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**Teaching the Hypermobile voice student -
what do singing teachers need to know? A
pilot study of exercises to aid in the vocal
health and strength of hypermobile singers**

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Project Proposal

Introduction

Background and Justification

The researcher has worked as a private singing teacher for 10 years working in contemporary commercial music with a large focus on the Musical Theatre genre. This was born out of an early found passion for evidence based vocal techniques through the Estill Voice Model in the final year of their own musical theatre training. In the past 10 years their own pedagogical style has been sculpted through continuous professional development and study of model and method based practices; aiming to centre their pedagogy through practical application of research findings. The researcher believes vocal teaching should follow the procedures of medicine and education (Titler,2008); implementing evidence-based teachings into the voice studio, which is essential for the improvement of vocal technique and health.

When a change in the researcher's working life led to a larger amount of time working within higher education musical theatre training, she began to notice trends of hypermobility within cohorts of her students. This experiential knowledge gained in the teaching studio gave realisation to the lack of consideration given to hypermobility in her daily teaching practices. This prompted an interest in investigating whether and how the impacts of excessive mobility should be taken into account in vocal coaching. Previous projects conducted by the researcher caused the researcher to question if their own hypermobility has impacted their voice in either a positive or negative manner. Initial research showed documented trends within hypermobile populations of a higher prevalence of hypermobility in women (Janssin et al., 2004; Clinch et al., 2011; Tinkle, 2020; Jindal 2016) and performers (HMSA, 1992; De Vries, 2021; Jeffery et al., 2022) which gave reason to the observed traits from the researcher.

Research on the hypermobile singer is in its infancy and literature on a specific pedagogy including considerations of the hypermobile singer is non-existent. Current research suggests that voice difficulties may be more pronounced in a hypermobile person than a non-hypermobile person and also gives insights into the voice difficulties that hypermobile people experience (Jeffery, 2020). The primary source of information regarding voice in

individuals with hypermobility is derived from medical practitioners as an observed trend, secondary to a patient's initial symptoms.

What is Joint Hypermobility?

Joint Hypermobility (JH) is a person's ability to move their limbs beyond the typical range along the physiological axes (Malfait et al. 2006) in both passive and active movement. Scientific research shows that joint hypermobility is linked to a genetic mutation impacting the production and arrangement of collagen, resulting in abnormalities in extracellular matrix protein composition (Fikree, 2013; Aubry-Rozier; 2021) which works as a the structural scaffolding of all connective tissue within the body (Pliego-Arreaga et al., 2024). Kirk, Ansell, and Bywaters (Malfait et al. 2006) were the first to study and document Joint Hypermobility (JH) in 1967 within the field of rheumatology. It was not until 31 years later that Hunter et al (1998) undertook the first study concerning voice in a hypermobile person in a survey of 411 people with Ehlers-Danlos Syndrome. There have only been three subsequent studies, of which only one, Jeffery (2021) has looked at the singing voice directly. This study focused on the experiences of hypermobility on the voice from the hypermobile professional singers' perspective. Jeffery highlighted how an awareness of hypermobility amongst singing teachers would greatly benefit this population.

The researcher believes that developing a pedagogical framework used to specifically target the vocal and physical challenges faced by the hypermobile singer positively impacts the singing teacher community, hypermobile singers and brings a broader social awareness of the condition. By understanding the condition and having a pre existing framework to work from, singing teachers will be able to bring these skills into the studio in real time, whilst allowing for growth and adaptation reflecting their own experiential knowledge. Singing students will gain understanding of their own hypermobile traits and be able to communicate more efficiently their vocal concerns regarding this. Through this the student and teacher can work cohesively to improve vocal techniques and vocal health and put in place preventative measures to aid in vocal care. This project will benefit the researchers own vocal technique as the researcher is part of the hypermobile singing population.

Is a hypermobile-focused vocal exercise regime necessary?

Hypermobility is estimated to affect up to 57% of the world population (Blajwajs et al., 2023) of which 10% show accompanying physical and/or psychological symptoms. The literature on vocal hypermobility and injury risk is lacking however studies in sport give insights. The literature shows conflicting results on the connection between hypermobility and injury risk, with some indicating a higher risk (Konopinski et al, 2016; Pacey, et al. 2015; Weber, 2015; Nicholas, 1970; Collinge and Simmonds, 2009), some suggesting hypermobility as advantageous in injury prevention (McCormack, Briggs, Hakim et al, 2004; 16) and some finding no relationship whatsoever (Jamshidi et al 2017; Stewart, 2004). Despite these conflicting results, all of these papers have one thing in common: there is a resounding agreement that awareness of hypermobility allows for preventative measures to be put in place. As there has been so little literature on hypermobility in the world of vocal pedagogy these comparisons cannot be made. However, there have been a handful of clinical case reports showing a direct link between hypermobility and vocal injury (Chatzoudis, et al. 2015; Arulanandam et al., 2016; Lam, Good and Birchall, 2022; Safi, 2017). A survey conducted on 276 professionally trained adult singers, diagnosed with Hypermobile Spectrum Disorder or Hypermobile Ehlers-Danlos Syndrome demonstrated that a substantial portion, 74.6%, had encountered voice difficulties as reported by the participants (Jeffery, Postavaru, Matei, Meizel, 2021).

These findings combined with past studies by the researchers found that there are essential elements that must be considered when working with a hypermobile singer;

- The need for a physical assessment to determine any postural maladaptations. (Clarke, Holmes, Feeley, et al., 2013; Rubin et. al, 2006; Arboleda and Frederick, 2008; Schneider et.al, 1997).
- Poor proprioception, altering a hypermobile person's ability to determine where they are in space. (Atwel et al., 2021; Titze, 1982; Rubin et al., 2006)
- Weakness in connective tissue affects the range of active and passive movement. (Atwel et al., 2021; Jeffery, 2020)
- The need for understanding and awareness of the condition. (Jeffery 2020; Blajwajs, 2023)
- Using rehabilitative exercises and/or microphones in studio settings to counteract vocal fatigue. (Jeffery, 2021)

I intend for this project to give singing teachers a clearer understanding of hypermobility and give them a pedagogical framework for teaching hypermobile singers.

Project aims

- To build on the researchers previous studies to extend their knowledge of active and passive range of movement, proprioception, postural alignment, laryngeal anatomy and rehabilitative vocal exercises.
- To undertake a rigorous literature review that will inform and justify the experiment design evidence-based research.
- To create a non-bias informative questionnaire for participant selection.
- To research, synthesise and analyse a range of exercises to test in a studio setting for the purpose of strengthening hypermobile affected connective tissue.
- To create a 4-6 week exercise programme for study participants informed by the researchers previous studies, this studies literature review, experiential knowledge and knowledge from the vocal pedagogy community.
- To increase knowledge and skills of analysing vocal acoustics using Voce Vista.
- To effectively analyse qualitative data from interviews with study participants.
- To design an effective evidence-based teaching framework for use with the hypermobile singer.

Research Methodology

The investigation is being undertaken within a pragmatic framework so it is not limited to qualitative or quantitative assumptions (Creswell 2014). The versatility of using the mixed methods best orientates 'itself towards solving practical problems in the real world' (Feilzer 2010 p.8). The researcher believes that the pragmatic approach may captivate the individual experiences (Cohen, 2000) of the hypermobile performer which can be wide and variable in both symptoms and severity (Kumar, 2017).

Methods

The researcher has conducted extensive literature reviews in previous independent studies titled, *A study into interventions for post-pubescent singers who present with hypermobility* and *An in-depth study into whether hypermobility poses a risk to the structures used for phonation in the post-pubescent human body*. Providing a strong theoretical knowledge of

the cause and effect of hypermobility on the human body and the potential risks to phonation. The literature review within this study will reinforce and extend that knowledge but also help to design the protocols of the coaching sessions through literature on muscle strengthening and vocal health.

