

Karen Linker

Student No.2119760

University of Wales, Trinity St David
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What are the challenges faced by singers with Parkinson's Disease or stutter speech disorder? Can singing ameliorate any of the symptoms of either of these neurological disorders, and how can a vocal tutor support students living with either of these conditions?

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Part 1: Portfolio

Introduction and Rationale

Within my practice as a freelance vocal coach, I tutor 28 students each week, including several students who are impacted by neurological conditions which present a challenge to their vocal production and/or their singing experiences. My student community includes singers with Down Syndrome, Autism, Neurogenetic Hypotonia, Parkinson's Disease, and a severe speech disorder (stutter). With support, as necessary, from other professionals, such as the medical practitioners and speech therapists who take responsibility for the health of these students, I operate my teaching studio as a fully inclusive singing community, and am committed to finding better ways to teach singing to those of my students who face unique challenges arising from these neurological conditions. To enhance my general knowledge of voice and teaching experience, I am seeking to obtain further skills and knowledge which is, specific to the full portfolio of students I teach (Rollings Bigler et al., 2021).

I am widely read and understanding of the benefits of singing, for all individuals, as regards general well-being (physical and mental) and feeling of social inclusion (Stacy et al., 2002; Beck et al., 2006; Clift et al., 2011; Erkkilä et al., 2011; Gick, 2011; Welch et al., 2014; Clements-Cortes, 2015; Hinshaw et al., 2015; Keeler et al., 2015; Osman et al., 2016; Clift et al., 2017; Plum and Stickley, 2017; Williams et al., 2018; Dingle et al., 2019; Lee et al., 2021; Nyashanu et al., 2021; Fahey et al., 2022) and believe that anyone who wants to sing should be supported and encouraged to do so. I am of the view, settled by my extensive research and experience within my own teaching practice, that it is possible to teach voice inclusively, by adjusting content and approach as appropriate, and, by enhancing my own knowledge as a vocal tutor, I can acquire the skills needed to teach a diverse student community and promote "diversity, equity, inclusion and belonging" within my teaching practice (Benson et al., 2022). Inclusion includes having access to services and resources (Juan-Morera et al., 2023) and by taking steps to properly educate myself as to the particular vocal challenges and needs of all my students, including my atypical students, I can better provide such a resource. Therefore, I have chosen to devote a significant part of my Masters study to an exploration of the challenges faced by those of my students whose singing is compromised by a genetic or neurological disorder, and the ways in which I can help them to navigate the challenges they encounter, thereby improving their vocal sound

and their singing experiences. Former modules of this Masters study focused on the impact of Down's Syndrome on singers, and led to a critical review of my teaching approach and practice. Research from those modules was transferred to my teaching practice, to the benefit of the students concerned, as confirmed by feedback from those students and my own observations of the impact of the adjusted teaching approach. I wish to replicate this learning and outcome for two of my other students, living with neurological conditions, namely Parkinson's Disease and stuttering speech disorder ("stutter").

Planned Programme of Study – Aims and Objectives

Aims

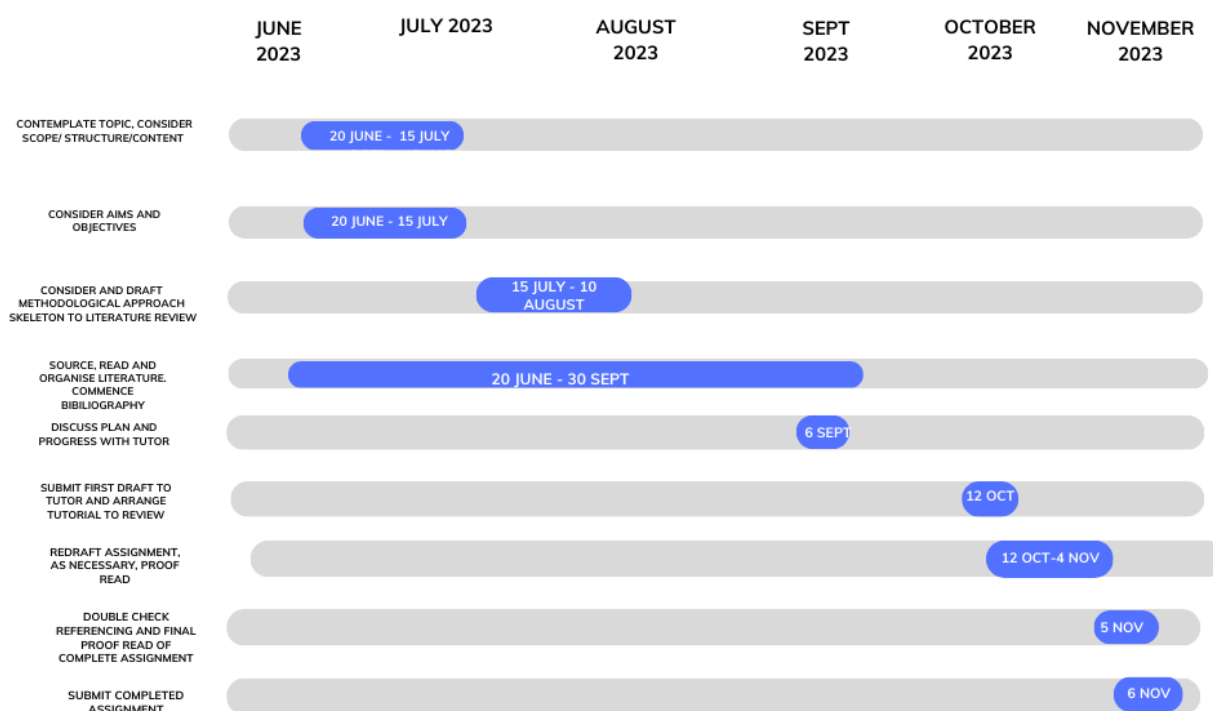
- To research and better inform my knowledge and understanding of the vocal challenges encountered by singers living with these specific neurological disorders, so as to better support them as their voice tutor;
- To acquire knowledge and understanding of any potential benefits of singing upon either of the neurological conditions discussed, with a view to subsequently producing a programme of targeted vocal exercises to improve or overcome any atypical vocal issues experienced by affected students;
- To ensure that, as far as possible, my voice studio is an inclusive environment and singing community.

Objectives

- To identify the significant researchers and contributors within my chosen field of enquiry, via a comprehensive search, across several disciplines, of relevant books, journals, research reports, dissertations, articles and any other sources of credible information available;
- To critically analyse and compare information and data obtained from the literature, by conducting a comprehensive literature review;

- To consider how to incorporate information obtained from the literature into my practice to benefit my students, and enhance and improve my teaching approach and content as well as their voices and singing experiences.

A chart setting out a timeline to ensure an organised and comprehensive implementation of each stage of this Assignment is set out below.



Literature Review Methodology

I conducted a literature review to obtain an understanding of the current status of research on my chosen topic and my specific enquiry therein, to identify any prominent themes and conflicts, and to inform my methodological choices for this and any further research and practice on this enquiry.

This research consisted of information obtained from as much relevant literature as could be found and accessed, considered alongside my personal experience of teaching students

with PD and stutter. In line with the pragmatist approach, literature was prioritised if it addressed issues relevant to my enquiry, and informed practical decisions regarding any adjustment to my teaching practice (Maclure, 2009; Kelly et al., 2020). Further, a pragmatist approach allowed for flexibility and a receptiveness to diverse theories and methodologies (Biesta, 2010; Feilzer, 2010, Creswell and Plano Clark, 2017; Morgan 2013; Korte et al., 2017) and enabled me to draw from a wide range of literature sources, based on both quantitative and qualitative evidence. The nature of my enquiry required identification and understanding of quantitative data, obtained from the literature, as regards the origin and impact upon the voice of the neurological disorders in question, but also required review of qualitative data arising from the study participants' reactions, response and feedback to therapy treatments which had been employed upon the basis of data obtained from scientific study. Whilst factual data is important when considering any enquiry that has a medical aspect, learning from people's experiences of a "phenomenon" (in this case the particular neurological disorders that impact my students) can provide insight and greater awareness of that phenomenon (Elo et al., 2020). Pragmatism is an action-based approach that bridges the gap between theory and practice (Kaushik and Walsh, 2019) and adoption of a pragmatist literature review enabled translation of research findings into practical application and identification of gaps in my knowledge for subsequent investigation (Nowell, 2015; Ramanadhan et al., 2021). As summarized by Goldkuhl, the primary goal of pragmatism is to obtain knowledge that leads to action and makes a significant and tangible difference in practice (Goldkuhl, 2012). The intention in adopting a pragmatist approach to this research and literature review, was to create a structure to learning and competently reflect upon the nature of the problems faced by my affected students, consider any potential solutions identified in my research, and implement solutions, where appropriate and possible, within my teaching studio (Morgan, 2014).

A narrative approach was the methodology applied to this literature review, in favour of a quantitative or qualitative systematic review (Green et al., 2006). Despite the risk of some personal bias being introduced and potentially reducing some credibility with the reader, presenting the review from a narrative perspective was, in my opinion, valid, since the nature of my enquiry was specific to my personal practice, and my perspective was informed by practical experience of teaching students with PD and stutter, such that I was able to prioritise and assess the literature, and identify where it appeared that evidence contained therein was lacking or dismissive (Siddharth and Gayatri, 2021). Nevertheless, I conducted my narrative review in a comprehensive manner so as to promote confidence in my work (Green et al., 2006; Bastian et al., 2010; Greenhaigh et al., 2018). I utilised several of the criteria required by formal systematic reviews, keeping my enquiries well-organised and

well-defined, and observed systematic review protocols such as creating inclusionary and exclusionary criteria, to properly inform the basis of my research and avoid introducing ambiguity, falsity or inaccuracies (Siddharth and Gayatri, 2021). I endeavoured to provide a reliable and trustworthy review of the literature I found (Snyder, 2019) and, in doing so, to create a foundation for advancing knowledge of this subject area. (Webster and Watson, 2002).

A narrative review was more appropriate, as much of the literature found contained quantitative data, generally relevant to the neurological conditions being discussed, but with little or no relevance to the specific query raised in this assignment. Despite the quantity of literature, there was very little which addressed the specific challenges of singers with PD or stutter. For example, PD has been found to cause bowing to vocal folds (Perez et al., 1996; Yüçetürk et al., 2002) but neither the specific effect upon the *singing* voice resulting from this impact, nor the treatment required to strengthen and improve a singing voice affected by the progression of PD was discussed in the literature and therefore an analysis of the quantitative data reported in the studies found did not assist my specific enquiry. The literature reviewed as regards the impact of PD on a singer was useful to an understanding of how the condition impacted upon systems and functions required for singing, for example, the vocal system, the respiratory system, the singer's ability to stabilise movement and posture, but did not go further to assist specifically with an exploration of how these issues might be improved or resolved for the singer. The literature did however provide sufficient information to draw analogies and conclusions as to the specific enquiry of this assignment; for example, as a vocal tutor, I am aware that the impact of PD upon respiratory function, as described in the literature, would affect the voice, because breath is foundational to singing (Alderson, 1979; Miller, 2000), and improving breath control leads to improvement in singing (Vennard, 2012). As regards stutter, the literature was informative and useful in its indication that stuttering was caused by a dysfunction of an area deep within the middle brain, the basal ganglia, leading to a decline in motor control. Whilst the literature, and my personal experience of teaching my affected long-term student, indicates that the act of singing is, unlike the act of speech, barely affected by stutter, some of the literature reviewed dealt with other neurological issues, common in individuals with stutter, for example a significantly reduced working memory (Yang et al, 2018) and as a vocal tutor, parallels could be drawn and conclusions reached as regards the impact of this upon the learning and performance experience of a singer.

Literature was reviewed across several professional disciplines, including that generated by medical practitioners and speech therapists, to understand the impact upon the vocal tract

and vocal production of both PD and stutter. The necessity of reviewing an extensive amount of literature across several disciplines and the lack of academic literature directly on point, as explained and exemplified above, would have made a formal systematic review, with the required meta-analysis and strict protocols, implausible for answering my specific enquiry within this assignment. Where I was unable to locate primary literature, in particular to answer questions regarding the benefits of singing and the support that could be offered to affected students, grey literature, such as the LSVT website, was considered and this provided useful and relevant information, such as details of exercises used to strengthen the speaking voice of PD patients (LSVT Global, 2015).

This literature review was conducted using mainly electronic databases, such as Google Scholar, Pubmed, Voice Study Centre Database, UWTSD Database, Mendelay, Researchgate and multiple medical journals, and undertaken in organised layers. Initial searches were broad and designed to ensure full awareness of any impacts and issues requiring further investigation to answer the enquiries raised. Subsequently, broad searches were undertaken in respect of both PD and stutter, to obtain detailed descriptions of the conditions and their origin (genetic in the case of PD, but both genetic and non-genetic in the case of stutter). Searches were carried out against the terms “stammer” and “stutter”, as although the terms are interchangeable, each is used in different jurisdictions, so both were searched for the purposes of this literature review to ensure collection of relevant literature from around the Globe, although only the term stutter was referred to in this work. Subsequently, more focussed searches such as “symptoms of Parkinson’s Disease” and “symptoms of stammer/stutter” were undertaken to understand the full impact of both conditions on the body, and obtain an awareness of how this affected not only voice and vocal production, but also other factors potentially relevant to the individual’s ability or desire to sing, including mobility, general physical health, and mental health. This broader enquiry and the resulting understanding of the impact of each condition, assisted resolution of the second limb of the enquiry, namely, how a vocal tutor could help navigate the challenges and support those singers living with either of these neurological conditions. To identify the specific impact of each neurological condition upon the vocal system and other relevant systems for singing, such as the respiratory system, narrower searches were then conducted, inputting search phrases such as “impact of Parkinson’s Disease on voice”, “impact of Parkinson’s Disease on Respiratory system” and “how does a stammer/stutter impact vocal production and singing”. This gave a broader view of all the challenges faced by the singer and further informed consideration of whether any of the issues highlighted in the literature could be tackled in the teaching studio, for example by way of targeted vocal exercise. To deal comprehensively with the assignment enquiry, a search was made for

information pertaining to the “benefits of singing” as regards both neurological conditions, in addition to a search for confirmation of any tested methods found to improve the voice and vocal sound of singers with either PD or stutter, with a view to incorporating these within an adjusted teaching approach, as appropriate.

