THE EFFECT OF WHITE NOISE ON THE SPEECH OF INDIVIDUALS WITH HYPOKINETIC DYSARTHRIA ASSOCIATED WITH PARKINSON'S DISEASE

Dagmar Annaert, Charlotte Paulyn
Prof. Dr. Gwen Van Nuffelen, Drs. Leen Van den Steen
WHITE NOISE

- Indication of the use of unilateral/bilateral white noise in clinical practices

- Studies regarding the effect of noise on speech markers
  (Adams and Lang, 1992; Adams et al., 2005; Dykstra et al., 2012; Fox and Ramig, 1997; Gryczka et al., 2011; Ho et al., 1999 & Quedas et al., 2007)

- Relevance of this intervention → Lombard-effect
The Lombard effect is defined as the spontaneous tendency of speakers to increase their vocal intensity when talking in the presence of noise (Brumm et al., 2011; Hotchkin et al., 2013 & Zollinger et al., 2011).

When noise no longer present → drop of intensity to baseline (Lombard, 1911)
EFFECT OF LOMBARD ON SPEECH

- Fundamental frequency
- Vowel length
- Spectral tilt
- Formant frequencies
- Speech rate

(Bond et al., 1989; Hanley & Steer, 1949; Junqua, 1993; Summers, Pisoni, Bemacki, Pedlow & Stokes, 1988)
LOMBARD EFFECT

Due to

Reflex

Need for better communication
Primary goal → increase intelligibility

Increase speech volume → more intelligible = Lee Silverman Voice Treatment

(Lee Silverman Voice Treatment (LSVT); Ramig, Fox and Sapir, 2004)
MECHANICS BEHIND LSVT

Think loud, speak loud

- Better articulation
- Better abduction
- Better respiratory support

BETTER INTELLIBILITY

- Speech rate
MECHANICS BEHIND LSVT

Common problem LSVT → Generalization

Passive effect of LE → solution?
**STUDIES**

Focus on intensity

<table>
<thead>
<tr>
<th>Researchers</th>
<th>Method</th>
<th>Results</th>
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<tbody>
<tr>
<td>Fox and Ramig (1997)</td>
<td>• N=30 – n=14 control group&lt;br&gt;• 4 conditions: MPT, monologue, cookie theft picture and rainbow passage (reading)&lt;br&gt;• Perception was also taken into account</td>
<td>In 3 of the 4 conditions, there was a significant difference of 2-4 dB in favor of the control group&lt;br&gt;MPT no significant difference</td>
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<td>Ho et al (1999)</td>
<td>• Comparison of implicit - explicit instructions&lt;br&gt;• N=12 with age and gender matched control group&lt;br&gt;• Pink noise → 10 dB SPL - 25 dB SPL</td>
<td>Implicit instructions → no significant difference in intensity&lt;br&gt;Explicit → significant differences in loudness</td>
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Focus on intensity only

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<tr>
<td>Adams et al (2005)</td>
<td>• n= 10 – age matched control group</td>
<td>A significant difference was found through all given conditions, though there was a contrast of 2-3 dB when comparing both groups</td>
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<td>• Multitalker noise → 50 - 65 - 60 - 70 - 55 dB → 55 - 70 - 60 - 65 - 50 dB</td>
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<td>Gryczka et al (2011)</td>
<td>• n = 8 – 8 control group members</td>
<td>Both groups show an increase in intensity</td>
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<td>• Reading and spontaneous speech (describing picture)</td>
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<td>• White noise → 45 dB and 75 dB</td>
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# Studies

Focus on intensity only

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<td>Dykstra and Allyson (2012)</td>
<td>• N=30 – 15 control group</td>
<td>Max intensity → 10 dB SPL less intense than control group</td>
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<td>• 3 parameters (maximum, habitual, and conversational intensity)</td>
<td>Habitual intensity → 5 dB less intense than control group</td>
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<td></td>
<td>• Different levels of noise → 50 - 55 - 60 - 65 - 70 dB SPL</td>
<td>Conversational intensity → same findings in both groups</td>
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<td>Significant differences in different noise conditions</td>
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FINDINGS ON INTENSITY LEVEL