A screening questionnaire will be made available to the entire student population of The Brighton Academy, an institute of higher education for Musical Theatre training. With ethical standards in mind, participation in this questionnaire will be on a voluntary basis and participants have the right to cease the questionnaire at any time without judgement, which will be made clear on the landing page. The questionnaire will allow for evaluation of Joint laxity in participants through the Beighton Score, a highly reliable tool (Jindal 2016) that can be administered by individuals with no specific training (Morlino and Castori, 2023). As there is no test to ascertain hypermobility in the voice (Jeffery, 2021) the questionnaire will explore participants' perceptions of their vocal health and durability. This will use a 7-point Likert scale to optimise inter-reliability (Symonds, 1924) and maximise reliability (McKelvie, 1978), whilst collecting qualitative data that may give further insights. The questionnaire will also contain *the 7 questions for consideration of hypermobility in the voice studio* devised in the researchers previous studies, adapted from the works of Grahame (2013), Tinkle (2020), Brockett and Chapman (2016), Ferrell (2004), Bates et al. (2021) and Wolf et al (2011).

The questionnaire will screen participants for the following selection criteria;

- Participants must be 16 years of age or older.
- Participants must present with a Beighton Score of 4 or more (Carroll, 2023; Morlino and Castori et al, 2017; Atwell et al, 2021)
- Participants must have a score of 3 or more on the initial consultation questions.
- Participants must be available to attend all coaching sessions and commit to 2 hours practise a week.

On completion, all participants will be provided with a PDF of resources, including immediate access to pastoral care and more specific medical bodies including hypermobility support charities and the British Association for Performing Arts Medicine. A purposive sample of 5 to 10 participants meeting this criteria will be invited to further participate in the coaching sessions.

Practical coaching sessions will be undertaken on campus at The Brighton Academy (See appendix 1 for institution permission). This will benefit students as it is a familiar setting to

them and it is the researchers intention to create an environment for the participants to feel as comfortable and at ease as possible.

Each participant will be given up to 3 hours of one to one tuition across a 6 week period. These sessions will consist of the delivery of 5 vocal exercises for vocal health, stamina and durability and 8 physical exercises to improve alignment and proprioception. Having the ability to physically examine the voice is outside the scope of this research so I will use Voce Vista to acoustically analyse each session to gain possible insights of the behaviour of the hypermobile singers voice through quantitative data analysis. Each session will begin with a short semi-structured interview, with the purpose of collecting participants' perspectives.

Ethics

Jefferys (2021) participants reported experiencing physical and emotional pain as a result of their hypermobility. As an insider the researcher has preceding knowledge of the colleges support system, and will utilise this by working directly with the college's pastoral team to ensure participants will have immediate access to pastoral sessions. All participants will be signposted before, during and after the study to specific hypermobile helplines and performance medical professionals and given the right to leave the study at any time without judgement. Participants' identity will be coded for anonymity within the study report.

Insider Researcher

The researcher will attempt to minimise the possible negative impacts of being an insider researcher such as pre-existing prejudices, knowledge of students capabilities and external interests by using semi-structured interviews to minimise external irrelevant subjects within the research setting. As a sufferer of hypermobility the researcher has the advantages of shared experiences with the participants but must take care to not project on participants by using semi-structured interview questions. identities will be redacted from the researcher's view when randomly selecting participants from the purposive sample.

As with all studies, there is a risk of participant drop out, the researcher aims to minimise this by providing an informative landing page on the initial screening questionnaire, so participants are able to make a fully informed decision on whether to participate. Musical theatre training is intense both physically and vocally and injury can occur in the three years of training, in a study by Stephens, Nevill and Wyon (2021) it was reported that 58% of male students and 62% of female students reported an injury in their 3 years of training. The

researcher has included a two week 'buffer' period in the event that a participant is unable to attend a session due to injury or sickness.

Below is a proposed timeline for this project.

	July			August			Septemeber			October			November			December			January			Feb	
Ethics form																							
Devise research question																							
Write research proposal																							
WRite Literature Review																							
Devise partitcipant questionnaire																							
Analyse questionnaire responses																							
Select study participants																							
Devise exercise programme																							
Devises semi-structured interviews																							
Deliver interviews																							
Analyse interview responses																							
Delivery of exercise programme																							
Devise exit interview																							
Deliver exit interview																							
Analyse exit interviw data																							
Write Report																							
Submit Draft																							
Rewrite 1																							
Rewrte 2																							
Assignment Submission																							
Create Presentation slides																							
Submit Presentation Slides																							
Write Presentaion Script																							
Presentation																							

Personal Learning Outcomes

- To better understand the biomechanics of muscle strengthening.
- To design and implement an evidence-based exercise program for use with hypermobile singers.
- To work towards publication of my research.
- To help raise awareness of hypermobility in the singing community.

Project Report

Introduction

Background and justification

The focus of this study arose from researcher experience working with a single level 6 Musical Theatre student who did not present as their usual highly professional and technically proficient self during one session. An open dialogue with this student revealed they were suffering pain from a previous vertebral fracture injury. This revealed that my initial consultations with singers had negated enquiry of physical injury or difficulties. From that moment on I altered my approach and made this a primary question in my initial consultations over time. This revealed just how many of my students suffered with hypermobility to many varying degrees. The current research study is therefore designed to heighten my knowledge of the condition and change my theories into evidence-informed action.

My research began in 2022 with a simple observation within a cohort of Musical Theatre undergraduates. The researcher observed that there high number of students presented as hypermobile (Warden, 2022) and this population of singers seemed to present with similar voice issues and technique struggles namely, the lack of awareness of alignment, breaks and cracks whilst moving from one register to another, the voice was quick to fatigue and temporal mandibular joint discomfort. These observations led me down an unexpected but rich path of three years of study culminating in this research.

My module 4 independent study titled 'A study into interventions for post-pubescent singers who present with joint hypermobility.' (Warden, 2022) began my inquiry into the hypermobile singer and very quickly highlighted that hypermobility was a vast and complex condition **(reference)**, affecting each person in very individual ways and looking at the condition as a whole was well outside the limits of the research I was undertaking. The focus of the research then turned to the physical, visible elements of hypermobility and was collated into

a resource to guide singing teachers through hypermobility assessments (see appendix C) and postural assessments (see appendix D) and gave physical strategies (see appendix E) to incorporate into their own pedagogy.

I then furthered my research through my module 5 work (Warden, 2024) based learning project intending to explore the genetic makeup of hypermobility to hypothesise if it could pose a risk to the biomechanical structures used for phonation. Research shows that the exact biomarker of Hypermobility Spectrum Disorder (HSD) is unclear (Pliego-Arreaga et al., 2024; Carol, 2023) and so lacks the markers detectable by laboratory tests, unlike Ehlers-Danlos Syndrome and Marfan Syndrome, of which joint hypermobility is a primary symptom (Malfait, 2006, Carroll, 2023). HSD was the new nomenclature introduced in 2017 to describe patients who present with joint hypermobility yet do not possess the biomarkers of a proven condition (Lowth and Tidy, 2019; Carroll, 2023; Atwell et al., 2021). Chiarelli's (2016) research found that joint hypermobility is caused by a defect in the production of collagen within the extracellular matrix, causing disorganisation in the structure of the collagen, a fundamental part of the foundation of connective tissue, which can lead to ineffective muscle function (Khalilgharibi and Mao, 2021). Therefore, it is a perfectly valid theory that hypermobility could directly affect the musculature used for phonation.

Research shows that it is estimated that up to 57% of the population have some degree of joint hypermobility (Eccles, 2019; Blajwajs et al., 2023), and 10% experience further physical or physiological symptoms due to their hypermobility (Timmons et al., 2023). There is a sizable gender difference in the hypermobile population, with women being more greatly impacted than men (Jeffery, 2021; Janssin et al., 2004; Tinkle, 2020; Clinch et al., 2011) and performing artists (Bridges, Smith & Reid 1992; Nicholson & Chan 2018; Clinch et al., 2011; Juul-Kristensen et al., 2017; NHS, 2020). Although it is clear hypermobility is prevalent within the population and within performing artists, very little research has been undertaken on hypermobility and the voice. Jeffery (2022) explored the experiences of singers diagnosed with Hypermobility Spectrum Disorder and hypermobility type Ehlers-Danlos Syndrome and found that 74.6% of this population experienced voice difficulties. An extensive search has found no research on strategies or approaches, to date, for voice pedagogists working with hypermobile singers.

