Introduction

For nearly two centuries clinicians have reported that stroke patients with non-fluent aphasia are nevertheless able to sing, with some of them even able to sing words. This astonishing observation has inspired the highly discussed Melodic Intonation Therapy. This therapy consists of a rehabilitation program with various elements, including three main components: melodic intoning, rhythmic speech, and the use of common phrases. The composition of Melodic Intonation Therapy may appear meaningful from a therapeutic point of view. However, when focusing on the different therapeutic elements and their individual contributions to clinical efficacy, some questions arise:

- To what extent are melody or rhythm decisive for speech production in aphasics?
- Does this depend on individual lesion locations in the brain?
- What role does memory play if one employs familiar song lyrics?
- To what extent may the benefits of Melodic Intonation Therapy be due to preserved automaticity in formulaic phrases?

Methods

The current study investigates seventeen German left middle cerebral artery stroke patients with non-fluent aphasia applying a cross-sectional repeated measures design. Patients are instructed to sing along with a vocal playback while utterances are recorded by a head microphone. Three raters independently evaluate the articulatory quality of the produced syllables, with over 3,500 syllables for each participant. Inter-rater reliabilities range from .93 to 1.00. Possibly confounding variables such as vocal frequency variability, pitch accuracy, and learning effects are controlled for. A highly well-known song is chosen based on a song familiarity study conducted with thirty-five healthy age-matched controls.

The experimental design focuses on melodic intoning, rhythmic speech, and the selection of the lyrics. Three modalities are applied: melodic intoning, rhythmic speech, and a spoken arhythmic control. In the conditions melodic intoning and rhythmic speech, patients are singing or speaking with accompaniment of a 4/4 percussion beat. In the spoken arhythmic control, the percussion beat turns into a 3/4 measure, and is shifted by an eighth note. The percussive manipulations do not affect the duration of each syllable.

Three types of lyrics are applied: original, formulaic, and non-formulaic lyrics. Formulaic lyrics consist of stereotyped phrases (“Hello, everything alright?”), which have been classified as automatized by eight clinical linguists. Non-formulaic lyrics comprise very unlikely, but syntactically correct phrases. Formulaic lyrics show significantly higher word transition frequencies than non-formulaic lyrics ($p < .05$) while not differing in word frequency, syllable frequency, phonetic complexity, and syntactic phrase structure.

On a neurophysiological level, a particular benefit from rhythmicity for basal ganglia lesion patients may be assumed. For this purpose, we consider CT or MRT scans of our participants.

Results

A repeated-measures ANOVA did not indicate an effect of melodic intoning. Instead, higher means were found for rhythmic speech, compared with the spoken arhythmic control ($p = 0.01$; Figure 1). Moreover, an interaction of basal ganglia lesions with rhythmicity was revealed ($p = 0.001$). Notably, the benefit from rhythmic control was found to be strongest in patients with larger basal ganglia lesions (Figure 2). Whichever lyric type was used, an effect from melodic intoning was consistently absent. However, main effects for each lyric type were revealed (original vs. formulaic: $p = 0.027$, formulaic vs. non-formulaic: $p < 0.001$; Figure 3).

Discussion

Contrary to some opinion, our data suggest that melodic intoning may not be decisive for non-fluent aphasia patients. Instead, our results indicate that rhythm may play a key role, particularly for patients with lesions including the basal ganglia. Our findings suggest that benefits typically attributed to melodic intoning in the past may actually have their roots in rhythm. Moreover, our data indicate that lyrics play a crucial role in speech production for non-fluent aphasics. Among the patients we studied, memory and preserved automaticity appeared to strongly mediate speech production.

Acknowledgments

Bianca Kleines & Julia Biokupik
Evangelisches Geriatricum, Berlin
Sankt Gertrauden Krankenhaus, Berlin
Zentrum für ambulante Rehabilitation, Berlin
Zentrum für angewandte Psycho- und Patholinguistik, Berlin

Poster publication