There was no exclusion of studies pertaining to either condition on the basis of age, gender or ethnicity of participants, but as regards the research on stutter, literature was separated according to whether study participants were children or adults (thus impacting upon the origin of the stutter - developmental or acquired) in order to consider whether a different approach to the vocal support offered to each of these groups was appropriate. As regards PD, the literature reviewed was self-limiting as regards the age of study participants, due to the fact that PD, whilst theoretically possible in children and teenagers, is extremely rare.

A concerted effort was made to conduct the review in an organised and thorough manner, with an adequate sampling of resources, leaning towards the integrative review described by Torraco (Torraco, 2005) where a broader summary of the literature is provided, allowing for the inclusion of diverse methodologies and both experimental and non-experimental studies (Whittlemore and Knafl, 2005), leading to a more comprehensive understanding of an issue (Broome, 1993). The aim was to use the literature sampled to offer reasoned opinions and conclusions as regards the enquiry, based upon primary evidence from multiple disciplines, supplemented as appropriate with information obtained from a small selection of grey literature sources, and existing knowledge and personal experience acquired from teaching singers with PD and stutter speech disorder. This information was used collectively to authentically represent the underpinning evidence, and demonstrate how conclusions to this assignment were derived (Greenhalgh et al., 2018).

Critical Reflection

This research produced a better understanding of the underlying causes of the challenges faced by singers with PD and stutter, and further insight into the importance of their vocal training and singing activity. Information pertaining to the origin and general presentation of each of these neurological conditions and, in particular their impact upon body functions and systems relevant to vocal production and quality has been invaluable, as has the education regarding psychological (internal processes) and psychosocial (external social and interpersonal influences) challenges, beyond vocal production, often faced by singers living with these neurological conditions, including depression, discrimination, social isolation and poor self-perception (Borod, 2008; Iverach and Rapee, 2014; Springer and Gibson,

2022;Türkili et al., 2022). These additional challenges may not affect the voice per se, but nevertheless can have a detrimental impact upon the singer's learning and performance experiences.

This research has revealed an overlap in the cause of symptoms between Parkinson's Disease and stuttering (Shahed and Jankovic, 2001; Esapy et al., 2018; Chang and Guenther, 2020;Suppa et al., 2023), namely the dysfunction of the basal ganglia and cerebellum which play a major role in motor control and coordination, including the control of vocalisation. This is useful information, as it suggests that a certain teaching approach and content might benefit singers with either condition, not only to improve vocal sound, but also to improve other factors detrimental to their singing experiences, such as lack of self-confidence and social isolation, (Svsaab et al., 1972; Green, 1999; Davis et al., 2002; Chapuis et al., 2004; Craig et al., 2009; Shrag et al., 2000; Ahn et al.,2022). For example, exercises beneficial to students with PD or stutter could be learnt and practiced together, and might, in that way, also have a social inclusionary benefit. The validity and safety of any new vocal exercises proposed for these students will be confirmed with a suitably qualified professional, such as a speech therapist, before incorporation into any revised teaching programme. The research relating to PD carried out for this assignment has revealed links between singing and improvement of motor symptoms of PD, and as a direct result of this assignment I have registered for certified training on the LSVT methods described below, which are used to improve the voices of PD patients. This is one example of how knowledge obtained from this research has been pragmatically applied to my teaching practice, to provide more proficient and targeted vocal support for the students in question.

A consideration of reflective models available to direct the process of critical reflection upon this research and learning was undertaken. The Gibbs' model (Gibbs,1988, as cited in Jasper, 2013) which is a cyclical model of deep and critical reflection, involving six stages (description, feelings, evaluation, analysis, conclusion and action plan) was initially appealing, particularly as research was strongly impacted by feelings and a strong desire to actively improve tuition for singers impacted by PD and stutter. However, I ultimately preferred the transformative model formulated by Jack Meizrow, (Meizrow, 1978, as cited in Kitchenham, 2008) in the late 1970s, and refined and revised over subsequent years. Key elements of the transformative model of critical reflection which resonated with me were:

1. Self-reflection: I explored my own thoughts, feelings, biases, and prejudices as regards the neurological conditions and disorders faced by some of my students. This involved admitting to unsubstantiated perceptions of their limitations within the vocal

studio and I realised that my own privileged health status and my lack of understanding and perhaps discomfort with the physical manifestations of their disorders was affecting my perspective and interactions with these students

2. Critical analysis: the transformative model emphasises the need to analyse and question social structures and inequalities and I reflected that by accepting students with atypical needs into my student community, but teaching them in a similar way to my typical students, I was failing to treat their vocal development as of equal importance to that of other students without neurological disorders and that realisation made me determined to adjust my teaching approach and make it more inclusive by ensuring I was able to teach all my students competently and in accordance with their particular learning needs
3. Action and social change: transformative critical reflection is not solely focused on individual insights and understanding but also aims to inspire action for social change. I hope to use the critical awareness that this research has inspired to work towards creating a more equitable and inclusive vocal teaching studio, to influence others to appreciate the necessity and value of creating such an environment for atypical vocal students and to thereby challenge social prejudice against singers with these neurological conditions

The transformative model focuses on the creation of a dynamic relationship between teacher and student, and the creation of shared knowledge to promote learning and personal growth (Slavich and Zimbardo, 2012). An intention of this work is to create such a resource by informing affected students of this research and seeking their input both as regards the information collated and the way this might be used to benefit their vocal development and singing experiences. In summary, the factors central to the transformative theory are the importance of critical reflection, self-awareness, keeping an open mind and the desire to promote change where this is desirable. It was this framework and these goals which resonated, in my attempt to discard old biases and preconceptions about the nature of challenges and the true extent of any limitations encountered by my students with PD and stutter, both as singers and performers.

The critical reflection of this learning process has already instigated changes within my teaching studio. The review of literature has taken several months and during this time some of the information has already been distilled and applied to my practice. For example, after reviewing and considering the purpose of the exercises employed by LVST-LOUD to strengthen and increase the volume of the voices of PD sufferers (discussed in part 2 of this assignment), warm up routines, containing a series of familiar singing exercises to improve

volume and projection by working on vocal balance, good closure of vocal folds and tuning resonance to achieve better projection, have been prepared. A selection of these exercises are included at Appendix 2. Further, the newly acquired understanding of the non-vocal challenges faced by both students has prompted me to invite these students to attend a short series of joint singing lessons, to meet and work together on exercises that will benefit them both and facilitate a new social connection, in a safe and familiar space. My final reflection is that this work has been an intense and much needed education as regards my understanding and responsibilities to these students.

Part 2: Assignment

Introduction

Within my singing community, I teach one adult female with advanced Parkinson's Disease and a teenage girl who has spoken with a severe stutter ("stutter") from the age of seven. Many of the features of PD and stutter can have a particular impact upon a singer, as discussed below. Therefore, the rationale for carrying out this research is to better educate myself as to the impact upon singing of these conditions, and, specifically, to assist, within my professional competency, the vocal development of the affected students. This module will explore the impact upon a singer of (I) Parkinson's Disease (PD) and (II) stutter speech disorder, and will research, critically analyse and, where appropriate, apply information obtained from a review of relevant literature to my teaching practice. A glossary of terminology used is provided at Appendix 1 hereto

(I) Parkinson's Disease (PD)

Parkinson's Disease (PD) is a progressive neurological disease, established as a neurological condition in 1817 (Parkinson, 1969; Goetz, 2011; York, 2017). The symptoms of PD are wide ranging, but of particular interest to this work, and explored below, are those symptoms which directly impact the voice and vocal production, and others which negatively impact upon a student's singing experience.

PD is the fastest rising neurodegenerative disease worldwide (Dorsey et al., 2018; Okunoye et al., 2022) and linked to the degeneration and dysfunction of the basal ganglia, a cluster of subcortical nuclei that are primarily responsible for motor control (Lanciego et al., 2012). The degeneration is caused by the progressive loss of dopamine producing cells in this mid-brain

area (Marsden and Parkes, 1977; Michel et al., 2016). Dopamine is a neurotransmitter which regulates movement and coordination, and the loss of dopamine results in motor symptoms including tremors (Hoehn and Yahr, 1967; Marjama-Lyons and Koller, 2000; Cichaczewski et al., 2014), muscle rigidity (Jankovic, 2008), Bradykinesia (Berardelli, 2001; Bohnen et al., 2013) and postural instability (Valente et al., 2001), and also non-motor symptoms including cognitive dysfunction causing memory, attention and intellectual compromise (Aarsland et al., 1996; Prakash et al., 2008; Cosgrove and Alty, 2018; Fang et al., 2020), mood disorders such as depression and anxiety (Borod, 2008; Kano et al., 2011), sleep disturbance (Zesiewicz, 2009; Fyfe, 2015), and autonomic dysfunction such as changes in blood pressure (Marttila and Rinne, 1977) and digestion (Edwards et al., 1991). Additionally, as a result of the decline of muscular control and the development of laryngeal abnormalities within the speech mechanism, PD compromises speech function (Perez et al., 1996; Herd et al., 2012) and indeed the onset of voice dysfunction is often the earliest indicator of motor impairment caused by PD (Ma et al., 2020). Many of the symptoms listed above, both motor and non-motor, impact upon the student singer and are therefore relevant to this enquiry.

The impact of PD on the speech mechanism has been extensively investigated, using clinical procedures such as laryngoscopy and stroboscopy, to examine the larynx and its function, as well as non-invasive tests such as CT scans and pulmonary function testing (Ma et al., 2020). In a 2001 study (Yüçetürk et al., 2002) videolaryngostroboscopy was used to evaluate, inter alia, the parameters of vocal fold edges and vertical levels of vocal folds, the maximum extent of vibration of the vocal folds and their symmetry across vibratory cycles, regularity of vibratory cycles, glottis closure, subglottal pressure against the lower vocal folds and mucosal wave, movement of ventricular folds and Arytenoid cartilage and thick mucoid secretion. That study concluded that dysfunction of intrinsic laryngeal muscles, caused by the progression of PD, was the cause of irregularities and abnormalities identified in each of the characteristics and functions examined and listed above. An earlier study in 1996 (Perez et al., 1996) carried out endoscopic and stroboscopic examinations of 29 PD patients to investigate the impact of PD on the larynx. Twenty two patients with idiopathic PD and seven patients with Parkinson's-plus syndromes comprised the participant group and tremor in phonation was observed in all participants. The primary location of the tremor in the twenty two PD patients was vertical laryngeal tremor; Arytenoid tremors were observed in the majority of the Parkinson's Plus patients. As regards the larger PD group, the most significant finding was incomplete phase closure and asymmetry of the vocal cords, although the maximum extent of vibration and mucosal wave form was within normal limits. It is interesting to note that laryngeal abnormalities caused by PD appear to vary significantly depending on gender (Stelzig et al., 1999). Other studies have shown that the hypo-

adduction/bowing of the vocal folds and loss of strength in laryngeal adductory muscles result in incomplete glottal closure, causing dysdiadochokinesis, breathiness, a shorter phonation time and less dynamic variation (Perju-Dumbrava et al., 2017; Ma et al., 2020; Ma et al., 2021; Ma et al., 2023). This loss of strength in adductory muscles is a familiar issue for vocal coaches who deal with this with adolescent students when what's known as the glottal chink appears during puberty (Fritzen et al., 1986; Boltežar et al., 1997; Sweet, 2018) and therefore exercises traditionally used to support the adolescent voice during this time, such as SOVT exercises, closed forward vowel exercises and gliding through vocal registers on the word "ney", may also be of use for PD patients.

The nature of voice changes caused by PD were examined in a comprehensive study undertaken by senior medical practitioners and professors of the Alfred Hospital and Faculty of Medicine at Monash University, Australia in 2020 (Ma et al., 2020). Voice changes were identified as hypophonia; dysphonia, hypokinetic articulation, dysprosody, festination and hesitancy. The specific features of dysphonia in PD have been discussed in other studies and acknowledged as a rough and hoarse sounding voice (Logemann et al., 1978; Stewart et al., 1995; Holmes et al., 2000), a jittery voice (Canter, 1963; Jiménez-Jiménez et al., 1997; Rusz et al., 2011; Teixeira et al., 2013), and breathiness (Hanson et al., 1984; Stewart et al., 1995; Midi et al., 2007). Impairments in volume and projection (hypophonia) and changes in pitch as PD progresses, have also been confirmed as commonly observed features of voice deterioration (Hanson et al., 1984; Stewart et al., 1995; Gamboa et al., 1997; Holmes et al., 2000; Midi et al., 2007).

The evolving medical position is that voice dysfunction caused by PD occurs prior to dysfunction in mobility (Harel et al., 2004), with speech changes occurring as early 7 years before a formal diagnosis of PD, thereby preceding the decline of all other motor features (Fereshtehnejad, et al., 2019). The Monash Hospital study mentioned above (Ma et al., 2020) focused on the phonatory and prosodic changes to the voice in a PD patient, measured by objective acoustic analysis as well as clinical experience and perceptual analysis, and concluded that dysfunction of the voice was the result of two main disturbances in the larynx, namely asymmetric rigidity of the intrinsic laryngeal muscles and incomplete glottal closure due to hypo-adduction/bowing of the vocal folds. They further concluded that phonatory dysfunction in PD correlates with bradykinesia and dopamine deficiency, albeit dopamine replacement does not consistently improve the dysfunction, suggesting that non-dopamine factors might also contribute to symptoms. The deterioration of the vocal function was exacerbated by compromised respiratory function and the reduction in subglottal pressure, laryngeal resistance and airflow (Hammer et al., 2010;

Wang et al.,2014); these exacerbating features are issues which may be experienced in healthy singers, due to inexperienced vocal technique and are familiar to a vocal coach who will employ exercises such as those suggested in Appendix 2, to equalize sub glottal pressure, encourage closure of the vocal folds and practice good breath management.