Intended Impact

Pliego-Arreaga et al. (2024) highlighted the importance of a professional understanding of the vast spectrum of symptoms to understand how HSD can impact individuals within their

workplace. A lack of this can be debilitating to singers seeking answers (Wolf, Cameron & Owens, 2011). This study aims to build on the researcher's previous studies to create and pilot a hypermobile-focused voice pedagogy to create a training programme available to the vocal community to heighten awareness and knowledge within the profession. I believe there is a need for awareness and knowledge of hypermobility in voice pedagogy and, more importantly, training courses tailored to the hypermobile singer, which is echoed in the literature (Jeffery, 2023).

Personal learning outcomes

The researcher wishes to further enhance their understanding of hypermobility through the lens of the musical theatre undergraduate to understand its physiological and vocal implications on this population. They will also have heightened their skills of identifying specific voice-related issues that singers with hypermobility may experience whilst remaining reflective throughout the research process, considering how the findings may alter their perspective and approach to their pedagogy. The researcher will explore the effectiveness of intervention strategies for managing the vocal challenges that singers present through a holistic approach of physical and vocal exercises. The researcher wishes to improve their critical evaluation skills to discern valid information from the existing literature and create testable strategies for this research.

Aims of Research Activity

The researcher aims to assess the challenges faced by musical theatre undergraduates with hypermobility arising from initial enquiry and investigate how hypermobility may affect physiological elements of singing, including the musculoskeletal system and laryngeal function. The researcher will create, propose, and trial vocal training techniques targeting the unique needs of the hypermobile singer. The researcher will analyse whether participants have pre-existing coping strategies for the management of their vocal difficulties. The researcher aims to collaborate with other professionals to strengthen the interdisciplinary approaches developed within the research.

Objectives of Research Activity

This research aims to collate first-hand perspectives on specific vocal challenges faced by the hypermobile singer through surveys and interviews. The researcher will gain the knowledge needed to develop an evidence-informed resource to aid hypermobile singers and educators that addresses best practices when training singers through a hypermobile lens. The goal is to help foster a supportive community by raising awareness of the needs of hypermobile singers and the importance of tailored hypermobile pedagogical approaches amongst vocal coaches and music educators.

Literature Review

Hypermobility is an emerging field of research in vocal pedagogy with minimal existing literature (Jeffery, 2021). The absence of published literature on the use and exploration of tailored exercises for the hypermobile voice necessitates the exploration of literature from multiple disciplines. This approach is essential and addresses the hypermobile voice confidently and knowledgeably. To proceed without this interdisciplinary knowledge would be unethical and would only perpetuate the 'misunderstanding and mistreatment' of hypermobility in many clinical settings (Grahame, 2013). The researcher recognised the need for a comprehensive analysis of literature from multiple disciplines (Warden, 2022; 2024), such as Rheumatology, Rehabilitation Sciences, Physiotherapy, Vocal Pedagogy, Genetics and Otolaryngology, given the multifaceted nature of hypermobility.

Due to the limited amount of pre-existing research and diverse characteristics of hypermobility, a systematic literature review may not adequately cover the multitude of themes and disciplines that this research requires, therefore, this literature review aims to determine an evidence-based foundation for integrative strategies for coaching hypermobile singers. To do so, The researcher will undertake a thematic literature review using hypermobile-specific trends from previous literature reviews (Warden, 2022; 2024). These include hypermobility, musculoskeletal function, reduced proprioception, temporomandibular joint issues, dysphonia, and vocal fatigue. This is intended to heighten the validity of the information used as a foundation to build an evidence-informed exercise strategy, which is crucial to ensure the best practice of evidence-informed teaching (Boyer, 1990).

Selection Criteria

A literature review was undertaken with the following criteria to develop a strategy for a hypermobile-focused pedagogy. Each theme was searched with “AND” and “OR” voice search strings through the Journal of Voice and PubMed databases for peer-reviewed articles, clinical studies, systematic reviews, meta-analyses and published chapters. One or more diagnoses of hypermobility type EDS, Hypermobility Spectrum Disorder and Generalised joint hypermobility must exist within the research sample. Temporal relevance will be deemed by using papers within the last 10 years, focusing on papers post-2017, due to a change in the diagnostic criteria for hypermobility in 2017. All ethnicities and genders will be included. Populations must be 18 years of age or older, as this is the age at which the musculoskeletal system becomes fully developed. Although the framework will be piloted on a university-aged population, Due to the minimal literature on hypermobility in the singing voice, the researcher does not wish to limit the literature to a university-aged population and risk excluding vital insights.

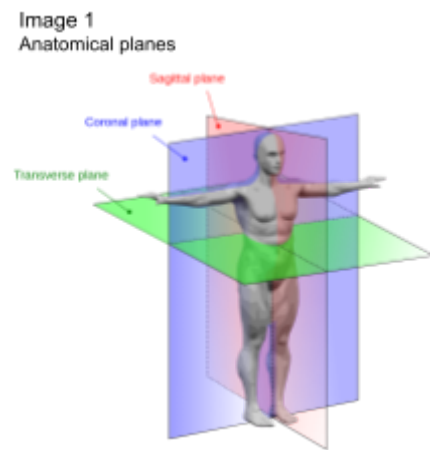
Emergent Literature Trends

Musculoskeletal function

Joint hypermobility is defined as a joint that can extend beyond the normal plane to have an increased range of motion (ROM)(Blajwajs et al., 2023). When this occurs in multiple joints and the axial skeleton, it is described as generalised joint hypermobility (GJH)(Tinkle, 2020). Hypermobility can be trained and is commonly seen in musical theatre (MT) performers, as many dance techniques require increased ROM. However, this study concerns heritable hypermobility acquired from a heritable disorder of connective tissue (HDCT).

The equilibrium of the musculoskeletal system (MS) can be easily disturbed, causing pain and an increased risk of injury (Cech & Martin, 2011; Safran et al., 1989). Those experiencing GJH due to an HDCT know this all too well. Mutations in the collagen found in the structural components of muscles can lead to laxity in connective tissues (Grahame, 2013), which may result in unstable joints and modifications to the musculoskeletal framework, including anterior or posterior pelvic tilt, hyperextension of the knees, anterior head thrust, and anterior shoulder rounding.

Maintaining correct posture minimises injury and reduces unnecessary stress on the body; this ideal state of posture was coined the 'equipoise' by Rolf (1989). Equipoise occurs when the ankles, knees, hips, thoracic spine, shoulders, and head are aligned vertically along the coronal plane (Rubin, Blake, & Mathieson, 2005). This functional posture should be absent of pain and muscular tension and create a harmonious balance between the three spatial planes (figure 1) (Carini, 2017). It has long been reported within vocal pedagogy that proper posture is imperative to allow for freedom of the vocal mechanism and good resonance production (Behrman, 2005; Chapman, 2006; Wilson Arboleda, Frederick, 2008; Rubin, Mathieson & Blake, 2004; Peckham, 2000). The impact of hypermobility on these key postural junctions has been extensively documented in the literature, as has the effect of posture on the voice. However, the connection between hypermobile posture and voice production has yet to be explored.