Overall findings → increase in intensity

! 3-4 dB less intense than matched control group

Possible explanation → sensorimotor deficit (Dykstra et al. (2012))
## Focus on other speech characteristics

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</table>
| Adams and Lang (1992)  | • N =5, no control group  
• 2 conditions (with and without white noise (bilateral 90 dB))  
• Reading (grandfather passage) | No significant differences in intelligibility and prosody  
Significant difference in intensity |
| Quedas et al (2007)    | • N =33 and control group  
• Parameters → intensity, fundamental frequency, stability of speech  
• Bilateral white noise → 0 - 40 - 70 - 90 dB SL | An increase in intensity and fundamental frequency in both groups.  
A better stability in control group. |
GENERAL REMARKS

▪ Overall focus on intensity

▪ Use of bilateral noise → no clinical implementation

▪ High intensity level of noise → agreeable?
RESEARCH PROBLEM

70% of PD-patients experience voice and speaking changes (Hartelius & Svensson, 1994)

→ Negative effect on speech intelligibility

! Quality of life may suffer
(Miller et al., 2006)
SIGNIFICANCE OF THE STUDY

To date no research has been conducted about the LE on parameters except for intensity (I) and fundamental frequency (F0) (Adams et al., 1992; Adams et al., 2005; Alf-Waress, 2008; Dykstra et al., 2012; Gross et al., 1997; Gryczka et al., 2011; Kalf et al., 2011; Krause et al., 2001; Schulz et al., 2000 & Skodda et al., 2013)

This study includes speech intelligibility and prosody
AIM OF THE STUDY

Effect unilateral noise

- Parameters
  → focus on intelligibility

- Verifying fatigue
- Subjective relevance

! Lack in current research
INCLUSION CRITERIA

- Parkinson’s Disease without comorbidity of other neurological disorders
- Hypokinetic dysarthria
- Intact hearing with audiometric threshold averages equal to or below 20dB hearing level (dBHL)
- Treatment of PD with Deep Brain Stimulation or Levodopa
- Measurements in ON-fase
- An adequate cognitive ability
PARTICIPANTS

Target population: n= 30
Preliminary: n= 5
Gender: 5♀
Age range: 73-75 years
Duration since diagnosis: 3-25 years
Medication: (preliminary) levodopa
DESIGN

3 measure moments
Total duration: 1h
PROCEDURE

Offering unilateral white noise (± 65 dB) during 30 minutes

Parameters:

- Intensity
- Fundamental frequency
- Prosody (speaking rate & intonation)
- Speech intelligibility
PRELIMINARY RESULTS
CHART NSVO-Z

Measure moment
- pre
- post1
- post2

NSVO-Z (in %)

Participants

1 2 3 4 5
CHART MEAN INTENSITY NSVO

Measure moment
- pre
- post1
- post2

Mean intensity\_nsvo (in dB)

Participants

0,0000
10,0000
20,0000
30,0000
40,0000
50,0000
CHART MEAN INTENSITY NSVO-Z

![Chart showing mean intensity NSVO-Z for different participants and measure moments.](image)

- **Participants:** 1, 2, 3, 4, 5
- **Measure moments:** pre, post1, post2

**Mean Intensity (in dB):**
- Participant 1: pre = 30,000, post1 = 40,000, post2 = 35,000
- Participant 2: pre = 45,000, post1 = 55,000, post2 = 50,000
- Participant 3: pre = 30,000, post1 = 40,000, post2 = 35,000
- Participant 4: pre = 45,000, post1 = 55,000, post2 = 50,000
- Participant 5: pre = 30,000, post1 = 40,000, post2 = 35,000
CHART FATIGUE

Based on visual analogue scales (VAS)
Remarks:

- User-friendly
- Comfortable BUT some of the participants would experience some uncertainty in their appearance

- Overall, the participants would recommend IF there is a favourable effect
CONCLUSION

Preliminary: variable results
A certain fatigue is observed

→ Further research is needed!