Studies have been undertaken to assess the effect of singing upon PD and reviews of those studies have been published (Barnish et al., 2016; Irons et al., 2019). Conflicting results were obtained from several of the earlier studies. Some of these studies suggested that singers with PD showed greater vocal strength, intelligibility and phonation duration (Haneishi, 2001; Benedetto et al.,2009;Evans et al., 2011;Yinger and Lapointe, 2012;Tanner et al., 2015). Other studies reported no change in these areas (Elefant et al., 2012; Shih et al., 2012). However the studies which found little or no change in symptoms of PD when singing, were studies based upon group singing activities and accordingly I conducted further literature searches to look for more studies where no discernible benefit of singing on PD was reported, to identify whether all of these were also conducted with groups of participants singing together, rather than participants taking solo vocal exercise sessions. The further studies identified were indeed also based upon group participation, and again the conclusions formed as to whether group singing improved motor control and stress levels were split. Some studies reviewed (Miluk-Kolasa et al.,1994; Khalaf et al., 2003; Fancourt et al., 2016) indicated that perceived stress and cortisol levels were reduced by music therapy in various clinical populations, including patients with PD. Other studies (Stegemöller et al.,2016; Stegemöller et al.,2017a; Stegemöller et al.,2017b) claimed that group singing did have a positive effect on symptoms of PD, referencing a significant decrease in tremor and improved gait and posture, (although no change in speech or facial expression or bradykinesia) after a single group therapy singing session of an hour's duration. However, this study was not rigorous enough to provide conclusive evidence, as there was limited control of the timing of any medication taken by participants and the participant group was small (18 in total) with varying results. It would appear from all the studies identified in this paper, that there is a gap in the literature, and that the impact of one-on-one voice lessons with PD patients might usefully be investigated, to determine whether this would provide more determinative evidence than that derived from the results of group therapy of the benefits of singing upon symptoms of PD.

A robust trial was undertaken in 2019 (Tamplin et al., 2019) by a team of PHD accredited researchers with medical backgrounds and music therapy backgrounds, which referenced the incomplete information to date regarding the therapeutic impact of singing upon PD, and

aimed to comprehensively explore the impact of singing upon voice and communication in people with PD. In this study, PD participants were recruited for a well-controlled trial, although it should be noted that there was selection bias, as participants were allowed to choose their group, and a variety of volunteer musicians facilitated the weekly and monthly sessions, such that better success might arguably be attributed to better musical support. This trial demonstrated significant improvements in vocal intensity and maximum expiratory pressure following singing intervention. A larger participant group of 75 people living with PD was recruited, and the singing model, continued at 2 dosage levels, weekly, and lasting for 3 months in total was taught to 47 of these participants. The singing model involved 30 minutes of intensive, music based vocal exercises which focused on respiratory control, singing volume and pitch control and then further exercises targeting speech volume and speech clarification. The exercises were followed by 60 minutes of singing familiar songs, applying the techniques taught in the earlier exercises. Sessions concluded with social interaction and conversation practice between participants. Measurements of the impact of singing upon vocal intensity, respiratory strength and speech communication were taken with appropriate software and showed that high dosage (weekly) therapeutically based intensive singing resulted in an increase in vocal strength and intensity and an increase in respiratory muscle strength extending phonation duration, as contrasted to a decline in vocal and respiratory strength, over the 3 month period, of the control group who did not engage in any form of singing activity. This study would therefore support weekly singing lessons to improve vocal intensity and respiratory function of PD patients, including singers with PD.

Although these studies provided useful information, the majority obtained their data from small participant groups, with a high selection bias. Furthermore, the data collected in respect of each study was qualitative and relied on participant feedback and observation, rather than more conclusive quantitative data. Although results were split as to the impact of singing on stress and motor control, the studies reviewed were unanimous in the conclusion that group therapy singing was beneficial for PD patients, ostensibly because it benefitted non-motor function such as respiratory muscle strength, executive function and memory (Han et al., 2018) and promoted feelings of well-being, social inclusion and support and improved the quality of life of PD patients (Kamioka et al., 2014; Machado Sotomayor et al., 2021; Speranza et al., 2022; Stegemöller et al., 2016; Stegemöller et al., 2017a; Stegemöller et al., 2021). Again, the unanimous conclusions as regards respiratory and memory improvement and the enhancement of well-being amongst PD participants supports the proposition that singing is beneficial for this demographic and therefore the role of the vocal tutor is an important one.

Other literature on topic considered how the decline of vocal function caused by PD might be ameliorated or remedied. The mechanisms of speech and singing share considerable similarities (Han et al., 2018) and it was useful therefore to review literature which discussed means of improving speech as well as pitched voice.

One of the most commonly used speech therapies for hypokinetic dysarthria is a specialized speech programme, developed by Dr Lorraine Ramig, and known as the Lee Silverman Voice Treatment (LSVT) which is designed to improve vocal quality and volume (Herd et al, 2012). LSVT uses targeted and repetitive training of the voice with focus on intensity of movement, and a sensory appreciation and adjustment as necessary, of the effort needed to raise the voice (Russell et al., 2010). The application and benefits of LSVT are widely reported (Johnson and Pring, 1980; Robertson and Thomson, 1984; Fox et al., 2002; Pichler, 2005; Fox et al., 2006; Sapir et al., 2006; Ramig and Fox, 2009; Ebersbach et al., 2010; Fox et al., 2012; Ramig, 2014; McDonnell et al., 2017; Saffarian et al., 2019). Studies incorporating LSVT exercise included those which focused on training the participant's control of respiration and pitch variations, resulting in enhanced vocal intensity (Johnson and Pring, 1980) and improvement in vocal quality, articulation, and intelligibility (Robertson and Thomson, 1984) Another study used a pushing technique to increase energy and projection and facilitate glottal closure, to produce a stronger more resonant sound and improve laryngeal airflow (de Angelis et al., 2009). The increase in vocal intensity, improved vocal fold adduction and improved respiration concluded in a study undertaken in 1995 (Ramig et al., 1995) was followed up (Ramig et al., 1996; Ramig, 2001) and the conclusion drawn that vocal intensity was sustained at 12 and 24-months post treatment Other studies measuring cerebral blood flow have demonstrated that LSVT causes a shift in cortical activity to the right hemisphere, which results in a more healthy state (Liotti et al., 2003; Narayana et al., 2009).

The exercises associated with LSVT focus on loudness, high effort, intense, vocalisation and sensory recognition and are carried out by trained LSVT specialists (Saffarian et al., 2019). Some of the types of specific exercises included in LSVT treatment are shown in a video created by the LSVT Global institute (LSVT Global, 2021). These exercises include 15 rounds of firm, sustained phonation on an open 'Ah' vowel, 15 rounds of a "stretched" 'Ah' vowel, sung over 2 syllables with pitch ascending and then descending, and speaking phrases with the same loudness and effort as demonstrated when singing an 'Ah' vowel. A copy of the official LSVT exercise sheet is attached at Appendix 3, and the nature of many of these exercises is familiar to vocal tutors.

LSVT is, it appears from the primary and grey literature reviewed, widely used around the Globe and commonly recommended to their patients by medical practitioners. There is, some literature criticising the LSVT method, based on an opinion that it leads to pressed voice (de Swart et al., 2003) and that Pitch Limiting Voice Treatment (PLVT) is preferable, this being a method similar in its aim of increasing volume and clarity, but setting pitch at lower levels, thereby reducing vocal strain. However the large volume of LSVT studies and favourable results reported, including longer term impact (Ramig, 2001), are convincing. It would appear therefore that aspects of LSVT training would be beneficial for the vocal coach supporting a singer with PD, and in order to incorporate what has been learnt from this research into my practice, I have, as indicated above, submitted an application to LSVT Global, to undertake the necessary training and obtain certification to conduct this therapy.

Other exercises commonly employed to ameliorate PD symptoms affecting vocal function and other functions required for singing, target respiratory muscles so as to improve breath support for vocalisation. Deep breathing and controlled exhalation techniques can strengthen respiratory muscles and better support vocal sound and production (Rodríguez et al., 2020; van de Wetering-van Dongen et al., 2020). In a 2001 study, (Haneishi, 2001) participants with PD attended 12 sessions of singing therapy, undertaking a programme of vocal warm ups and exercises, with a focus on phonation and breath management. Participants engaging in these sessions showed significant improvement in speech intelligibility and vocal quality and strength. Similar results were shown in a later study (Di Benedetto et al., 2009) where significant improvements in vowel formation and reading fluency were observed after participants with PD attended 13 sessions of singing therapy. Exercises practicing gliding from one pitch to another, pitch inflections and pitch variation are beneficial to improve pitch deviation arising from PD. Articulation and pronunciation exercises can improve specific speech sounds and enhance intelligibility (Ganzeboom et al., 2022). It is reasonable to deduce that warm up exercises are also beneficial, including gentle humming, trills, tongue stretches and vocalizing through various pitches and vowels to prepare the vocal folds for singing and speaking. The common straw phonation SOVT exercise commonly used in the voice studio was considered in a recent PD clinical trial which concluded that its use in voice therapy was effective in improving and increasing vocal intensity and quality (Dos Santos et al., 2022).

In order to fully answer the third limb of the enquiry in this assignment, it is necessary to consider the total impact upon affected singers of each condition and to decide whether a vocal tutor could and should address factors which strictly fall outside a singer's vocal development, when considering the nature and extent of support that is appropriate within the vocal studio. Studies undertaken to determine the impact of PD upon the individual's quality of life have provided strong qualitative data indicating depression (Gamarra et al., 2009), poor self-esteem (McDaniels et al., 2023) and social withdrawal (McDaniels et al., 2022). These are factors which can be addressed within my practice, not only by sharing and employing information derived from this research as regards vocal practices to improve PD symptoms (thereby having a positive knock-on impact upon other psychological and social issues), but also by seeking to integrate at least some of my PD student's vocal activities with other students, for example by arranging joint lessons with my student with stutter, in which we could undertake vocal exercises beneficial to both students and also encourage and enjoy the social aspect of these shared lessons.

(II) Speech Disorder- Stuttering

Stuttering (also known as stammering) is a speech disorder which disrupts the fluency and time pattern of speech flow (Wepman, 1971; Perez and Stoeckle, 2016), and is characterised by repetition of sounds and syllables, prolongation of consonants, and interruptions known as blocks, whereby the individual is unable to initiate any sound (Andrews, 1981; Zebrowski, 1994). These disruptive actions are often accompanied by an increase in tension and exertion, as the speaker struggles to end the involuntary interruption (Starkweather, 1987; Hood and Mowrer, 1994; Ham, 1999; Guitar, 2014). As discussed below, a stutter can affect much more than the voice, as feelings of frustration, loss of self-control and embarrassment commonly accompany speech dysfluency and often lead to psychological and social problems, such as poor self-image, anxiety or depression and discrimination (Al Ghamdi et al., 2022). Accordingly, a stutter is a complex speech disorder that may be best described as a syndrome, consisting of linguistic, motor and psychosocial symptoms (Wingate, 1964; Smith & Weber, 2016).

There are two main categorisations of stuttering, namely, developmental and acquired stuttering (Van Borsel and Taillieu, 2001; Zunic et al., 2021). Developmental stuttering occurs in early childhood, and is widely thought to be the result of slow development of speech or language skills. It is often outgrown, but in some cases can persist into adulthood

and become a chronic condition (Watkins et al., 2007; Perez and Stoeckle, 2016; Busan et al., 2021). Acquired stuttering (trauma induced or neurogenic) can occur in both children and adults, and results from dysfunction of neurological processing in the midbrain (Büchel and Sommer, 2004).

Regardless of whether the stuttering is determined to be developmental or acquired, neuroimaging research has shown that individuals who stutter, do so due to functional anomalies in the right frontal operculum/anterior insula, temporal areas, basal ganglia and cerebellum which prevent speech fluent movement. (Jiang et al., 2012). Research undertaken in 2004 (Alm, 2004) described the relationship between the frontal brain regions affecting speech and motor activity, and also considered the relationship between genetic abnormalities, impaired cellular metabolism and abnormal function of the neural system and their potential cumulative effect upon dopamine levels, which, as discussed above in relation to PD, are critical to motor and speech function. Alm (Alm, 2004) compared symptoms of stuttering with other basal ganglia motor disorders like Parkinson's disease. It was explained that dysfunction of the basal ganglia-thalamocortical motor circuits, located in the mid-brain, played a key role in stuttering, and suggested that the impaired ability of the basal ganglia to produce timing signals for the initiation of the next motor segment in speech was what caused a stutter. Thus the explorations around stuttering involved consideration of many of the neurological features already attributed to Parkinson's Disease and such common features may provide useful information when considering how best to approach vocal development and improvement within the teaching studio, in both PD and students with stutter, albeit that the literature and my teaching experience indicate that students with stutter do not face the same challenges using their singing voices as do those with PD.

It is relevant in this assignment to consider the literature on stutter as it pertains to speech, because of the behavioural similarities between singing and speaking, as well as the shared network in the brain that underlies both singing and speaking (Kleber et al., 2009; Ozdemir et al., 2006). The reasons for a speech stutter not being apparent during singing and why and how singing is used as a therapeutic tool to treat stutter are discussed below.

A paper published on the therapeutic effects of singing upon neurological disorders (Wan et al., 2010) considered relevant literature pertaining to the use of singing to ameliorate some of the speech deficits associated with neurological conditions, including PD and stuttering. Studies have shown that long term singing can cause changes of activity in the nervous system and induce plastic changes in the brain improving motor function (Gaser and Schlaug 2003; Kleber et al., 2009).

Some studies suggested that singing was effective therapy for a stutter because singing stimulates the musculature associated with respiration, phonation, articulation, and resonance; singing creates higher vocal intensity and requires greater vocal control than speech (Tonkinson, 1994; Brown, 2003; Natke et al., 2003) and increases respiratory muscle strength (Wiens et al., 1999). Research undertaken by the university of Iowa (Johnson, 1955), an institution at the forefront of research on causes and treatment of stuttering, suggested that singing reduced or eradicated a stutter because, like other music making activities, singing was a process controlled by the right side of the brain, not the left side as is used for speech; in other words, when singing, the stutterer did not utilise the dysfunctional left frontal hemisphere.