Research indicates that excessive flexibility in the ankles and knees is common among individuals diagnosed with symptomatic joint hypermobility, with prevalence rates reaching as high as 93% (Kamanli et al., 2004) and 78% (Ramesh, 2005) respectively in the hypermobile population. In sports literature, significant relationships have been established between joint hypermobility and ankle instability, directly linked to increased injury risk (Decoster, 1997, 1999; Söderman, 2001; Foss, 2009). Injuries of the lower limbs were found to be the most prevalent in musical theatre training (Stephens, 2021). Although this study does not remark on GJH, statistically speaking, the cohorts would contain hypermobile individuals (Tinkle, 2020; Castori M. et al., 2010; Eccles, 2019; Bridges, Smith & Reid, 1992; Nicholson & Chan, 2018; Clinch et al., 2011; Juul-Kristensen et al., 2017). Lower limb instability may explain the increased reports of hip pain within the hypermobile community (Santore et al., 2020). However, De Coster mused that an extended range of motion in the hip joint can lead to microtrauma and inflammation (2005). This extensive hip mobility is often observed in professional ballet dancers (Phan, 2020), a mandatory training area for many MT undergraduates.

Musculoskeletal patterns have been observed not only in the lower limbs but also in the upper body. A significant relationship has been identified between joint hypermobility, shoulder instability, and injury (Johannessen et al., 2016; Rombaut, Malfait, Cools, & Calders, 2010; Chahal et al., 2010). A study by Cameron et al. (2010) discovered that

individuals with generalised joint hypermobility are nearly 2.5 times more likely to experience shoulder instability than those without the condition. The neck and shoulders are interconnected through various muscular structures, including the sternocleidomastoid, levator scapulae, trapezius, and splenius (Rubin et al., 2005). A forward head position can significantly disrupt the body's alignment. Both Chapman (2006) and Heman-Ackha (2005) have noted that such misalignment can alter the shape of the pharynx, directly affecting vocal resonance. Moreover, this misalignment causes an imbalance in the upper spine, shifting the role of neck muscles from mobilisers to stabilisers (Rubin, Blake, & Mathieson, 2004). This change can also lead to ineffective breathing patterns (Wolf, Cameron, & Owens, 2011; Hall, 2006).

Alterations away from the Equipoise in a student's alignment are the most visible symptom of joint hypermobility and are observed frequently within the researchers' teaching studio. Common maladaptations (Wolf, 2011; Finsterbush & Pogrund, 1982) observed in situ include hyperextension of the knees and anterior thrust of the head. Singing requires the whole body and demands the body to be in an 'ideal' alignment (Lagier, 2010). The literature shows that hypermobility can alter alignment in multiple places and must be carefully considered by the singing teacher, so alignment considerations must be included within a hypermobile-focused pedagogy. The researcher hopes that spreading knowledge and awareness of hypermobility and its impact on the performer within the student and teaching body of professional musical theatre training may help reduce injuries recently reported at 1.46 per 1000 hours of training in pre-profession MT dancers (Stephens, 2021) if this number is presumed in healthy non-hypermobile body the literature shows that rate of injury could be far higher in a hypermobile trainee.

Reduced Proprioception

Proprioception refers to the body's ability to sense where it is in its surroundings and how each body part relates to the other in space (Blumer, Carrero-Rojas, de la Cruz, Streicher, and Pastor, 2024) and plays a vital role in alignment and movement management (Nooij & Zampieri, 2023). Research shows that joint proprioceptive impairment is present in numerous musculoskeletal ailments, all of which share symptomatic joint hypermobility (Smith et al., 2013; Atwell et al., 2021; Castori et al., 2017). This lack of proprioceptive feedback can put a person at risk of injury as the body cannot sense the extended range of movement in the joints beyond the 'norm' (Bates, 2015; Johansson, 2000; Stillman, 2002) which can cause micro and macro traumas increasing the vulnerability of the joint (De Coster et al., 2005). This is highly problematic to the hypermobile MT undergraduate, as the

multidisciplinary athletic nature of the training is highly demanding on the body. Students receive at least 35 hours of contact time weekly in the researcher's workplace, which, according to Rueter (2021), places them at a higher risk of injury than the general hypermobile undergraduate population.

The hypermobile person can also experience overly tightened muscles (Gensermer, 2021) from prolonged muscle contraction used to counter laxity in the joints (Ghibellini, 2015), leading to the proprioceptive deficit. This reduces the ability to identify the sensation of these holding patterns, causing the potential for reduced vocal freedom and resonance (Jeffery, 2021; Rubin, Blake and Mathieson, 2004;2005) and increasing muscular pain and fatigue (Castori, 2012). A framework for working with hypermobile singers should include proprioceptive exercises for the musculoskeletal system, echoing the rehabilitative approach suggested by Scheper (2016). The researcher will follow Simmonds and Keers's (2007) recommendation and begin to develop the design of the proposed framework with exercises to increase body awareness and proprioception to allow the best foundation for muscle strengthening.

Temporomandibular Joint (TMJ)

The temporomandibular joint is located in front of the ears and is the point at which the jaw (mandible) is hinged. The articulation features a ball-shaped head located on the mandible that rotates and glides along the lateral aspect of the skull (Dimon, 2018). The jaw's primary function is to provide mastication; the muscles that close the jaw can deliver 70 lbs per square inch of force (Jahn, 2022). However, these muscles are the antagonistic partners to the much weaker muscles that open the jaw. Singers must master the interplay of push and pull between these muscles to allow for proper articulation and resonate tone without tension (Ghibellini et al., 2015).

Research and observation have shown that there are less discernible musculoskeletal changes present in hypermobility, such as hypermobility in the Temporomandibular joint, which has been shown to negatively impact both speech and singing (Jeffery, 2021). In recent years, ear, nose and throat specialists have seen a rise in patients with hEDS and HSD in laryngology clinics in the UK. The most common comorbid symptom in this patient increase was temporomandibular joint dysfunction (TMJD) (Williams, 2023), including abnormal temporomandibular function (Mitakides & Tinkle, 2017; Van Camp et al., 2020), pain or restricted movement (Willich, Böhner, Köppe et al. 2023), subluxations (Di Giacomo,

Celli, Lerardo et al. 2018) and dislocations (Castori, Tinkle, Levy et al 2017; Oelerich, Daume, Yekkalam, Hanisch and Menne 2024).

Pasinato et al. (2011) established that generalised joint hypermobility (GJH) is a significant risk factor for the onset of temporomandibular disorders (TMDs) when looking at individuals diagnosed with TMD, a notable 64.71% were also found to exhibit GJH, which encompassed temporomandibular joint hypermobility (TMJH). For the past thirty years, research has explored the links between TMDs and singing; however, the literature does not definitively clarify whether singing contributes to the onset of TMDs (Wollenburg & Wolowski, 2024). Despite this, there is clear evidence that the hypermobile person has a high prevalence of experiencing TMJDs (Kavuncu et al., 2006; Ogren et al., 2021; De Coster Van Den Berghe and Martens, 2005), and it is essential to acknowledge that proficient vocalisation is significantly dependent on optimal mandibular performance (Ghibellini et al., 2015; Miller, 1996). Therefore, it would be beneficial to integrate TMJ exercises into a strategy that emphasises hypermobility-focused training.

Dysphonia

While reviewing the broader literature on voice and hypermobility, one common presenting symptom arose; each case showed at least one participant with hypermobility presenting with dysphonia (Jeffery, 2021). Although the literature is limited, there is an increase in reports of laryngeal manifestations of hypermobility in the last 10 years, yet only consisting of case reports and 2 case studies (Chatzoudis et al., 2015; Arulanandam et al., 2016; Birchall Lam and Good 2021, 2022; and Safi 2017; Williams et al., 2023; Menton., 2024; Sharma et al., 2024; Yan et al., 2022). Each study reported abnormalities in the participant's voice, and some of the findings of these combined studies include incoordination and reduced mobility of the vocal folds, hypotonia of the vocal folds, hypermobility of the vocal folds and hypermobility of the Arytenoids. Each conducted retrospective reviews of case studies of patients with hypermobility type Ehlers-Danlos syndrome (hEDS) and/or Hypermobility Spectrum Disorder (HSD). Treatments ranged from voice therapy (Arunlanandam, 2016; Safi, 2017; Yan et al., 2022) to surgery for hyoid bone hypermobility. Birchall, Lam and Good (2021) found that 91 patients in twelve studies showed laryngological presentations of hypermobility. Arudanandam (2016) concluded that laryngological symptoms are not strong enough to diagnose a patient with a heritable connective tissue disorder due to their multifactorial nature. However, they are certainly prevalent in patients with hypermobility.

