmatic organization of texts and tries to respect it when reading aloud.

<table>
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<tr>
<th>Nr</th>
<th>Text chunks/Phonetic chains</th>
<th>Silence (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>G-star</td>
<td>0.155</td>
</tr>
<tr>
<td>2</td>
<td>è uno stilista famoso e fà jeans molto</td>
<td>0.255</td>
</tr>
<tr>
<td>3</td>
<td>Belli</td>
<td>0.921</td>
</tr>
<tr>
<td>4</td>
<td>Oggi a Milano G-star vende</td>
<td>0.391</td>
</tr>
<tr>
<td>5</td>
<td>i suoi jeans</td>
<td>0.405</td>
</tr>
<tr>
<td>6</td>
<td>a solo venti</td>
<td>0.288</td>
</tr>
<tr>
<td>7</td>
<td>Euro</td>
<td>0.940</td>
</tr>
<tr>
<td>8</td>
<td>vende prezzo molto basso</td>
<td>0.752</td>
</tr>
<tr>
<td>9</td>
<td>L’attrice Laura Chiatti fa pubblicità</td>
<td>0.678</td>
</tr>
<tr>
<td>10</td>
<td>ai jeans</td>
<td>0.236</td>
</tr>
<tr>
<td>11</td>
<td>Di</td>
<td>0.226</td>
</tr>
<tr>
<td>12</td>
<td>G-Star nel negozio di Milano</td>
<td></td>
</tr>
</tbody>
</table>

**Table 4-5: Text phrasing by Jurate.**

Such an awareness is not recognizable in the reading performed by Reda, who reads almost word by word, making very long pauses between paragraphs (1.117 s and 1.468 s), thus clearly revealing her articulatory difficulty.

\(^{13}\) Lenden and Flipsen, “Prosody and voice characteristics of children with cochlear implants”, 68.
Table 4-6: Text phrasing by Reda.

Resorting to the most significant data collected and to the intelligibility rates from the pre-test, it is possible to notice that Albina, who has the lowest level of deafness, is significantly less fluent than Jurate. Both in reading for the pre-test extract and when she reads the whole article (see Fig. 4-2), Albina uses a phrasing strategy much more in line

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14 Fluency data expressed in syllable/speech chain from the pre-test Albina 3; Jurate 6; Reda 2.
with the existing literature findings on the slow, and scanned speech of deaf people. This speaking strategy is nevertheless successful, since Albina has proved to be the only “sufficiently” understandable of the three deaf during the pre-test, even if her phrasing is deeply affected by her general tendency to overuse pauses. On the contrary, the profoundly deaf Jurate, the most fluent deaf participant, adopting the same “pragmatic” phrasing strategy used by the native speaker, is nevertheless perceived as hard to understand by native Italians. Moreover, the articulation rate proves that Albina is the fastest deaf speaker, and consequently the most confident in producing segmental units, which have proved to be also sufficiently understandable to native speakers. On the contrary, Reda’s results show no significant communicative skills, either in phrasing or in fluency or in the intelligibility of what she says.

4.2. The acted speech task

The spectro-acoustic data of the corpus of speech acts (1 assertion, 2 requests and 3 commands) confirms the results of the task of read speech. Once more, the prosodic features differentiating the speech of deaf women from that by the hearing participant are the greater number of silences, lower fluency, lower articulation and speech rate. If we consider the data concerning articulation rate and speech rate, it is possible to infer that the most significant difference between the two groups of participants are in the performance of the assertion and of the requests.

Fig. 4-3: Articulation rate per speaker and speech act.
Fig. 4-4: Speech rate per speaker and speech act.

Here, the hearing native speaker performs the two speech acts at a speech and articulation rate of about 6-7 syll./s, instead the values of these two parameters for deaf women are about 2-3 syll./s. The divergences decrease in commands where the gap between the hearing and the deaf participants is only 2 syllables long.

As for the frequency of silences, the native speaker is always the most fluent, because she performs all speech acts as single phonetic chains.

Fig. 4-5: Fluency per speaker and speech act.
If we compare the data within the group of deaf speakers, Reda is the most fluent. She segments only one request in two phonetic chains, and in doing so she preserves the integrity of the utterance unit of the speech acts. A completely different strategy is instead adopted by Albina, who segments all utterances in one or more phonetic chains. Reda’s higher fluency shows that she is more similar to the native speaker than Albina, from a prosodic point of view. Nevertheless her performance is characterized by segmental misarticulations and disfluencies that heavily affect the message intelligibility and its communicative efficacy. Similarly to the results of the reading task, there are no meaningful differences in speech rate. The severity of deafness seems instead to have an impact on the articulation rate since, with the exception of only one command (Apri la porta), Albina, the severely deaf one, is always the fastest speaker. It is important to underline, however, that the lower values of articulation rate by profound deaf women do not correspond to more accurate articulatory movements, as usually happens in the speech by hearing speakers, but they are mainly due to their difficulty in producing the required phones.