Prior to 2017, the functional abnormalities within the left and right frontal hemispheres causing imbalanced activity between left and right hemispheres when speaking, was unexplained. It was known that a region in the left frontal brain of stutterers was hypoactive and the corresponding area of the right hemisphere was hyperactive, but scientists were unclear as to the cause of the imbalance and whether the underactive left hemisphere was dysfunctional and causing the right side to compensate, or whether the right side being hyperactive was actually the cause of the left side being hypoactive. (Moore and Haynes, 1980). A study undertaken in 2017 (Neef et al., 2017) concluded that it was actually a dysfunctional over-active right hemisphere that was the root of stuttering, demonstrating through quantitative data (magnetic resonance imaging) that fiber tracts in the hyperactive right hemisphere were obstructing and interrupting the operation of both the left inferior frontal gyrus, which processes the planning of speech movement, and the left motor cortex, which controls actual speech movement, making it impossible for the affected person to speak fluently. The study also ascertained that the stronger the fibre tract the more severe the stuttering, concluding that at least one cause of stuttering was the neural inhibition of speech movement.

Thus despite the 20th century view that stuttering was a psychological problem (Bergland, 2021) accumulating evidence to date suggests that the root cause of stuttering is the existence of structural and functional anomalies in the cortico-basal ganglia-thalamocortical motor loop (CBGT), the 3-part system of neural circuits that connects cortical and subcortical brain regions, and facilitates functional connectivity between the cerebrum's cortical brain areas, the basal ganglia, and the thalamus (the largest subcortical structure which acts as a relay point between the brainstem and the cerebral cortex) (Parent and Hazrati, 1995) . Research has been undertaken to explore whether singing therapy is effective in improving

speech-motor abnormalities associated with various neurological conditions (Cohen 1992; Jeffries et al., 2003; Wan et al., 2010). However, more recently, theoretical research carried out by Guenther (Chang and Guenther, 2020; Guenther, 2021) has claimed that the CBGT motor loop is heavily involved in the initiation of speech motor programmes and that any anomaly in the structure or function of this system would disrupt speech initiation, causing stutter. In other words it was posited that stuttering was in fact a speech initiation issue, not a motor impairment issue. This finding is hugely significant, as if stuttering is not, as previously thought, due to impairment of motor control, then the possibilities for treatment are potentially far more straightforward and may simply involve use of a highly targeted drug (Guenther, 2021). If these recent findings are true (and supported by future research carried out to test the hypothesis), then this information may be of relevance to the second and third limbs of my enquiry, namely how could singing ameliorate the symptoms of stutter and how could I teach these students in a more appropriate and focused manner, since therapy for better speech initiation may be supported by traditional vocal onset exercises used for singing. The vocal onset exercises common in vocal teaching studios, aim to achieve balanced and coordinated vocalisation, with optimal vocal fold alignment and sub glottal air pressure balance, ensuring a healthy and efficient sound that has neither too much nor too little compression. Such exercises might be useful to support more fluent initiation of speech in a person who stutters if it is indeed initiation of speech rather than a motor control dysfunction which is responsible for the stutter. This therapy might be helpful to a singer with a stutter as the exercises would already be familiar to them from their vocal training and ameliorating their speech stutter would benefit their overall singing experience, beyond their vocal production, as discussed below. What's more, since one of the fundamental requirements of successful singing is accurate pitch, and pitch matching requires skills related to vocal motor production (Tsang and Conrad, 2011), this information may be significant for a singer with stutter who struggles with pitch accuracy and has previously believed that correction possibilities were limited by their speech disorder.

Another 2021 study of note was a functional magnetic resonance imaging study (Thibault et al., 2021) where the discovery was made that tool use and language syntax share the same neural circuits rooted in the basal ganglia, such that training one skill has a direct impact on the other. Clearly this discovery is of huge significance as regards the possibilities of training and improving the speech of someone affected by dysfunction within the basal ganglia due to neurological disorder. This correlation between tool use and improved speech might have application within a voice studio where percussion instruments are available for use; a "tool" might be replaced with a percussion instrument, such as a triangle or a xylophone, the use

of which would require similar precision and exertion as a “tool”. If simple use of percussion also improved speech function, implications for a student with severe stutter would be significant, since although singing may not be affected by speech disorder, the singing experience and ability to perform may be compromised, as is the case with my student, whose stutter affects her spoken interaction with the audience and her accompanists, and impacts upon her self-confidence on stage.

Whilst singing itself does not appear to be affected by the existence of a stutter, and indeed singing is used as a form of speech therapy for a stutter, there are nevertheless other factors which arise from a stutter and impact the singing experience. Individuals with fluency speech disorders often experience psychological, emotional, social, and functional issues (Tichenor & Yaruss, 2019) and their inability to communicate effectively may lead to physical tension, social anxiety, a sense of loss of control, poor self-esteem and withdrawal. (Blood et al., 2003; Boyle, 2015; Craig & Tran, 2014; Iverach et al., 2016; Cherif et al., 2018). For a singer with a stutter, any one of these issues may be debilitating as regards performing within the teaching studio and/or on stage. Although the stutter may not impact their singing voice, as emphasised in a recent paper on performance anxiety, “one of the greatest influencers of voice is the singer’s psychological readiness to sing and perform”. (Kiik-Salupere and Ross, 2020 p. 242) and this readiness is compromised when factors beyond vocal production and quality overwhelm a singer and affect a performance.

It has also been suggested that there may be a relationship between stuttering and working memory. (Bajaj, 2007; Wagovich & Anderson, 2010; Arongna et al., 2020). This underlying relationship is not yet completely understood but may be related to interruptions in sensorimotor timing for developmental stuttering and may involve both the basal ganglia and the prefrontal cortex (Bowers et al., 2018). Any compromise of working memory could have significant implications for a performing or professional singer, as singers, like all musicians, rely on working memory (Chan, Ho, & Cheung, 1998; Brandler & Rammsayer, 2003; Taylor and Dewhurst, 2017).

Most existing treatments for stutter have focused on encouraging more fluent speech, by focussing on other functions which enhance fluency and thus singing has been identified as having therapeutic potential. A study carried out in 1976 (Healy et al., 1976) examined whether singing could reduce stuttering and, if so, whether familiarity with the lyrics was significant. Participants were asked to read or sing the lyrics of songs well-known to them, firstly with original, familiar lyrics and subsequently with altered, unfamiliar lyrics. Singing the

lyrics resulted in the greatest reduction of stutter and this effect was further enhanced by singing familiar lyrics. The study concluded that increased phonation duration, intonation, as well as familiarity, might all contribute to the fluency-enhancing effect of singing. The superior therapeutic impact of singing over reading has been examined and confirmed under varying speeds of production (Glover et al., 1996). Other research has investigated whether the reduction of stuttering during singing is associated with increased voicing duration and sound pressure levels. Participants were asked to read aloud and then sing altered lyrics of a familiar song to the original melody. Results showed there was a significant increase in fluency when the lyrics were sung (Healy et al., 1976). In another study, (Andrews et al., 1982) participants with a stutter were asked to sing a song of their choice for 10 minutes. Results showed that singing reduced the frequency of stuttering by over 90%, and corroborated the conclusions in earlier studies (Healy et al., 1976) that increased phonation duration was an effective fluency enhancer.

One commonly used treatment for stutter is Melodic Intonation Therapy. This treatment emphasises the rhythm and intonation of language through slow, pitched vocalisation or singing accompanied by rhythmic hand tapping of syllables (Albert et al., 1973; Norton et al., 2009; Zumbansen et al., 2014). The success behind MIT (Zhang et al., 2021) is thought to occur because speaking almost exclusively uses regions in the left hemisphere, (which explains why people who stutter have damage to the left hemisphere) whereas singing engages the right hemisphere, which reduces the physiological impact of damage in the left hemisphere, enabling fluency to occur (Schlaug et al., 2008). MIT is not useful in treating all types of aphasia, however it has been shown to have a positive impact upon Broca's aphasia, which is a common type of aphasia found in stuttering (Hough, 2010; Zumbansen et al., 2014).

Conclusion

My research has shown that symptoms of PD, for example tremors and dysfunction of the vocal cords, directly impact vocal quality and sound, and the challenge for singers with this condition is obvious. It is clear that the vocal coach has an important role to play for students with this condition, as many of the exercises which the literature has indicated can ameliorate the symptoms of PD, not just in relation to the voice, but also as regards tremors and respiratory function, are familiar to an experienced vocal tutor and can easily be added to existing vocal exercise undertaken by all my students in their lessons. The benefit of vocal exercises in the context of the inevitable decline of vocal function suffered by singers with PD, is now proven by the studies reported in the literature and accordingly changes and

enhancements to this student's standard 15 minute warm up and exercise routine are appropriate and will be instigated. Although resources are not available to me for obtaining quantitative data to prove any benefit of a new more targeted exercise programme, qualitative data can be obtained from my student with PD, based on her personal experiences in the studio, supplemented by my observations of the impact of enhanced exercises, providing further information with which to support this student.

By comparison the symptoms of stutter have a far smaller impact, if any, upon the singing voice, and therefore challenges to vocal production faced by a singer with a stutter may be minimal. Nevertheless it appears that there is a significant role for a vocal coach to support students with both conditions, as this research has shown that singing improves the symptoms of both neurological disorders and this may impact beyond the improvement of vocal production. Indeed, this research has shown impacts common to both conditions, such as the impact upon self-esteem, social inclusion and mental health (Tichenor & Yaruss, 2019; Al Ghamdi et al., 2022; McDaniels and Subramanian, 2022) and such challenges might be improved for both students by arranging a number of joint vocal sessions to work on mutually beneficial vocal exercise, thereby promoting social discourse and inclusion.

Following the conclusion of this research, informal sessions have already been arranged with my students impacted by (i) PD and (ii) stutter, to obtain feedback and further insight as to what more might be done to improve their confidence as singers, consolidate inclusion within our student community and ensure that they benefit from our working relationship at the highest possible level.

References

- Aarsland, D., Tandberg, E., Larsen, J.P. and Cummings, J.L. (1996). Frequency of Dementia in Parkinson Disease. *Archives of Neurology*, 53(6), pp.538–542.
doi:<https://doi.org/10.1001/archneur.1996.00550060082020>.
- Ahn, S., Springer, K. and Gibson, J.S. (2022). Social withdrawal in Parkinson's disease: A scoping review. *Geriatric Nursing*, [online] 48, pp.251–261.
doi:<https://doi.org/10.1016/j.gerinurse.2022.10.010>.
- Al-Ghamdi, S., Al-Ghamdi, H., Allarakia, B., Alshatri, F., Al-Ghamdi, A. and Al-Ghamdi, M. (2022). Association between stuttering and psychosocial complications in Saudi Arabian

individuals: A pilot study. *Journal of Family Medicine and Primary Care*, 11(10), p.6087. doi:https://doi.org/10.4103/jfmpc.jfmpc_39_22.

Alderson, R.M. (1979). *Complete Handbook of Voice Training*. Prentice Hall.

Alm, P.A. (2004). Stuttering and the basal ganglia circuits: a critical review of possible relations. *Journal of Communication Disorders*, 37(4), pp.325–369. doi:<https://doi.org/10.1016/j.jcomdis.2004.03.001>.

Andrews, G. (1981). Stuttering — a Tutorial. *Australian & New Zealand Journal of Psychiatry*, 15(2), pp.105–109. doi:<https://doi.org/10.3109/00048678109159418>.

Angelis, E.C., Mourao, L.F., Ferraz, H.B., Behlau, M.S., Pontes, P.A.L. and Andrade, L.A.F. (2009). Effect of voice rehabilitation on oral communication of Parkinson's disease patients. *Acta Neurologica Scandinavica*, 96(4), pp.199–205. doi:<https://doi.org/10.1111/j.1600-0404.1997.tb00269.x>.

Arongna, Sakai, N., Yasu, K. and Mori, K. (2020). Disfluencies and Strategies Used by People Who Stutter During a Working Memory Task. *Journal of Speech, Language, and Hearing Research*, 63(3), pp.688–701. doi:https://doi.org/10.1044/2019_jslhr-19-00393.

Bajaj, A. (2007). Working memory involvement in stuttering: Exploring the evidence and research implications. *Journal of Fluency Disorders*, 32(3), pp.218–238. doi:<https://doi.org/10.1016/j.jfludis.2007.03.002>.

Barnish, J., Barran, S.M., Atkinson, R.A. and Barnish, M.S. (2016). Potential Benefit of Singing for People with Parkinson's Disease: A Systematic Review. *Journal of Parkinson's Disease*, 6(3), pp.473–84.

Baumgartner, C.A., Sapir, S. and Ramig, L.O. (2001). Voice Quality Changes Following Phonatory-Respiratory Effort Treatment (LSVT®) Versus Respiratory Effort Treatment for Individuals with Parkinson Disease. *Journal of Voice*, 15(1), pp.105–114. doi:[https://doi.org/10.1016/s0892-1997\(01\)00010-8](https://doi.org/10.1016/s0892-1997(01)00010-8).

Beck, R., J., Gottfried, T., L., Hall, D., J., Cisler, C., A. and Bozeman, K., W. (2006). Supporting the Health of College Solo Singers: The Relationship of Positive Emotions and Stress to Changes in Salivary IgA and Cortisol during Singing. *Journal for Learning through the Arts*, 2(1). doi:<https://doi.org/10.21977/d92110079>.

Benson, E.A., Robinso-Martin, T. and Naismith, M.L. (2022). Practicing Equity, Diversity, Inclusion, and Belonging in the Singing Voice Studio. *Voice and Speech Review*, 16(2), pp.166–179.

Berardelli, A. (2001). Pathophysiology of bradykinesia in Parkinson's disease. *Brain*, 124(11), pp.2131–2146. doi:<https://doi.org/10.1093/brain/124.11.2131>.

Bergland, C. (2021). Neurological Research Changes Our Understanding of Stuttering. *Psychology Today*.

Biesta, G. (2010). Pragmatism and the philosophical foundations of mixed methods research. In: *Handbook of Mixed Methods in Social & Behavioral Research*. Thousand Oaks: Sage.

Blood, G.W., Blood, I.M., Tellis, G.M. and Gabel, R.M. (2003). A preliminary study of self-esteem, stigma, and disclosure in adolescents who stutter. *Journal of Fluency Disorders*, 28(2), pp.143–159. doi:[https://doi.org/10.1016/s0094-730x\(03\)00010-x](https://doi.org/10.1016/s0094-730x(03)00010-x).