The most recent study arising from the inclusion criteria was that of Williams et al. (2023), who used the Voice Handicap Index (VHI) (Jacobson et al., 1997) to collate the self-reported symptoms of dysphonia within a cross-sectional survey study within EDS and HSD. Williams found that the hypermobile sample had a mean score of 31.99 on the Voice Handicap Index, showing mild to moderate dysphonia. However, the cohort had a wide distribution of scores, ranging from mild to severe dysphonia. This is reflected in the study by Lam et al. (2022) and is higher than reported in the general population (Menton et al., 2024). Although dysphonia is highly reported in the literature, the researcher has not commonly observed this theme within the cohorts of musical theatre undergraduates. This could be due to the lower age range of the students, with 100% of the cohorts ranging from 16 to 25 years of age, compared to 8.5% in Jeffery (2021) and 0% in Birchall et al. (2021).

Vocal Fatigue

Jeffery's (2021) study found that participants commonly reported vocal fatigue. Some experienced this with little use, which, in one case, was so persistent that it stopped the participant's career progression. This finding is reflected in the study of EDS and HSD patients by Arulanandams (2016) and Birchall, Lam, and Woods (2017). Connective Tissue Disorders can cause chronic fatigue (Castori, Tinkle, Levy, Grahame, Malfait, Hakim, 2017; Castori 2012, 2010; Ghibellini, 2015; Hakim, 2017) and tiredness (Keer, 2003) of the body and are more common in the hypermobile population than the general population (Gazit, 2003). HSD sufferers reported that their fatigue had affected their vocal technique (Jeffery, 2021). In some cases, participants have reported that vocal fatigue leads to hoarseness (Jeffery, 2021; Arulanandam, 2016), another common symptom in connective tissue disorders (Lacovou, 2014). Menton (2023) found that of 289 participants, 22.3% reported hoarseness for at least two days a month. Although Sharma (2023) had a much smaller sample of nine participants, eight reported hoarseness, of which 6 were singers. This could indicate that singing increases the risk of hoarseness for hypermobile people.

In a comprehensive review of Hypermobility Spectrum disorder by Carroll (2023), fatigue was found to be an extra-articular manifestation associated with HSD and hypothesised that this could result from muscle weakness. There is conflicting evidence regarding muscle strength and hypermobility. Some have found an association between generalised joint hypermobility and reduced muscle strength (Scheper, 2014; Sahin, 2008); however, some have found that there is no significant difference between muscle strength of hypermobile and non-hypermobile people (Jindal et al., 2016; Jensen, 2013). However, of all these studies, Scheper had a significantly larger sample size than the others, and all other studies were

limited to explorations of the knee only. An assumption of muscle weakness in hypermobile people can be taken from Scheper's (2014) more generalised study with higher sample validity. Grahame (2013) states that HSD comprises three phases that support Carroll's (2023) hypothesis within this framework. Firstly, laxity in the connective tissue causes muscle weakness, which (phase 2) causes the muscle to fatigue quickly. Castori (2017) has found that muscle weakness directly influences proprioception, which is highly reduced in hypermobile people (Smith et al., 2013; Simmonds & Keer, 2007). Combined with these research studies, it is unsurprising that every participant in the Arulanandam et al. study (2016) reported feeling they had a 'weak' voice.

Additional themes identified by Jeffery

Jeffery (2021) is the first to explore the hypermobile singer's experience. Three themes that occurred from interviews which are not seen in the literature due to their specificity to a singer's experience are:

- Difficulties in achieving volume
- Difficulties in maintaining modal phonation
- Unpredictable cracks and breaks in phonation.

Hunter (2017), a retired SLP and trustee to Ehlers-Danlos Support UK, highlights factors necessary for efficient voice production often impeded by HCTDs: posture, breathing, articulation, vocal fold closure, and resonance. All of these elements have been explored in the literature review except breathing. However, breathing techniques are impacted by misalignments in the body. Hall (2006) states, ' Proper alignment (free of tension) of the head, neck torso, arms, legs and feet is directly related to breathing technique in the music theatre singer' (). Phonation in singing relies heavily on subglottal pressure, influenced by a sophisticated interplay of passive recoil mechanisms and active muscle contractions (Petterson, 2005). The balance between the passive and active forces may be affected by reduced proprioception, hypermobility or tension. The researcher's inside experience of breathing is encountering pain during respiration due to ribcage hypermobility and the associated tension in the latissimus dorsi muscles. The researcher will explore these themes further within the musical theatre undergraduate sample via questionnaire.

Comorbidities with hypermobility

Anxiety

Individuals exhibiting joint hypermobility are often observed to experience notable psychological distress (Sinibaldi, Ursini and Castori, 2015), of which the most frequently reported was anxiety and anxiety-related disorders (Smith et al., 2014). Murray et al. (2013) found that 73% of hypermobile subjects suffered anxiety in their lived experience (Murray et al., 2013). Musical theatre practitioners are often placed in 'high stake' situations, which can trigger a 'fight or flight' response and are more common among trainees. James and Shipley (2022) found that in a study of thirty-three musical theatre performers, 63.6% showed 'above average performance anxiety' in the revised K-MPAI (Kenny, 2023). Given that hypermobility is prominent in the performing arts (Bridges, Smith & Reid, 1992; Nicholson & Chan, 2018; Clinch et al., 2011; Juul-Kristensen et al., 2017), this is an area the researcher will explore in the proposed framework. Sinibaldi and colleagues (2015) stressed the need for psychological considerations in managing joint hypermobility.

Research Methodology

Ontology and Methodology

This study adopts a constructivist perspective, facilitating an investigation into individuals' unique experiences and subjective interpretations (Taber, 2011). This approach highlights that each singer's experience of hypermobility and voice is unique as 'truth lies in the human experience' (Wagner, 2012, p10). This framework encourages a richer insight into the intertwined subjective experiences of hypermobility and voice by engaging participants through qualitative methods such as interviews and observation (Shannon-Baker, 2023). By adopting a constructivist methodology, participants will have the opportunity to articulate their challenges and achievements, contributing to their overall artistic, physical, and educational progress through reflective practice. Importantly, their insights will inform pedagogical change and health management within the discipline.

Participants

A voluntary survey was distributed to the Musical Theatre undergraduates of The Brighton Academy, having been granted institutional approval (see appendix A). The survey remained available for two weeks (starting from the 17th of September 2024) and garnered thirty-seven responses. Three responses were not included in the participant selection process: one due to lack of consent to participate, one due to lack of consent to store data and lastly, one student diagnosed with Marfan's Syndrome, which the researcher felt was beyond their understanding and was an unplanned variable that may impact results. A purposive sample of seven students was then selected using the following criteria;

- Participants must be at least 18 years old, as this is the age at which both genders have a fully developed musculoskeletal system (Haff, 2016; Carroll, 2023).
- Participants must have a minimum Beighton score of 5 out of 9 to indicate generalised joint hypermobility (Brighton, 1969).
- Participants must answer positively to a minimum of 2 questions concerning musculoskeletal manifestations.
- Participants' gender and ethnicity were collected but not limited to the search criteria.

Qualitative research focuses on understanding the complexities of personal experiences, and this criterion aims to select the most suitable participants who will contribute to gathering in-depth data (Marshall, 1996) to heighten the rigour and quality of the research. Accurately predicting a sufficient sample size proved challenging. The researchers intended to include 4-9 participants, mirroring similar studies conducted on hypermobility (Arulanandam et al., 2016; Birchall et al., 2021; Sharma et al., 2024; Yan et al., 2022). After discussion with tutors and advice from pedagog Lin Hilton, seven participants with the highest Beighton and MS manifestation scores were selected from the twenty-three eligible students.

Precautions were taken to minimise dropout from the course, including an extensive questionnaire landing page (See appendix F.) detailing the expected commitment needed to participate and reminded of this upon selection. Six of the seven students chose to participate ($f=6$) with a mean age of 19.6 years of age and had 97% attendance.