As for the intonational structure employed to express the three speech acts, the native speaker differentiates very precisely her pitch contours on the basis of the communicative intent to convey:

- An assertion has an initial pitch peak with a gradual lowering on the remainder of the utterance;
- A request has an initial pitch peak with final rising contour;
- A command has an initial pitch peak with final falling contour.

In every case the intonation unit is the utterance.

The deaf women use pragmatic and prosodic strategies that do not correspond to those used by Italian native speakers. Albina, for example phrases the utterances in words, and Jurate is not able to vary her pitch contour to convey the three specific communicative intents. The most extreme case is represented by Reda, who pronounces all speech acts with a flat pitch contour. She has also the lowest tonal range.

---

Table 4-7: Tonal range per speaker.

Concluding, in order to collect exhaustive data, we gave two sentences of different length for command and request. In this way it was possible to notice the lack of significant variation in articulation and speech rates of deaf speakers’ productions with sentences of different syllable length expressing the same speech act, such as the commands: Apri la porta and Ti ordino di aprire la finestra. For example the speech rate of Apri la porta is 2,4 syll./s and Ti ordino di aprire la finestra 3,1 syll./s in the performance of Albina, while in Jurate’s they are respectively 2,4 and 2,1 syll./s. The same does not hold for the native speaker, who varies her rate in order to perform the sentences as single utterances, and coherently realizes single pragmatic units.

There are significant exceptions to this rule though, since in at least one case Reda is almost as fast as the native speaker, both in speech and articulation rate, performing the command Apri la porta at a speech and articulation rate of 4,5 syll./s.

And Jurate, surprisingly, is also as fluent as the native Italian performing Esci subito and Che ora è?.

The only performances showing some prosodic competence are indeed those produced by the least intelligible participants of the study, a fact that compels us to draw the conclusion that the scanning strategy used by Albina is the only one capable of overcoming the segmental impairments these speakers have, and which allows her to perform sufficiently understandable speeches. But the segmental strain affects prosody, which is incorrectly managed.

On the contrary, the good performances shown by the profoundly deaf prove the existence of a prosodic competence, independent of their real production skills and level of deafness. This competence is linked to the implicit awareness that communication develops through units, and unity is given in different ways depending on the message channel, such as prosody, among many others, for spoken communication.

In the task of acted speech, the acoustic deficit, which prevents deaf participants from receiving sound feedback, is responsible for their rhythmic irregularity and lack of control on the pitch contour. These results are partially overturned in the task of semi-spontaneous interaction,
during which all of the three deaf speakers are able to produce a request using the right prosodic contour: an initial pitch peak with final rising contour (Figures 4-6, 4-7 and 4-8).

Fig. 4-6: Pitch contours in Albina’s request during the semi-spontaneous speech production. *Mi chiamo Albina e tu?* (“My name is Albina, what about you?”).

Fig. 4-7: Pitch contours in Jurate’s request during the semi-spontaneous speech production. *Come stai?* (“How are you?”).
5. Conclusions

The spectro-acoustic analysis of read and acted speech corpora show significant differences between the performance of the hearing native speaker and of those of the 3 deaf women. In both tasks, the native speaker is always the most fluent, and fastest, in terms of articulation and speech rate.

As for the differences within the group of deaf women, the data on read speech show that there are parameters whose diverse values cannot be attributed to the degree of deafness (fluency), and features that are more affected by the level of hearing loss (articulation rate and tonal range). The more profound the deficit, the narrower the tonal range, and the longer the time to reach the articulatory targets. Nevertheless, the lower values in the articulation rate are mainly due to the deaf people’s difficulty in vocal production, but the nearly native-like fluency in Reda’s acted speech task—the least comprehensible deaf person, unable even to produce a coherent text phrasing—seems to prove the existence of a communicative awareness and competence detached from the articulatory difficulties that prevent efficient spoken communication. While the acoustic deficit deeply compromises the segmental speech productions, the acted speech task highlighted some prosodic competence (fluency) that preserves communicative units, and in the semi-spontaneous interaction even the most profoundly deaf people produce the required prosodic curves for questions. Pragmatic awareness is also clear in the text phrasing of a profoundly deaf person.
The study provides evidence that the search for intelligibility and communication of contents in deaf speakers reduces prosodic control, but prosody has nevertheless proved to be a linguistic skill that these speakers do possess. Moreover, we have focused on communicative ability and searching for real speech behaviours, and not for artificial lab performances, as Lenden and Flipsen (2007) have correctly declared, asking for a new kind of research into the speech productions of deaf speakers.
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