Bohnen, N.I., Frey, K.A., Studenski, S., Kotagal, V., Koeppe, R.A., Scott, P.J.H., Albin, R.L. and Müller, M.L.T.M. (2013). Gait speed in Parkinson disease correlates with cholinergic degeneration. *Neurology*, [online] 81(18), pp.1611–1616. doi:<https://doi.org/10.1212/WNL.0b013e3182a9f558>.

Borja Juan-Morera, Icíar Nadal García, Belén López Casanova and Eva Vicente Sánchez (2023). Self-Perception of Inclusion in an Inclusive Choir: An Analysis Using the Scale for the Assessment of Inclusion (SAI). *PubMed*, 13(9). doi:<https://doi.org/10.3390/bs13090758>.

Borod, J. (2008). Depression in Parkinson's disease: Health risks, etiology, and treatment options. *Neuropsychiatric Disease and Treatment*, p.81. doi:<https://doi.org/10.2147/ndt.s1453>.

Brandler, S. and Rammsayer, T.H. (2003). Differences in Mental Abilities between Musicians and Non-Musicians. *Psychology of Music*, 31(2), pp.123–138. doi:<https://doi.org/10.1177/0305735603031002290>.

Broome M.E. (1993). Integrative literature reviews for the development of concepts. In B.L. Rogers & K. Knafl (Eds.), *Concept Development in Nursing*, (2nd ed., pp. 231-250). W.B. Saunders Co. (n.d.).

Brown, O. (2003). Good Voice Equals Good Speaking Equals Good Singing. *Voice and Speech Review*, 3(1), pp.140–142. doi:<https://doi.org/10.1080/23268263.2003.10739393>.

Büchel, C. and Sommer, M. (2004). What Causes Stuttering? *PLoS Biology*, [online] 2(2), p.e46. doi:<https://doi.org/10.1371/journal.pbio.0020046>.

Canter, G.J. (1963). Speech Characteristics of Patients with Parkinson's Disease: I. Intensity, Pitch, and Duration. *Journal of Speech and Hearing Disorders*, 28(3), pp.221–229. doi:<https://doi.org/10.1044/jshd.2803.221>.

Chan, A.S., Ho, Y.-C. and Cheung, M.-C. (1998). Music training improves verbal memory. *Nature*, [online] 396(6707), pp.128–128. doi:<https://doi.org/10.1038/24075>.

Chang, S.-E. and Guenther, F.H. (2020). Involvement of the Cortico-Basal Ganglia-Thalamocortical Loop in Developmental Stuttering. *Frontiers in Psychology*, 10. doi:<https://doi.org/10.3389/fpsyg.2019.03088>.

Chapuis, S., Ouchchane, L., Metz, O., Gerbaud, L. and Durif, F. (2004). Impact of the motor complications of Parkinson's disease on the quality of life. *Movement Disorders*, 20(2), pp.224–230. doi:<https://doi.org/10.1002/mds.20279>.

Cherif, L., Boudabous, J., Khmakhem, K., Kammoun, S., Hadj kacem, I., Ayadi, H. and Moalla, Y. (2018). Self-esteem and anxiety in stuttering children and attitude of their parents. *Health Education and Care*, 3(2). doi:<https://doi.org/10.15761/heh.1000138>.

Cichaczewski, E., Munhoz, R.P., Maia, J.M., Nohama, P., N6vak, E.M. and Teive, H.A. (2014). Electrophysiologic characteristics of tremor in Parkinson's disease and essential tremor. *Arquivos de Neuro-Psiquiatria*, 72(4), pp.301–306. doi:<https://doi.org/10.1590/0004-282x20140006>.

Clements-Cortés, A. (2015). Singing for Health, Connection and Care. *Music and Medicine*, 7(4), p.13. doi:<https://doi.org/10.47513/mmd.v7i4.428>.

Clift, S., Hancox, G., Staricoff, R. and Whitmore, C. (2011). *Singing and health: a systematic mapping and review of non-clinical research*. Canterbury: Canterbury Christ Church University.

Clift, S., Manship, S. and Stephens, L. (2017). Further evidence that singing fosters mental health and wellbeing: the West Kent and Medway project. *Mental Health and Social Inclusion*, 21(1), pp.53–62. doi:<https://doi.org/10.1108/mhsi-11-2016-0034>.

- Cohen, N.S. (1992). The Effect of Singing Instruction on the Speech Production of Neurologically Impaired Persons. *Journal of Music Therapy*, 29(2), pp.87–102. doi:<https://doi.org/10.1093/jmt/29.2.102>.
- Cosgrove, J. and Alty, J. (2018). Cognitive deficits in Parkinson's disease: current perspectives. *Journal of Parkinsonism and Restless Legs Syndrome*, Volume 8, pp.1–11. doi:<https://doi.org/10.2147/jprls.s125064>.
- Craig, A., Blumgart, E. and Tran, Y. (2009). The impact of stuttering on the quality of life in adults who stutter. *Journal of Fluency Disorders*, 34(2), pp.61–71. doi:<https://doi.org/10.1016/j.jfludis.2009.05.002>.
- Davis, S., Howell, P. and Cooke, F. (2002). Sociodynamic relationships between children who stutter and their non-stuttering classmates. *Journal of Child Psychology and Psychiatry*, 43(7), pp.939–947. doi:<https://doi.org/10.1111/1469-7610.00093>.
- de Swart, B.J.M., Willemse, S.C., Maassen, B.A.M. and Horstink, M.W.I.M. (2003). Improvement of voicing in patients with Parkinson's disease by speech therapy. *Neurology*, 60(3), pp.498–500. doi:<https://doi.org/10.1212/01.wnl.0000044480.95458.56>.
- Dingle, G.A., Clift, S., Finn, S., Gilbert, R., Groarke, J.M., Irons, J.Y., Bartoli, A.J., Lamont, A., Launay, J., Martin, E.S., Moss, H., Sanfilippo, K.R., Shipton, M., Stewart, L., Talbot, S., Tarrant, M., Tip, L. and Williams, E.J. (2019). An Agenda for Best Practice Research on Group Singing, Health, and Well-Being. *Music & Science*, 2, p.205920431986171. doi:<https://doi.org/10.1177/2059204319861719>.
- Dorsey, E.R., Sherer, T., Okun, M.S. and Bloem, B.R. (2018). The Emerging Evidence of the Parkinson Pandemic. *Journal of Parkinson's Disease*, [online] 8(s1), pp.S3–S8. doi:<https://doi.org/10.3233/jpd-181474>.
- Dos Santos, A.P., Shevon Troche, M., Berretin-Felix, G., Barbieri, F.A., Brasolotto, A.G. and Alves Silverio, K.C. (2022). Effects of Resonance Tube Voice Therapy on Parkinson's Disease: Clinical Trial. *Journal of Voice*, 22.
- Ebersbach, G., Ebersbach, A., Edler, D., Kaufhold, O., Kusch, M., Kupsch, A. and Wissel, J. (2010). Erratum: Comparing exercise in Parkinson's disease-The Berlin LSVT@BIG study. *Movement Disorders*, 25(14), pp.2478–2478. doi:<https://doi.org/10.1002/mds.23486>.

- Edwards, L.L., Pfeiffer, R.F., Quigley, E.M.M., Hofman, R. and Balluff, M. (1991). Gastrointestinal symptoms in Parkinson's disease. *Movement Disorders*, 6(2), pp.151–156. doi:<https://doi.org/10.1002/mds.870060211>.
- Elefant, C., Baker, F.A., Lotan, M., Lagesen, S.K. and Skeie, G.O. (2012). The Effect of Group Music Therapy on Mood, Speech, and Singing in Individuals with Parkinson's Disease -- A Feasibility Study. *Journal of Music Therapy*, 49(3), pp.278–302. doi:<https://doi.org/10.1093/jmt/49.3.278>.
- Erkkilä, J., Punkanen, M., Fachner, J., Ala-Ruona, E., Pöntiö, I., Tervaniemi, M., Vanhala, M. and Gold, C. (2011). Individual music therapy for depression: Randomised controlled trial. *British Journal of Psychiatry*, 199(2), pp.132–139. doi:<https://doi.org/10.1192/bjp.bp.110.085431>.
- Espay, A.J., Aybek, S., Carson, A., Edwards, M.J., Goldstein, L.H., Hallett, M., LaFaver, K., LaFrance, W.C., Lang, A.E., Nicholson, T., Nielsen, G., Reuber, M., Voon, V., Stone, J. and Morgante, F. (2018). Current Concepts in Diagnosis and Treatment of Functional Neurological Disorders. *JAMA Neurology*, 75(9), p.1132. doi:<https://doi.org/10.1001/jamaneurol.2018.1264>.
- Evans, C., Canavan, M., Foy, C., Langford, R. and Proctor, R. (2011). Can group singing provide effective speech therapy for people with Parkinson's disease? *Arts & Health*, 4(1), pp.83–95. doi:<https://doi.org/10.1080/17533015.2011.584883>.
- Fahey, H., Phelan, H., Clift, S. and Moss, H. (2022). A chorus of voices: social singing and health promotion. *Health Promotion International*, (36), pp.1–3.
- Fancourt, D., Williamon, A., Carvalho, L.A., Steptoe, A., Dow, R. and Lewis, I. (2016). Singing modulates mood, stress, cortisol, cytokine and neuropeptide activity in cancer patients and carers. *ecancermedicalscience*, [online] 10. doi:<https://doi.org/10.3332/ecancer.2016.631>.
- Fang, C., Lv, L., Mao, S., Dong, H. and Liu, B. (2020). Cognition Deficits in Parkinson's Disease: Mechanisms and Treatment. *Parkinson's Disease*, 2020, pp.1–11. doi:<https://doi.org/10.1155/2020/2076942>.
- Fox, C., Ebersbach, G., Ramig, L. and Sapir, S. (2012). LSVT LOUD and LSVT BIG: Behavioral Treatment Programs for Speech and Body Movement in Parkinson Disease. *Parkinson's Disease*, [online] 2012, pp.1–12. doi:<https://doi.org/10.1155/2012/391946>.

Fox, C., Ramig, L., Ciucci, M., Sapir, S., McFarland, D. and Farley, B. (2006). The Science and Practice of LSVT/LOUD: Neural Plasticity-Principled Approach to Treating Individuals with Parkinson Disease and Other Neurological Disorders. *Seminars in Speech and Language*, 27(4), pp.283–299. doi:<https://doi.org/10.1055/s-2006-955118>.

Fox, C.M., Morrison, C.E., Ramig, L.O. and Sapir, S. (2002). Current Perspectives on the Lee Silverman Voice Treatment (LSVT) for Individuals With Idiopathic Parkinson Disease. *American Journal of Speech-Language Pathology*, 11(2), pp.111–123. doi:[https://doi.org/10.1044/1058-0360\(2002/012\)](https://doi.org/10.1044/1058-0360(2002/012)).

Fox, P.T., Ingham, R.J., Ingham, J.C., Hirsch, T.B., Downs, J.H., Martin, C., Jerabek, P., Glass, T. and Lancaster, J.L. (1996). A PET study of the neural systems of stuttering. *Nature*, 382(6587), pp.158–162. doi:<https://doi.org/10.1038/382158a0>.

Fyfe, I. (2015). Sleep disorder deficits suggest signature for early Parkinson disease. *Nature Reviews Neurology*, 12(1), pp.3–3. doi:<https://doi.org/10.1038/nrneurol.2015.232>.

Gamboa, J., Jiménez-Jiménez, F.J., Nieto, A., Montojo, J., Ortí-Pareja, M., Molina, J.A., García-Albea, E. and Cobeta, I. (1997). Acoustic voice analysis in patients with Parkinson's disease treated with dopaminergic drugs. *Journal of Voice*, [online] 11(3), pp.314–320. doi:[https://doi.org/10.1016/s0892-1997\(97\)80010-0](https://doi.org/10.1016/s0892-1997(97)80010-0).

Ganzeboom, M., Bakker, M., Beijer, L., Strik, H. and Rietveld, T. (2022). A serious game for speech training in dysarthric speakers with Parkinson's disease: Exploring therapeutic efficacy and patient satisfaction. *International Journal of Language & Communication Disorders*. doi:<https://doi.org/10.1111/1460-6984.12722>.

Gick, M.L. (2011). Singing, health and well-being: A health psychologist's review. *Psychomusicology: Music, Mind and Brain*, 21(1-2), pp.176–207. doi:<https://doi.org/10.1037/h0094011>.

Glover, H., Kalinowski, J., Rastatter, M. and Stuart, A. (1996a). Effect of Instruction to Sing on Stuttering Frequency at Normal and Fast Rates. *Perceptual and Motor Skills*, 83(2), pp.511–522. doi:<https://doi.org/10.2466/pms.1996.83.2.511>.

Glover, H., Kalinowski, J., Rastatter, M. and Stuart, A. (1996b). Effect of Instruction to Sing on Stuttering Frequency at Normal and Fast Rates. *Perceptual and Motor Skills*, 83(2), pp.511–522. doi:<https://doi.org/10.2466/pms.1996.83.2.511>.

Glover, H., Kalinowski, J., Rastatter, M. and Stuart, A. (1996c). Effect of Instruction to Sing on Stuttering Frequency at Normal and Fast Rates. *Perceptual and Motor Skills*, 83(2), pp.511–522. doi:<https://doi.org/10.2466/pms.1996.83.2.511>.

Goetz, C.G. (2011). The History of Parkinson's Disease: Early Clinical Descriptions and Neurological Therapies. *Cold Spring Harbor Perspectives in Medicine*, [online] 1(1). doi:<https://doi.org/10.1101/cshperspect.a008862>.

Goldkuhl, G. (2012). Pragmatism vs interpretivism in qualitative information systems research. *European Journal of Information Systems*, [online] 21(2), pp.135–146. doi:<https://doi.org/10.1057/ejis.2011.54>.

Green, B.N., Johnson, C.D. and Adams, A. (2006). Writing narrative literature reviews for peer-reviewed journals: secrets of the trade. *Journal of Chiropractic Medicine*, 5(3), pp.101–117. doi:[https://doi.org/10.1016/s0899-3467\(07\)60142-6](https://doi.org/10.1016/s0899-3467(07)60142-6).