Insider-researcher

As a singing technique teacher and lecturer within the performing arts college, the researcher has inside knowledge of the course structure and the physical and emotional demands of the students. The researcher has direct experience teaching musical theatre undergraduates and believes undergoing the research in their workplace will be educative to the participants, student body, faculty and researcher (Reed and Proctor, 1995), allowing for input into individual practice (Costley, 2010). The researcher hopes to disseminate these findings through organisations such as the British Association of Singing Teachers. A benefit of being an insider researcher within an educational institution is a pre-established rapport and trustworthiness (Costley, 2010) between teacher and student, allowing for an easy flow of conversation during interviews. However, this pre-established relationship may cause conversation to drift from the topic. The researcher will use predetermined questions to minimise this risk. Transparency to participants about the researcher's hypermobility helped to mitigate insider bias and noticeably put participants at ease talking about their hypermobile experiences. Being a hypermobile singer and teacher, the researcher had first-hand experience with some of the issues the participants described, which were occasionally emotionally labour-intensive. The researcher used reflexivity to revisit the literature and understand these experiences of hypermobility and treatments available to work through this. Triangulation of semi-structured interviews, observation, and literature reviews were used to minimise the risk of insider bias and give way to objectivity.

Ethical Considerations

Before completing the Joint Hypermobility and Voice questionnaire, participants were directed to a landing page explaining the research's context and intention. They were then taken to a consent form that detailed the course subject matter, what was expected of them, and, significantly, their right to withdraw from the study at any point without repercussions or judgment, with no impact on their degree or standing within the college (See appendix G.). All students were informed that their study involvement would remain anonymous as their identities were replaced with identifying numbers. Students who were not selected to participate were emailed with thanks for their participation, directed to the Hypermobility Syndrome Association helpline and website. Participants were also reminded that they could email the researcher at any time with questions concerning their hypermobility and would have access to the findings of their questionnaire and final research results should they want them.

Once participants were selected, they were asked to complete a further consent form reiterating the previous statements (see appendix H). Additional measures were implemented to safeguard the participants' identity, including conducting sessions outside of college hours. However, to ensure their comfort, the sessions were held on campus, a familiar setting for the students. At the beginning of each session, participants were reminded that their involvement was voluntary and that they had the right to leave or refrain from answering any question they were uncomfortable with. Every effort was made to ensure that all questions were pertinent to the study. In compliance with the GDPR law, all participants' information was securely stored in a password-protected folder on a drive further safeguarded by biometric measures.

Study Protocol

Questionnaire

Questionnaires were used to collect demographic data, such as age, sex, and ethnicity. The Brighton scoring system was used to test for and measure joint hypermobility (see appendix I) (Melek, Reinhold, Pearce, 2021). An adult is considered to have generalised joint hypermobility if they score five or more. The remainder of the questionnaire was grouped into two themes: musculoskeletal injuries and vocal manifestations. Musculoskeletal injuries are seen commonly amongst the hypermobile population and are used for minor criteria in the Brighton scale (Grahame et al., 2000) and Hakim and Grahame's five-point questionnaire (2003). Vocal manifestations questions used a 7-point Likert scale to determine how much participants agreed or disagreed with their experiences of voice difficulties that arose from the literature. The close-ended nature of the Likert scale allowed for quantitative comparisons when selected participants were given vocal manifestations questions again during the exit interview. To minimise bias in all instances, participants were given the opportunity to 'neither agree nor disagree'.

Semi-structured Interview

Interviews were delivered individually at The Brighton Academy of Performing Arts within each course session. The first interview lasted 30 minutes and comprised the whole first session, allowing participants to expand on their questionnaire responses. Sessions two through seven began with a short semi-structured interview to explore the student's experiences of each exercise throughout the process. An exit interview was conducted after the 8-week course was complete. In all instances, the interviewer used open-ended questions to help guide and avoid influencing the participants. All interviews were

audio-recorded and transcribed verbatim, and any data compromising anonymity was redacted. Inductive coding was used to analyse interview data; this is especially useful in educational settings and practitioner research and 'prioritises the and honours the participant's voice' (Saldaña, 2013, p91). Inductive coding allows codes to emerge within the research and gives rich data to be cross-analysed from one interview to the other.

Weekly sessions

The 8-part course was delivered over nine weeks (beginning the w/c 7/10/24), with a single-week break after week two to align with the students' term dates. This timeframe was aimed to give time for the exercises to start to positively impact the participants habitually, as Ferrell et al. (2004) found an increase in proprioception in participants from an 8-week plan of exercises. The time frame for the course did not allow for the four-month period in which States et al. (2009) found improved postural alignment in participants or Van Meulenbroek et al. (2020) multidisciplinary approach used to enhance the quality of life in 12 to 21-year-old HSD and EDS sufferers. However, participants were given four weeks to self-implement the practice before undertaking an exit interview. The researcher intends to see if the techniques and exercises explored have any impact within this time, insert them into day-to-day practice, and create a framework for hypermobile focused vocal training which could be made available to the vocal pedagogy community through relevant associations.

Course design

Due to the minimal literature on hypermobility and the singing voice, the researcher chose to use an emergent study design; this used a foundation of themes seen within the literature and developed with trends observed among participants. This also allowed the researcher to personally tailor each exercise to the participant's requirements, such as vocal range and vocal stamina.

Professional singing technique requires the whole body (Chapman, 2016), and hypermobility is a multifaceted, complex condition (Celletti & Camerota, 2013). Therefore, it is evident that a multidisciplinary approach would best benefit the hypermobile singer. Van Meulenbroek et al. (2020) garnered success with this approach with participants of the same age group as this research.

Areas identified for attention from the literature review to provide vocal techniques tailored to the hypermobile singer are;

- Proprioception
- Alignment
- Jaw tension
- Vocal Fatigue
- Anxiety

Proprioception and Alignment

Body mapping, a somatic method for body alignment and awareness, was developed by Conable (Conable, 1992) based on the Alexander Technique. It focuses on bringing awareness to the body's alignment to identify any points of imbalance or anatomical misinformation. Body mapping offers a way to retrain the brain using anatomical knowledge, strategies, and techniques to release any possible muscle tension or misalignments (Conable & Conable, 2000). Each person's body map is unique to them, representing their learned patterns and movements within the brain. These maps determine how we move and hold our bodies; we can only move as these maps dictate (Hval, 2009). However, the proprioceptive deficit from hypermobility can further blur or misinterpret these maps in the brain, supporting the need for body mapping. The personalisation of body mapping ensures that each individual's unique body map is understood and catered to, enhancing their body alignment and awareness.

Body mapping involves six points of dynamic balance within the body;

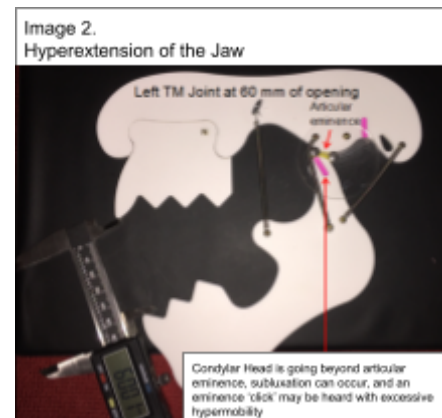
- The Axial-occipital joint
- The Shoulder joint
- The Lumbar spine
- The Hips joints
- The Knees
- The ankles.

After undergoing a three week course on Body Mapping with Dr Jan Prokop (Prokop, 2024), the researcher, equipped with sufficient knowledge, was able to guide participants through the basic forms of Body Mapping. This practical experience is a testament to the ease of deliverability of the method. The researcher took participants through their personal body maps to identify areas of concern and then led them through alignment and proprioceptive exercises for each point of the map. (See appendix J for worksheet and exercises). All

exercises were conducted in front of a mirrored wall to give instant visual feedback, helping to increase proprioceptive feedback (Simmonds & Keer, 2007).