Green, T. (1999). The relationship of self-conception to perceived stuttering severity in children and adults who stutter. *Journal of Fluency Disorders*, 24(4), pp.281–292. doi:[https://doi.org/10.1016/s0094-730x\(99\)00020-0](https://doi.org/10.1016/s0094-730x(99)00020-0).

Greenhalgh, T., Thorne, S. and Malterud, K. (2018). Time to challenge the spurious hierarchy of systematic over narrative reviews? *European Journal of Clinical Investigation*, [online] 48(6), p.e12931. doi:<https://doi.org/10.1111/eci.12931>.

Guenther, F.H. (2021). A neurocomputational view of developmental stuttering. *Journal of the Acoustical Society of America*, 150(4_Supplement), pp.A111–A111. doi:<https://doi.org/10.1121/10.0007800>.

Guitar, B. (2014). *Stuttering : an Integrated Approach to Its Nature and Treatment*. Philadelphia: Lippincott Williams & Wilkins.

Ham, R. (1999). Stuttering: An Integrated Approach to Its Nature and Treatment, 2nd edition. *Journal of Fluency Disorders*, 24(4), pp.333–335. doi:[https://doi.org/10.1016/s0094-730x\(99\)00018-2](https://doi.org/10.1016/s0094-730x(99)00018-2).

Hammer, M.J. and Barlow, S.M. (2009). Laryngeal somatosensory deficits in Parkinson's disease: implications for speech respiratory and phonatory control. *Experimental Brain Research*, 201(3), pp.401–409. doi:<https://doi.org/10.1007/s00221-009-2048-2>.

Han, E.Y., Yun, J.Y., Chong, H.J. and Choi, K.-G. (2018). Individual Therapeutic Singing Program for Vocal Quality and Depression in Parkinson's Disease. *Journal of Movement Disorders*, 11(3), pp.121–128. doi:<https://doi.org/10.14802/jmd.17078>.

Haneishi, E. (2001). Effects of a Music Therapy Voice Protocol on Speech Intelligibility, Vocal Acoustic Measures, and Mood of Individuals with Parkinson's Disease. *Journal of Music Therapy*, 38(4), pp.273–290. doi:<https://doi.org/10.1093/jmt/38.4.273>.

HANSON, D.G., GERRATT, B.R. and WARD, P.H. (1984). CINEGRAPHIC OBSERVATIONS OF LARYNGEAL FUNCTION IN PARKINSON'S DISEASE. *The Laryngoscope*, 94(3), p.348–353. doi:<https://doi.org/10.1288/00005537-198403000-00011>.

Harel, B., Cannizzaro, M. and Snyder, P.J. (2004). Variability in fundamental frequency during speech in prodromal and incipient Parkinson's disease: A longitudinal case study. *Brain and Cognition*, 56(1), pp.24–29. doi:<https://doi.org/10.1016/j.bandc.2004.05.002>.

Healey, E.C., Mallard, A.R. and Adams, M.R. (1976). Factors Contributing to the Reduction of Stuttering during Singing. *Journal of Speech and Hearing Research*, 19(3), pp.475–480. doi:<https://doi.org/10.1044/jshr.1903.475>.

Herd, C.P., Tomlinson, C.L., Deane, K.H., Brady, M.C., Smith, C.H., Sackley, C.M. and Clarke, C.E. (2012). Comparison of speech and language therapy techniques for speech problems in Parkinson's disease. *Cochrane Database of Systematic Reviews*. doi:<https://doi.org/10.1002/14651858.cd002814.pub2>.

Hinshaw, T., Clift, S., Hulbert, S. and Camic, P.M. (2015). Group singing and young people's psychological well-being. *International Journal of Mental Health Promotion*, 17(1), pp.46–63. doi:<https://doi.org/10.1080/14623730.2014.999454>.

Hoehn, M.M. and Yahr, M.D. (1967). Parkinsonism: onset, progression, and mortality. *Neurology*, [online] 17(5), pp.427–427. doi:<https://doi.org/10.1212/wnl.17.5.427>.

Hood, S.B. and Mowrer, D.E. (1994). Fluency and stuttering. *Journal of Fluency Disorders*, 19(2), pp.134–137. doi:[https://doi.org/10.1016/0094-730x\(94\)90020-5](https://doi.org/10.1016/0094-730x(94)90020-5).

Irons, J.Y., Coren, E., Young, M.K., Stewart, D.E., Gschwandtner, M. and Mellick, G.D. (2019). Singing for people with Parkinson's disease. *Cochrane Database of Systematic Reviews*. doi:<https://doi.org/10.1002/14651858.cd013279>.

Iverach, L. and Rapee, R.M. (2014). Social anxiety disorder and stuttering: Current status and future directions. *Journal of Fluency Disorders*, [online] 40, pp.69–82.
doi:<https://doi.org/10.1016/j.jfludis.2013.08.003>.

J. Holmes, Jennifer M. Oates, Debbi, R. (2000a). Voice characteristics in the progression of Parkinson's disease. *International Journal of Language & Communication Disorders*, [online] 35(3), pp.407–418. doi:<https://doi.org/10.1080/136828200410654>.

J. Holmes, Jennifer M. Oates, Debbi, R. (2000b). Voice characteristics in the progression of Parkinson's disease. *International Journal of Language & Communication Disorders*, [online] 35(3), pp.407–418. doi:<https://doi.org/10.1080/136828200410654>.

Jankovic, J. (2008). Parkinson's disease: Clinical Features and Diagnosis. *Journal of Neurology, Neurosurgery & Psychiatry*, 79(4), pp.368–376.
doi:<https://doi.org/10.1136/jnnp.2007.131045>.

Jeffries, K.J., Fritz, J.B. and Braun, A.R. (2003). Words in melody: an H(2)15O PET study of brain activation during singing and speaking. *Neuroreport*, [online] 14(5), pp.749–754.
doi:<https://doi.org/10.1097/00001756-200304150-00018>.

Jiang, J., Lu, C., Peng, D., Zhu, C. and Howell, P. (2012). Classification of Types of Stuttering Symptoms Based on Brain Activity. *PLoS ONE*, 7(6), p.e39747.
doi:<https://doi.org/10.1371/journal.pone.0039747>.

Jiménez-Jiménez, F.J., Gamboa, J., Nieto, A., Guerrero, J., Orti-Pareja, M., Molina, J.A., García-Albea, E. and Cobeta, I. (1997). Acoustic voice analysis in untreated patients with Parkinson's disease. *Parkinsonism & Related Disorders*, 3(2), pp.111–116.
doi:[https://doi.org/10.1016/s1353-8020\(97\)00007-2](https://doi.org/10.1016/s1353-8020(97)00007-2).

Johnson, J.A. and Pring, T.R. (1990). Speech therapy and Parkinson's disease: A review and further data. *International Journal of Language & Communication Disorders*, 25(2), pp.183–194. doi:<https://doi.org/10.3109/13682829009011973>.

Johnson, W. (1955). *Stuttering in Children and Adults. Thirty Years of Research at the University of Iowa*. Univ Of Minnesota Press.

Kamioka, H., Mutoh, Y., Tsutani, K., Yamada, M., Park, H., Okuizumi, H., Tsuruoka, K., Honda, T., Okada, S., Park, S.-J., Kityuguchi, J., Abe, T., Handa, S. and Oshio, T. (2014). Effectiveness of Music Therapy: a Summary of Systematic Reviews Based on Randomized

Controlled Trials of Music Interventions. *Patient Preference and Adherence*, [online] 8, p.727. doi:<https://doi.org/10.2147/ppa.s61340>.

Kano, O., Ikeda, K., Cridebring, D., Takazawa, T., Yoshii, Y. and Iwasaki, Y. (2011). Neurobiology of Depression and Anxiety in Parkinson's Disease. *Parkinson's Disease*, 2011, pp.1–5. doi:<https://doi.org/10.4061/2011/143547>.

Kaushik, V. and Walsh, C.A. (2019). Pragmatism as a Research Paradigm and Its Implications for Social Work Research. *Social Sciences*, [online] 8(9), p.255. doi:<https://doi.org/10.3390/socsci8090255>.

Keeler, J.R., Roth, E.A., Neuser, B.L., Spitsbergen, J.M., Waters, D.J.M. and Vianney, J.-M. (2015). The neurochemistry and social flow of singing: bonding and oxytocin. *Frontiers in Human Neuroscience*, [online] 9. doi:<https://doi.org/10.3389/fnhum.2015.00518>.

KHALFA, S., BELLA, S.D., ROY, M., PERETZ, I. and LUPIEN, S.J. (2003). Effects of Relaxing Music on Salivary Cortisol Level after Psychological Stress. *Annals of the New York Academy of Sciences*, 999(1), pp.374–376. doi:<https://doi.org/10.1196/annals.1284.045>.

Kleber, B., Veit, R., Birbaumer, N., Gruzelier, J. and Lotze, M. (2009). The Brain of Opera Singers: Experience-Dependent Changes in Functional Activation. *Cerebral Cortex*, 20(5), pp.1144–1152. doi:<https://doi.org/10.1093/cercor/bhp177>.

Lanciego, J.L., Luquin, N. and Obeso, J.A. (2012). Functional neuroanatomy of the basal ganglia. *Cold Spring Harbor Perspectives in Medicine*, [online] 2(12), pp.a009621–a009621. doi:<https://doi.org/10.1101/cshperspect.a009621>.

Lee, S., O'Neill, D. and Moss, H. (2021). Dementia-inclusive group-singing online during COVID-19: A qualitative exploration. *Nordic Journal of Music Therapy*, pp.1–19. doi:<https://doi.org/10.1080/08098131.2021.1963315>.

Liotti, M., Ramig, L.O., Vogel, D., New, P., Cook, C.I., Ingham, R.J., Ingham, J.C. and Fox, P.T. (2003). Hypophonia in Parkinson's disease: Neural correlates of voice treatment revealed by PET. *Neurology*, 60(3), pp.432–440. doi:<https://doi.org/10.1212/wnl.60.3.432>.

Logemann, J.A., Fisher, H.B., Boshes, B. and Blonsky, E.R. (1978). Frequency and Cooccurrence of Vocal Tract Dysfunctions in the Speech of a Large Sample of Parkinson Patients. *Journal of Speech and Hearing Disorders*, 43(1), pp.47–57. doi:<https://doi.org/10.1044/jshd.4301.47>.

LSVT Global (2015). *What is LSVT LOUD*. [online] Lsvtglobal.com. Available at: <https://www.lsvtglobal.com/LSVTLOUD>.

LSVT Global (2021). *Parkinson's Disease Exercises: LSVT LOUD Vocal Therapy*. [online] [www.youtube.com](https://www.youtube.com/watch?v=L8bkqvf6TRs). Available at: <https://www.youtube.com/watch?v=L8bkqvf6TRs>. [Accessed 24 Oct. 2023].

Ma, A., Desai, N., Lau, K., Marimuthu Palaniswami, O'Brien, T.J., Paari Palaniswami and Thyagarajan, D. (2023). Automated measurement of inter-arytenoid distance on 4D laryngeal CT: A validation study. *PLOS ONE*, 18(1), pp.e0279927–e0279927. doi:<https://doi.org/10.1371/journal.pone.0279927>.

Ma, A., Lau, K. and Thyagarajan, D. (2020). Voice changes in Parkinson's disease: What are they telling us? *J Clin Neurosci*, 72, pp.1–7. doi:<https://doi.org/10.1016/j.jocn.2019.12.029>.

Ma, A., Lau, K.K. and Thyagarajan, D. (2021). Radiological correlates of vocal fold bowing as markers of Parkinson's disease progression: A cross-sectional study utilizing dynamic laryngeal CT. *PLOS ONE*, 16(10), p.e0258786. doi:<https://doi.org/10.1371/journal.pone.0258786>.

Machado Sotomayor, M.J., Arufe-Giráldez, V., Ruíz-Rico, G. and Navarro-Patón, R. (2021). Music Therapy and Parkinson's Disease: A Systematic Review from 2015-2020. *International journal of environmental research and public health*, 18(21), p.11618. doi:<https://doi.org/10.3390/ijerph182111618>.

Marjama-Lyons, J. and Koller, W. (2000). Tremor-Predominant Parkinson's Disease. *Drugs & Aging*, 16(4), pp.273–278. doi:<https://doi.org/10.2165/00002512-200016040-00003>.

Marsden, C.D. and Parkes, J.D. (1977). SUCCESS AND PROBLEMS OF LONG-TERM LEVODOPA THERAPY IN PARKINSON'S DISEASE. *The Lancet*, [online] 309(8007), pp.345–349. doi:[https://doi.org/10.1016/S0140-6736\(77\)91146-1](https://doi.org/10.1016/S0140-6736(77)91146-1).

Marttila, R.J. and Rinne, U.K. (1977). Level of Blood Pressure in Patients with Parkinson's Disease. *European Neurology*, 16(1-6), pp.73–78. doi:<https://doi.org/10.1159/000114883>.

McDonnell, M.N., Rischbieth, B., Schammer, T.T., Seaforth, C., Shaw, A.J. and Phillips, A.C. (2017). Lee Silverman Voice Treatment (LSVT)-BIG to improve motor function in people with

Parkinson's disease: a systematic review and meta-analysis. *Clinical Rehabilitation*, 32(5), pp.607–618. doi:<https://doi.org/10.1177/0269215517734385>.

Michel, Patrick P., Hirsch, Etienne C. and Hunot, S. (2016). Understanding Dopaminergic Cell Death Pathways in Parkinson Disease. *Neuron*, 90(4), pp.675–691. doi:<https://doi.org/10.1016/j.neuron.2016.03.038>.

Midi, I., Dogan, M., Koseoglu, M., Can, G., Sehitoglu, M.A. and Gunal, D.I. (2007). Voice abnormalities and their relation with motor dysfunction in Parkinson's disease. *Acta Neurologica Scandinavica*, 0(0), p.071121035509003-??? doi:<https://doi.org/10.1111/j.1600-0404.2007.00965.x>.

Miller, R. (2000). *Training soprano voices*. New York: Oxford University Press.

Miluk-Kolasa, B., Obminski, Z., Stupnicki, R. and Golec, L. (2009). Effects of music treatment on salivary cortisol in patients exposed to pre-surgical stress. *Experimental and Clinical Endocrinology & Diabetes*, 102(02), pp.118–120. doi:<https://doi.org/10.1055/s-0029-1211273>.

Morgan, D.L. (2013a). *Integrating qualitative and quantitative methods : a pragmatic approach*. Thousand Oaks, California: Sage Publications, Inc.

Morgan, D.L. (2013b). *Integrating qualitative and quantitative methods : a pragmatic approach*. Thousand Oaks, California: Sage Publications, Inc.

Narayana, S., Fox, P.T., Zhang, W., Franklin, C., Robin, D.A., Vogel, D. and Ramig, L.O. (2009). Neural correlates of efficacy of voice therapy in Parkinson's disease identified by performance-correlation analysis. *Human Brain Mapping*, p.NA-NA. doi:<https://doi.org/10.1002/hbm.20859>.

Natke, U., Donath, T.M. and Kalveram, K.Th. (2003). Control of voice fundamental frequency in speaking versus singing. *The Journal of the Acoustical Society of America*, 113(3), pp.1587–1593. doi:<https://doi.org/10.1121/1.1543928>.

Neef, N.E., Anwender, A., Büttfering, C., Schmidt-Samoa, C., Friederici, A.D., Paulus, W. and Sommer, M. (2017). Structural connectivity of right frontal hyperactive areas scales with stuttering severity. *Brain*, 141(1), pp.191–204. doi:<https://doi.org/10.1093/brain/awx316>.

Nyashanu, M., Pfende, F. and Osborne, J. (2021). Evaluating the benefits of inclusive community singing towards well-being: narratives of diverse community members attending

an inclusive singing group. *Journal of Public Mental Health*, ahead-of-print(ahead-of-print). doi:<https://doi.org/10.1108/jpmh-05-2021-0061>.

Okunoye, O., Marston, L., Walters, K. and Schrag, A. (2022). Change in the incidence of Parkinson's disease in a large UK primary care database. *npj Parkinson's Disease*, [online] 8(1). doi:<https://doi.org/10.1038/s41531-022-00284-0>.

Osman, S.E., Tischler, V. and Schneider, J. (2016). 'Singing for the Brain': A qualitative study exploring the health and well-being benefits of singing for people with dementia and their carers. *Dementia*, [online] 15(6), pp.1326–1339. doi:<https://doi.org/10.1177/1471301214556291>.

Özdemir, E., Norton, A. and Schlaug, G. (2006). Shared and distinct neural correlates of singing and speaking. *NeuroImage*, 33(2), pp.628–635. doi:<https://doi.org/10.1016/j.neuroimage.2006.07.013>.

P. Di Benedetto, Matteo Cavazzon, Federica Mondolo, G. Rugiu, Peratoner, A. and E. Biasutti (2009). Voice and choral singing treatment: a new approach for speech and voice disorders in Parkinson's disease. *European Journal of Physical and Rehabilitation Medicine*, 45(1), pp.13–9.

Parent, A. and Hazrati, L.-N. (1995). Functional anatomy of the basal ganglia. I. The cortico-basal ganglia-thalamo-cortical loop. *Brain Research Reviews*, 20(1), pp.91–127. doi:[https://doi.org/10.1016/0165-0173\(94\)00007-c](https://doi.org/10.1016/0165-0173(94)00007-c).

Parkinson, J. (1969). AN ESSAY ON THE SHAKING PALSY. *Archives of Neurology*, 20(4), pp.441–445. doi:<https://doi.org/10.1001/archneur.1969.00480100117017>.

Perez, H.R. and Stoeckle, J.H. (2016). Stuttering: Clinical and research update. *Canadian Family Physician*, 62(6), pp.479–484.

Perez, K.S., Ramig, L.O., Smith, M.E. and Dromey, C. (1996). The Parkinson larynx: tremor and videostroboscopic findings. *Journal of Voice: Official Journal of the Voice Foundation*, [online] 10(4), pp.354–361. doi:[https://doi.org/10.1016/s0892-1997\(96\)80027-0](https://doi.org/10.1016/s0892-1997(96)80027-0).

Perju-Dumbrava, L., Lau, K., Phylard, D., Papanikolaou, V., Finlay, P., Beare, R., Bardin, P., Stuckey, S., Kempster, P. and Thyagarajan, D. (2017). Arytenoid cartilage movements are hypokinetic in Parkinson's disease: A quantitative dynamic computerised tomographic study. *PLOS ONE*, 12(11), p.e0186611. doi:<https://doi.org/10.1371/journal.pone.0186611>.

- Pichler, K. (2005). Das Lee Silverman Voice Treatment (LSVT). *Nervenheilkunde*, 24(10), pp.873–878. doi:<https://doi.org/10.1055/s-0038-1630024>.
- Plumb, L. and Stickley, T. (2017). Singing to promote mental health and well-being. *Mental Health Practice*, 20(8), pp.31–36. doi:<https://doi.org/10.7748/mhp.2017.e1182>.
- Prakash, K., Bannur, B., Chavan, M., Saniya, K., Sailesh, K. and Rajagopalan, A. (2016). Neuroanatomical changes in Parkinson's disease in relation to cognition: An update. *Journal of Advanced Pharmaceutical Technology & Research*, [online] 7(4), p.123. doi:<https://doi.org/10.4103/2231-4040.191416>.
- Ramig, L. (2014). Development and Dissemination Pathway of a Voice Treatment for Parkinson's Disease (LSVT LOUD). *the Clinical Research Education Library*, 4(1), pp.1–50. doi:<https://doi.org/10.1044/cred-pvid-implscid2p7>.
- Ramig, L. and Fox, C. (2009). O.032 Intensive voice treatment for Parkinson disease (LSVT LOUD): a neuroplasticity principled approach supported by technology. *Parkinsonism & Related Disorders*, 15, p.S9. doi:[https://doi.org/10.1016/s1353-8020\(09\)70047-1](https://doi.org/10.1016/s1353-8020(09)70047-1).
- Ramig, L.O. (2001). Intensive voice treatment (LSVT(R)) for patients with Parkinson's disease: a 2 year follow up. *Journal of Neurology, Neurosurgery & Psychiatry*, 71(4), pp.493–498. doi:<https://doi.org/10.1136/jnnp.71.4.493>.
- Ramig, L.O., Countryman, S., O'Brien, C., Hoehn, M. and Thompson, L. (1996). Intensive speech treatment for patients with Parkinson's disease: Short- and long-term comparison of two techniques. *Neurology*, 47(6), pp.1496–1504. doi:<https://doi.org/10.1212/wnl.47.6.1496>.
- Ramig, L.O., Countryman, S., Thompson, L.L. and Horii, Y. (1995). Comparison of Two Forms of Intensive Speech Treatment for Parkinson Disease. *Journal of Speech, Language, and Hearing Research*, 38(6), pp.1232–1251. doi:<https://doi.org/10.1044/jshr.3806.1232>.
- Robertson, S.J. and Thomson, F. (1984). Speech therapy in Parkinson's Disease: a study of the efficacy and long term effects of intensive treatment. *International Journal of Language & Communication Disorders*, 19(3), pp.213–224. doi:<https://doi.org/10.3109/13682828409029837>.
- Rodríguez, M.Á., Crespo, I., Del Valle, M. and Olmedillas, H. (2020). Should respiratory muscle training be part of the treatment of Parkinson's disease? A systematic review of randomized controlled trials. *Clinical Rehabilitation*, [online] 34(4), pp.429–437. doi:<https://doi.org/10.1177/0269215519896054>.

Rollings Bigler, A., Osborne, K., Ballantyne, C., Horne, B., James, K., Manternach, B., Redman, Y. and Treinkman, M. (2021). Voice Pedagogy for the 21st Century: The Summation of Two Summits. *Journal of Singing*, 78(1), pp.11–28. doi:<https://doi.org/10.53830/cxbg6722>.

Russell, J.A., Ciucci, M.R., Connor, N.P. and Schallert, T. (2010). Targeted exercise therapy for voice and swallow in persons with Parkinson's disease. *Brain Research*, 1341, pp.3–11. doi:<https://doi.org/10.1016/j.brainres.2010.03.029>.

Rusz, J., Cmejla, R., Ruzickova, H. and Ruzicka, E. (2011). Quantitative acoustic measurements for characterization of speech and voice disorders in early untreated Parkinson's disease. *The Journal of the Acoustical Society of America*, [online] 129(1), pp.350–367. doi:<https://doi.org/10.1121/1.3514381>.

Saffarian, A., Amiri Shavaki, Y., Shahidi, G.A., Hadavi, S. and Jafari, Z. (2019). Lee Silverman voice treatment (LSVT) mitigates voice difficulties in mild Parkinson's disease. *Medical journal of the Islamic Republic of Iran*, 33(5).

Sapir, S., Ramig, L.O. and Fox, C. (2006). The Lee Silverman Voice Treatment® for voice, speech and other orofacial disorders in patients with Parkinson's disease. *Future Neurology*, 1(5), pp.563–570. doi:<https://doi.org/10.2217/14796708.1.5.563>.

Schrag, A., Jahanshahi, M. and Quinn, N. (2000). How does Parkinson's disease affect quality of life? A comparison with quality of life in the general population. *Movement Disorders*, 15(6), pp.1112–1118. doi:[https://doi.org/10.1002/1531-8257\(200011\)15:6%3C1112::aid-mds1008%3E3.0.co;2-a](https://doi.org/10.1002/1531-8257(200011)15:6%3C1112::aid-mds1008%3E3.0.co;2-a).

Shahed, J. and Jankovic, J. (2001). Re-emergence of childhood stuttering in Parkinson's disease: A hypothesis. *Movement Disorders*, 16(1), pp.114–118. doi:[https://doi.org/10.1002/1531-8257\(200101\)16:1%3C114::aid-mds1004%3E3.0.co;2-2](https://doi.org/10.1002/1531-8257(200101)16:1%3C114::aid-mds1004%3E3.0.co;2-2).

Shih, L.C., Piel, J., Warren, A., Kraics, L., Silver, A., Vanderhorst, V., Simon, D.K. and Tarsy, D. (2012). Singing in groups for Parkinson's disease (SING-PD): A pilot study of group singing therapy for PD-related voice/speech disorders. *Parkinsonism & Related Disorders*, 18(5), pp.548–552. doi:<https://doi.org/10.1016/j.parkreldis.2012.02.009>.

Smith, A. and Weber, C. (2016). Childhood Stuttering – Where are we and Where are we going? *Seminars in speech and language*, [online] 37(4), pp.291–297. doi:<https://doi.org/10.1055/s-0036-1587703>.

Snyder, H. (2019). Literature Review as a Research methodology: an Overview and Guidelines. *Journal of Business Research*, [online] 104(104), pp.333–339. doi:<https://doi.org/10.1016/j.jbusres.2019.07.039>.

Speranza, L., Pulcrano, S., Perrone-Capano, C., di Porzio, U. and Volpicelli, F. (2022). Music affects functional brain connectivity and is effective in the treatment of neurological disorders. *Reviews in the Neurosciences*, 0(0). doi:<https://doi.org/10.1515/revneuro-2021-0135>.

Stacy, R., Brittain, K. and Kerr, S. (2002). Singing for health: an exploration of the issues. *Health Education*, 102(4), pp.156–162. doi:<https://doi.org/10.1108/09654280210434228>.

Starkweather, C.W. (1987). *Fluency and Stuttering*. Englewood Cliffs, NJ: Prentice Hall.

Stegemöller, E., Forsyth, E., Patel, B. and Elkouzi, A. (2022). Group therapeutic singing improves clinical motor scores in persons with Parkinson's disease. *BMJ Neurol Open*, 4(2).

Stegemöller, E.L., Hibbing, P., Radig, H. and Wingate, J. (2017a). Therapeutic singing as an early intervention for swallowing in persons with Parkinson's disease. *Complementary Therapies in Medicine*, 31, pp.127–133. doi:<https://doi.org/10.1016/j.ctim.2017.03.002>.

Stegemöller, E.L., Hurt, T.R., O'Connor, M.C., Camp, R.D., Green, C.W., Pattee, J.C. and Williams, E.K. (2017b). Experiences of Persons With Parkinson's Disease Engaged in Group Therapeutic Singing. *Journal of Music Therapy*, 54(4), pp.405–431. doi:<https://doi.org/10.1093/jmt/thx012>.

Stegemöller, E.L., Radig, H., Hibbing, P., Wingate, J. and Sapienza, C. (2016). Effects of singing on voice, respiratory control and quality of life in persons with Parkinson's disease. *Disability and Rehabilitation*, 39(6), pp.594–600. doi:<https://doi.org/10.3109/09638288.2016.1152610>.

Stegemöller, E.L., Zaman, A., Shelley, M., Patel, B., Kouzi, A.E. and Shirtcliff, E.A. (2021). The Effects of Group Therapeutic Singing on Cortisol and Motor Symptoms in Persons With Parkinson's Disease. *Frontiers in Human Neuroscience*, [online] 15, p.703382. doi:<https://doi.org/10.3389/fnhum.2021.703382>.

Stelzig, Y., Hochhaus, W., Gall, V. and Henneberg, A. (1999). [Laryngeal manifestations in patients with Parkinson disease]. *Laryngorhinootologie* ., 78(10), pp.544–551.

Suppa, A., Costantini, G., Gomez-Vilda, P. and Saggio, G. (2023). Voice Analysis in healthy subjects and patients with neurological disorders. *Frontiers in Neurology*, 14. doi:<https://doi.org/10.3389/fneur.2023.1288370>.

SVSAAB, L., GROSS, J. and LANGOVÁ, J. (1972). STUTTERING AND SOCIAL ISOLATION. *The Journal of Nervous and Mental Disease*, 155(1), pp.1–5. doi:<https://doi.org/10.1097/00005053-197207000-00001>.

Tamplin, J., Morris, M.E., Marigliani, C., Baker, F.A. and Vogel, A.P. (2019). ParkinSong: A Controlled Trial of Singing-Based Therapy for Parkinson's Disease. *Neurorehabilitation and Neural Repair*, 33(6), pp.453–463. doi:<https://doi.org/10.1177/1545968319847948>.

Tanner, M., Rammage, L. and Liu, L. (2015). Does singing and vocal strengthening improve vocal ability in people with Parkinson's disease? *Arts & Health*, 8(3), pp.199–212. doi:<https://doi.org/10.1080/17533015.2015.1088047>.