Jaw tension

Once alignment had been addressed participants were moved to focusing on the jaw as it is widely reported that Temporomandibular joint (TMJ) pain and discomfort can be directly linked to poor posture (Minervini et al., 2023; Miçooğulları et al 2024). TMJ is intrinsically linked to the muscular function of the head and neck, poor alignment or tension in these places of the body is often linked to jaw tension. This connection was a prevalent issue among many students, as revealed in their initial questionnaires.



The Jaw's usual range of movement (ROM) is 4- 5 cm, achieved by a hinge and glide movement from the TMJ (Dimon, 2018). The first 25mm of opening is controlled by rotation at the TMJ, and the further 15 to 25mm by gliding the joint out of the socket along the temporal bone. However, excessive movement, such as hypermobile Jaw opening beyond the normal ROM (figure 2), can lead to issues. This includes noises from the Jaw, such as clicks and pops, and the risk of subluxation (Karegeannes, 2015).

Given that the jaw only needs to open about 2.5cm to voice any vowel (Austin, 2007), it's crucial to develop body mapping and awareness of overextension of the jaw. These techniques were employed with each participant to manage jaw tension. Additionally, students at TBA, who already receive instruction on external massage techniques for Massata tightness, were guided through a series of tongue stretches tailored by Waltz Fritz (2022) to alleviate potential jaw tension arising from habitual patterns within the mouth (see exercises 1-4 in jaw of jaw tension worksheet appendix K).

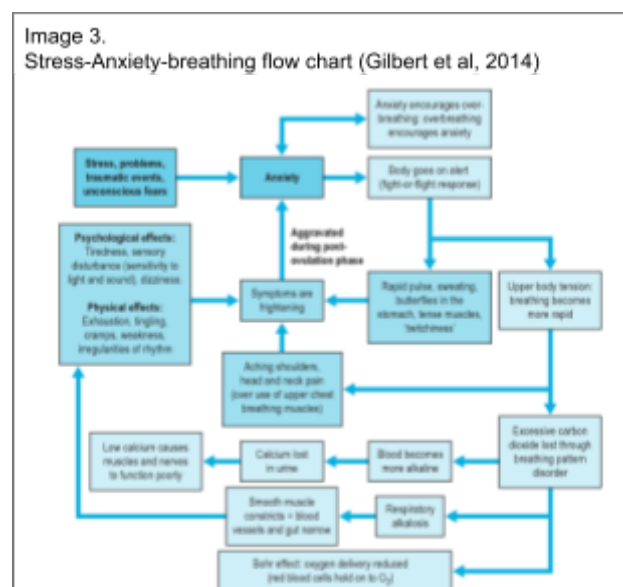
Breath control and Anxiety

Next, participants were given breathing exercises that targeted incorrect breathing patterns, compensatory breathing patterns in the neck, and vagus nerve stimulation for Anxiety. These

exercises are crucial in managing anxiety and empowering participants to take control of their breathing and performance.

It has been found that the sternocleidomastoid (SCM) and scalene muscles can be used as accessory muscles for inhalation, lifting the clavicle by up to 5mm (McGee, 2018). This behaviour is problematic for singers where the SCMs and scalenes' primary function should be posture and functional head movement (Bordoni et al., 2023). People with hypermobility can experience tension and laxity as some muscles must work harder to compensate for laxity in other muscles (Tinkle, 2020). Breathing patterns can restrict the movement of the thoracic region, leading to increased tension in the accessory muscles involved in respiration and adversely affecting the descent of the diaphragm (CliftonSmith & Rowley, 2011). Participants underwent a guided exercise focused on improving their awareness and breathing free of accessory respiratory behaviours from the neck (see exercise 1 for breath in Jaw tension worksheet appendix K)

People with hypermobility have been found to suffer from breathing pattern disorders (Bascom et al., 2021). The researcher most commonly observed high thoracic breathing in their studio. Not only is this inefficient for singing, but it can also cause a stress anxiety response (CliftonSmith & Rowley, 2011). The stress-anxiety-breathing flow chart from Chaitow, Bradley, and Gilbert (2014) was particularly helpful in helping participants understand the effects of breath on performance anxiety levels (see Figure 3). By practicing the breathing exercises, participants can be reassured of their efficiency and their ability to manage performance anxiety.



Students were given an exercise (See exercise 2, breathing in Jaw tension worksheet, appendix K) intended to release tension and muscular guarding from the abdominal wall, lower back and hip joints, offering a sense of relief and promoting a functional breath working the abdomen, diaphragm and pelvic floor synchronically during inhalation and exhalation (Di Bon, 2020). This exercise is also intended to stimulate the vagus nerve, which activates the parasympathetic nervous system, moving the body away from the fight or flight response (Gerritsen & Band, 2018).

Vocal strength and stamina

The Vocal folds comprise 43% collagen (Bühler, 2011); given hypermobility is a symptom occurring from a mutation in collagen affecting the structures in the foundation of muscle, it is not unfeasible that the vocal folds may be hypermobile. Castori et al. (2009) found that 8 of 21 patients presenting with hEDS had hypotonia of the vocal folds. Pliego (2024) states that the primary response to joint hypermobility is to improve muscle strength. The vocal manifestation of hypermobility that arose from the literature and the questionnaires may be improved by targeted strengthening exercises for the antagonistic muscle pair, the thyroarytenoid and cricothyroid muscles.

The first exercise participants were given was a modified arpeggio scale on a closed, relaxed [a] (Hilton, 2024). This scale was used as a baseline over the passaggio to self-measure any changes in the voice across the research for both participants and researchers.

An central exercise for the course is an isotonic exercise in the modal range used for strengthening the Thyroarytenoid (TA) by placing it in a held contraction for an extended time (See extended tone of Appendix L). Isometric exercises are used for strengthening and building muscles and increasing the muscle's ability to resist force (Widodo et al., 2022); this is especially important in the belt technique used in musical theatre due to the increased closed phase of the mucosal wave. These exercises are often used by Speech and language pathologists in vocal therapy and were developed by Stemple (1994) to combine the principles of exercise physiology and voice. The exercise is to be performed on a 'O' (ə) this is the the most effective vowel for vocal efficiency with a low larynx and high velum (Stemple, et al., 1994). The exercise should be performed no lower than a third above the singer's lowest and no higher than an octave above the singer's lowest note to avoid the extremities of the range (Jeffery, 2001). This exercise should encourage low intensity M2

and be performed with high repetition (Roy et al., 2001). Widodo et al. (2022) found that this approach had improved performance and minimise injury in hamstrings. The next area addressed from the literature was the hypermobility of the adductors (Yan et al., 2022; Sharma et al., 2024). Participants undertook an isometric exercise of small descending scales (Sol to Do) using plosives [b],[d] or [g] to encourage adduction of vocal folds. Later, the integration of vowels moved the exercise towards application in melodic phrasing. Lastly, participants were given an exercise for contraction of the Cricothyroid (CT) muscle, as the Thyroarytenoids antagonist pair elongates in the TA, working as a cool-down exercise.

Frequent overuse and overstretching have been seen to exacerbate symptoms in some hypermobile studies (Grahame, 2007; Hakim et al., 2010). The researcher was vigilant about the vocal workload being given to the participants and worked within their comfortable parameters at all times. The researcher actively chose not to work in the extremities of the participant's vocal ranges to avoid 'overstretching' which is cautioned against in hypermobile studies. Overstretching has also been seen to reduce proprioception when conducted in the MS (Behm, 2004; Wilson et al., 2008).

Course feedback

The researcher conducted an exit interview with each participant four weeks after the final session date (see appendix U for exit interview transcriptions). Participants were asked the same questions about their vocal manifestations as before the course, using the same Likert rating scale. A semi-structured interview was then conducted to determine how the participants responded positively and negatively to the course. The researcher is optimistic that this study will provide valuable insights into how the exercises impacted participants, vocal technique and health, their quality of life and training. These insights could potentially lead to the development of a framework for working with hypermobile singers, with a focus on the musical theatre discipline.