Taylor, A.C. and Dewhurst, S.A. (2017). Investigating the influence of music training on verbal memory. *Psychology of Music*, 45(6), pp.814–820. doi:<https://doi.org/10.1177/0305735617690246>.

Teixeira, J.P., Oliveira, C. and Lopes, C. (2013). Vocal Acoustic Analysis – Jitter, Shimmer and HNR Parameters. *Procedia Technology*, [online] 9, pp.1112–1122. doi:<https://doi.org/10.1016/j.protcy.2013.12.124>.

Thibault, S., Py, R., Gervasi, A.M., Salemme, R., Koun, E., Lövdén, M., Boulenger, V., Roy, A.C. and Brozzoli, C. (2021). Tool use and language share syntactic processes and neural patterns in the basal ganglia. *Science*, 374(6569). doi:<https://doi.org/10.1126/science.abe0874>.

Tonkinson, S. (1994). The Lombard effect in choral singing. *Journal of Voice*, 8(1), pp.24–29. doi:[https://doi.org/10.1016/s0892-1997\(05\)80316-9](https://doi.org/10.1016/s0892-1997(05)80316-9).

Torraco, R.J. (2005). Writing Integrative Literature Reviews: Guidelines and Examples. *Human Resource Development Review*, 4(3), pp.356–367. doi:<https://doi.org/10.1177/1534484305278283>.

Tsang, C.D. and Conrad, N.J. (2011). Music Training and Reading Readiness. *Music Perception: An Interdisciplinary Journal*, 29(2), pp.157–163. doi:<https://doi.org/10.1525/mp.2011.29.2.157>.

Türkili, S., Türkili, S. and Aydın, Z.F. (2022). Mental well-being and related factors in individuals with stuttering. *Heliyon*, [online] 8(9), p.e10446.
doi:<https://doi.org/10.1016/j.heliyon.2022.e10446>.

Vaike Kiik-Salupere and Ross, J. (2020). How Professional and Student Singers Cope with Performance Anxiety. *Routledge eBooks*. doi:<https://doi.org/10.4324/9781315162607-20>.

Valente, E.M., Bentivoglio, A.R., Dixon, P.H., Ferraris, A., Ialongo, T., Frontali, M., Albanese, A. and Wood, N.W. (2001). Localization of a Novel Locus for Autosomal Recessive Early-Onset Parkinsonism, PARK6, on Human Chromosome 1p35-p36. *The American Journal of Human Genetics*, 68(4), pp.895–900. doi:<https://doi.org/10.1086/319522>.

Van Borsel, J. and Taillieu, C. (2001). Neurogenic stuttering versus developmental stuttering. *Journal of Communication Disorders*, 34(5), pp.385–395.
doi:[https://doi.org/10.1016/s0021-9924\(01\)00057-0](https://doi.org/10.1016/s0021-9924(01)00057-0).

van de Wetering-van Dongen, V.A., Kalf, J.G., van der Wees, P.J., Bloem, B.R. and Nijkrake, M.J. (2020). The Effects of Respiratory Training in Parkinson's Disease: A Systematic Review. *Journal of Parkinson's Disease*, 10(4), pp.1315–1333.
doi:<https://doi.org/10.3233/jpd-202223>.

Vennard, W. (2012). *Singing : the mechanism and the technic*. New York: Carl Fischer.

Wan, C.Y., Rüber, T., Hohmann, A. and Schlaug, G. (2010). The Therapeutic Effects of Singing in Neurological Disorders. *Music Perception*, 27(4), pp.287–295.
doi:<https://doi.org/10.1525/mp.2010.27.4.287>.

Wang, Y., Shao, W., Gao, L., Lu, J., Gu, H., Sun, L., Tan, Y. and Zhang, Y. (2014). Abnormal Pulmonary Function and Respiratory Muscle Strength Findings in Chinese Patients with Parkinson's Disease and Multiple System Atrophy—Comparison with Normal Elderly. *PLoS ONE*, 9(12), p.e116123. doi:<https://doi.org/10.1371/journal.pone.0116123>.

Watkins, K.E., Smith, S.M., Davis, S. and Howell, P. (2007). Structural and functional abnormalities of the motor system in developmental stuttering. *Brain*, 131(1), pp.50–59.
doi:<https://doi.org/10.1093/brain/awm241>.

Webster, J. and Watson, R.T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *Management Information Systems Quarterly*, 26, p.3.

Welch, G.F., Himonides, E., Saunders, J., Papageorgi, I. and Sarazin, M. (2014). Singing and social inclusion. *Frontiers in Psychology*, [online] 5(803).

doi:<https://doi.org/10.3389/fpsyg.2014.00803>.

WEPMAN, J.M. (1971). Stuttering: Research and Therapy and The Nature of Stuttering. *Contemporary Psychology: A Journal of Reviews*, 16(11), pp.743–743.

doi:<https://doi.org/10.1037/0011224>.

Whittemore, R. and Knafl, K. (2005). The integrative review: updated methodology. *Journal of Advanced Nursing*, 52(5), pp.546–553.

Wieland, E.A., McAuley, J.D., Dilley, L.C. and Chang, S.-E. (2015). Evidence for a rhythm perception deficit in children who stutter. *Brain and Language*, 144, pp.26–34.

doi:<https://doi.org/10.1016/j.bandl.2015.03.008>.

Wiens, M.E., Reimer, M.A. and Guyn, H.L. (1999). Music Therapy as a Treatment Method for Improving Respiratory Muscle Strength in Patients with Advanced Multiple Sclerosis: A Pilot Study. *Rehabilitation Nursing*, 24(2), pp.74–80. doi:<https://doi.org/10.1002/j.2048-7940.1999.tb01840.x>.

Williams, E., Dingle, G.A. and Clift, S. (2018). A systematic review of mental health and wellbeing outcomes of group singing for adults with a mental health condition. *European Journal of Public Health*, 28(6), pp.1035–1042. doi:<https://doi.org/10.1093/eurpub/cky115>.

Wingate, M.E. (1964). Recovery from Stuttering. *Journal of Speech and Hearing Disorders*, 29(3), pp.312–321. doi:<https://doi.org/10.1044/jshd.2903.312>.

Yinger, O.S. and Lapointe, L.L. (2012). The Effects of Participation in a Group Music Therapy Voice Protocol (G-MTVP) on the Speech of Individuals with Parkinson's Disease. *Music Therapy Perspectives*, 30(1), pp.25–31. doi:<https://doi.org/10.1093/mtp/30.1.25>.

York, G.K. (2017). The history of James Parkinson and his disease. *Journal of the Neurological Sciences*, 381, p.35. doi:<https://doi.org/10.1016/j.jns.2017.08.147>.

Yücetürk, A., Yılmaz, H., Eğrilmez, M. and Karaca, S. (2002). Voice analysis and videolaryngostroboscopy in patients with Parkinson's disease. *European Archives of Oto-Rhino-Laryngology*, 259(6), pp.290–293. doi:<https://doi.org/10.1007/s00405-002-0462-1>.

Zebrowski, P.M. (1994). Duration of Sound Prolongation and Sound/Syllable Repetition in Children Who Stutter. *Journal of Speech, Language, and Hearing Research*, 37(2), pp.254–263. doi:<https://doi.org/10.1044/jshr.3702.254>.

Zesiewicz, T. (2009). Sleep disorders in Parkinson's disease. *Neuropsychiatric Disease and Treatment*, p.535. doi:<https://doi.org/10.2147/ndt.s4578>.

Zunic, L., Sinanovic, O. and Majic, B. (2021). Neurogenic Stuttering: Etiology, Symptomatology, and Treatment. *Medical Archives*, 75(6), p.456. doi:<https://doi.org/10.5455/medarh.2021.75.456-461>.

Appendix 1

Glossary of Terms

TERM	DEFINITION
Basal Ganglia	A group of subcortical nuclei near the centre of the brain, responsible primarily for motor control
Bradykinesia	Impairment of voluntary motor control and slow movements or freezing. It's most commonly a symptom of Parkinson's disease of the primary symptoms of Parkinson's Disease
Stroboscopy	A procedure using a flexible or rigid endoscope combined with a microphone and strobe light The microphone is placed next to the larynx and is used to estimate the fundamental frequency of the voice.
Pulmonary Function Testing	A non-invasive test to measure lung volume, capacity, rates of flow, and gas exchange
Idiopathic Parkinson's Disease	Where the cause of the Parkinson's Disease is unknown
Parkinson's-Plus Syndromes	Parkinson-plus syndromes are characterized by the primary features of Parkinson disease, including bradykinesia, ataxia, resting tremor, and rigidity but also include additional features such as dementia, cognitive deficits, and cranial nerve impairment
Dysdiadochokinesis	The inability to perform rapid alternating muscle movements.
Hypophonia	An abnormally weak voice due to lack of coordination of the speech muscles.
Hypokinetic Articulation	A form of Down Syndrome caused by a mixture of two types of cells, some containing the usual 46 chromosomes and some containing 47.
Dysprosody	Speech that has an atypical or absent rhythm, intonation, melody, or start/stop pattern
Festination	The tendency to speed up when performing repetitive movement.
Hypokinetic Dysarthria	Speech characterised by reduced pitch variation (monotonicity), reduced loudness, breathy voice, imprecise consonants, variable speaking rate, and short rushes of speech
Right Frontal Operculum	Part of the frontal lobe that controls orofacial movements required for nonverbal

	facial expression, mastication and deglutition, speech articulation, prosody, and syntactic and semantic aspects of language
Anterior Insula	Controls non sensory functions such as cognition, emotion and social functioning
Cerebellum	The cerebellum coordinates gait and maintains posture, controls muscle tone and voluntary muscle activity but is unable to initiate muscle contraction.
Basal Ganglia-Thalamocortical Motor Circuits	A system of neural circuits in the brain that interact, but separately process limbic, associative and sensorimotor information.
Left Inferior Frontal Gyrus	A part of the frontal lobe of the brain, which has a key role in language and executive function
Left Motor Cortex	The primary region of the motor system.
Aphasia	A language disorder caused by damage in a specific area of the brain that controls language expression and comprehension

Appendix 2

Vocal Exercises

To correct over-breathy voice and encourage good vocal fold closure

- a) Slide on the voiced consonant “z” until you feel a good breath balance. Then add the “oo” vowel and add “oo” to each “z” you pitch, going up and down your registers. Then remove the “z” altogether and just sing “oo” with correct breath balance.
Try the same exercise with the voiced consonant “V”, followed by the vowel “ah”.
- b) Try the same exercise with the connector “M” followed by each of the vowels.

Call out the phrase “Uh-Oh” or “No Way” several times. Repeat this call using pitch and employing various dynamics bringing the vocal cords into good alignment.

Produce a spoken siren on the vowel “E” to get clean closure. Then choose a note and sustain the tone. Try this all around your vocal range. Then sing a legato “E” on a 5 note scale.
- c) Sing 5 note slides through a straw, throughout your vocal range.
- d) Lip trill 5 note scales throughout your vocal range
- e) Use vocal fry to complete a series of small voice slides

To improve volume and projection without strain

- f) Using an “Ng” sound, choose a single note on a comfortable pitch in the middle of your lower range. Do not use excess air pressure. Once you have a consistent balanced tone, move from NG to each of the vowels, for example “Ng – Ah”; “Ng-Oo”, “Ng-Ee” etc.
- g) Using the “Ng” sound, sing a series of 3 note scales, taking care not to push too hard, but achieving volume with the resonant tuning known as twang that is created

To improve breath management

- h) Inhale continuously through the nose for 5 seconds. Suspend your breath for 5 seconds. Release a tiny amount of breath using the sound “Shhh” for 5 seconds. Suspend your breath again for 5 seconds. Inhale for 5 seconds and repeat 3 rounds. Relax and repeat.

Appendix 3

LSVT Loud Exercises

LSVT LOUD	
Ramig et al. [87-88, 103]	
Intensity: STANDARDIZED	
<u>Dosage</u> : 4days/week for 4 weeks (16 sessions in one month)	
<u>Repetitions</u> : Minimum 15 repetitions/task	
<u>*Effort</u> : push for max patient-perceived effort each day (8 or 9 on scale of 1-10 with 10 being the most)	
Simple Focus: LOUD	
Increased movement amplitude directed predominately to respiratory/laryngeal systems	
Daily Tasks : first half of the treatment session (25 minutes)	
<u>Task 1: Maximum sustained movements</u>	
15 reps: sustain “ah” in good quality, Loud voice as long as possible	
<u>Task 2: Directional movements</u>	
15 reps each: say “ah” in Loud good quality voice going high in pitch;	
15 reps each: say “ah” in Loud good quality voice going low in pitch	
<u>Task 3: Functional movements</u>	
Patient self-identifies 10 phrases or sentences he/she says daily in functional living (e.g., “Good morning”) 5 reps of the list of 10 phrases. “Read phrases using same effort/loudness as you did during the long ‘ah’”	
Hierarchy : second half of the treatment session (25 minutes)	
-Designed to train rescaled amplitude/effort of movement achieved in CORE exercises from Daily Tasks into in context specific and variable speaking activities	
-Incorporate multiple repetitions with a focus on high effort (e.g., list of 20 phrases/sentences repeated 10 times for 200 repetitions)	
-Tasks increase complexity across weeks (Words-phrases-sentences-reading-conversation) and can be tailored to each subjects goals and interests (e.g., golf vs. cooking)	
-Tasks progress in difficulty by increasing duration (maintain LOUD for longer periods of time) amplitude (loudness - within normal limits), and complexity of tasks (dual processing, background noise and attentional distracters)	
Sensory Calibration	
<u>Treatment</u> : Focus attention on how it feels and sounds to talk LOUD	
<u>Carryover activities</u> : start day one; daily assignments (treatment and non-treatment days); use loud voice in real life situations; - difficulty of the assignment matches the level of the hierarchy where the person is working; make patient accountable and look for comments from patient that people in their daily living have said, such as, “I can hear you better”	
<u>Homework practice</u> : start day one: daily assignments to practice at home (Daily tasks and hierarchy exercises); treatment days (one other time for 5-10 minutes); non-treatment days (two times for 10-15 minutes); homework book provided and patient made accountable	