Research Findings

Joint Hypermobility and the Voice

A questionnaire concerning joint hypermobility and the voice was sent to the Musical Theatre undergraduates of The Brighton Academy and had thirty-seven responses, of which thirty-five consented to participate and have their data stored. This questionnaire aimed to determine the hypermobile symptoms within the sample and to see if hypermobility negatively and/or positively impacts the singing voice.

Questionnaire Sample Demographics

The Beighton Scoring System has been recognised as the most commonly used form of testing in clinical settings for hypermobility (Castori et al., 2017), which measures five joints within the body for hyperextension. One point is given for hyperextension in each of these joints, the knees, elbows, fifth fingers, thumbs and spine, all of which can be easily self-tested with simple direction (Morlino & Castori, 2023). A score of five or above out of 9 on the Beighton scale shows generalised hypermobility in an adult (Beighton, 1969).

Thirty-four out of thirty-five respondents had at least one hypermobile joint, and the percentage of participants who met the Beighton score criteria was higher than not, at 64.7% (Figure 4). This is unsurprising given that hypermobility is more

Figure 4.
Distribution of Beighton Score in sample

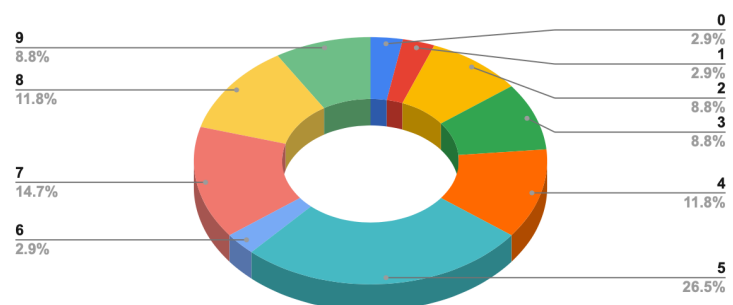
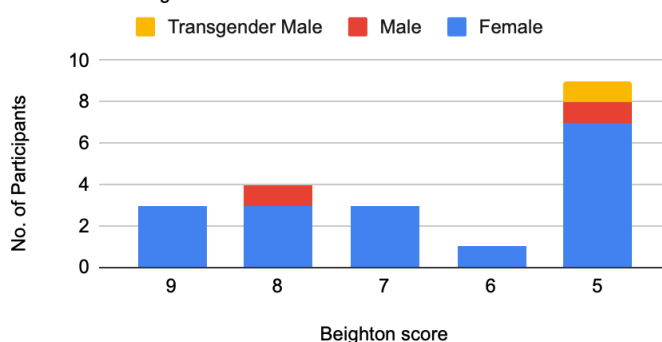


Figure 5.
Distribution of Beighton Scores for GJH and Sex



prominent in females than males (Tinkle, 2020; Jansson et al., 2004; Clinch et al., 2011) and the performing arts (Jeffery et al., 2022). All respondents were performing artists, of whom 74.3% stated their sex as female at birth. Twenty-one

participants met the criteria for inclusion in the course, of which 85.8% were female at birth (Figure 5).

Of the responses, five participants had a formal diagnosis of hypermobility. However, three used the outdated term of Hypermobility Syndrome, showing they were diagnosed before 2017, and two had been diagnosed with Hypermobility Spectrum Disorder (HSD) but did not know which of the four subtypes they had. The researcher believes this reflects Grahame's (2013) opinion that hypermobility is 'misunderstood, overlooked, misdiagnosed and mistreated' (p50) in clinical settings.

Beighton Scores

The axial spine was the point with the highest prevalence in the Beighton scoring system among the responses (figure 6). This is tested by placing both hands flat on the floor from standing; it is positive if this can be performed without bending the legs. Musical theatre is a multidisciplinary art form, and all Brighton Academy receive between twelve to twenty hours of dance training per week; part of this training includes flexibility in the spine. Therefore, the high prevalence of spine flexibility is unsurprising. Hypermobility was least present in the elbow joints in the total sample but occurred in 68% of those with the highest Beighton scores, compared to 15% who tested negative for GHJ. This may be a valuable tool to quickly assess for excessive hypermobility in voice lessons, unlike the spine and little fingers, which did not show a large difference in presentation between positive and negative Beighton scores.

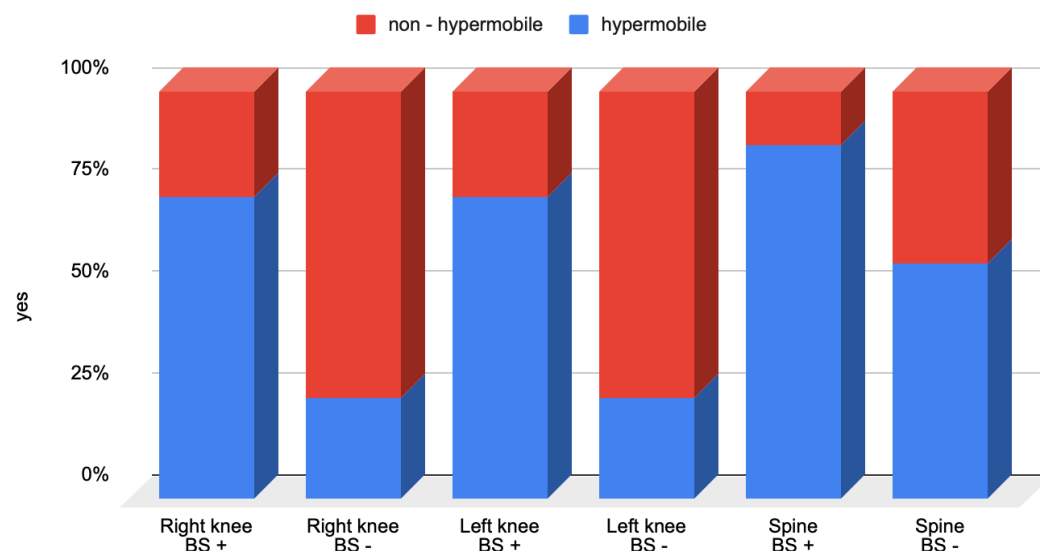
Figure 6.
Distribution of points of hypermobility

points of testing	Participants																																					Total (%)	
Participants no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37		
Sex	F	M	n.a	M	F	F	F	F	F	F	F	M	F	F	F	F	F	F	F	F	F	TM	M	F	M	F	F	F	F	F	F	F	F	F	F	M	F	27F/6M/1TM/1n.a	
Right Little Finger	H	Y	Y	Y	Y	H	Y	N	H	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	H	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N	26/35 (74.3)	
Left Little Finger	Y	Y	Y	Y	Y	H	Y	N	H	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	H	Y	N	N	Y	Y	Y	N	25/35 (71.4)	
Right Thumb	Y	N	Y	Y	Y	H	H	N	H	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	H	Y	N	N	Y	N	N	N	Y	N	N	N	Y	N	N	N	N	16/35 (45.7)
Left Thumb	Y	N	Y	Y	Y	H	Y	N	H	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	H	N	N	N	Y	N	N	N	Y	N	Y	Y	Y	N	H	N	17/35 (48.6)	
Right Elbow	Y	N	N	Y	Y	Y	N	N	Y	N	-	N	N	Y	Y	Y	Y	Y	N	Y	N	Y	H	N	N	-	N	Y	Y	Y	Y	Y	N	Y	N	N	N	N	16/35 (45.7)
Left Elbow	Y	N	N	Y	N	Y	N	N	Y	N	-	N	N	Y	Y	Y	Y	N	N	Y	H	N	N	H	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	N	N	15/35 (42.9)
Right Knee	Y	N	N	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	Y	N	-	Y	Y	-	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	N	20/35 (57.1)	
Left Knee	Y	N	N	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	Y	N	-	Y	Y	-	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N	Y	N	N	N	20/35 (57.1)	
Spine	Y	H	Y	H	Y	Y	Y	Y	N	Y	Y	Y	H	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	H	N	27/35 (77.1)	
Beighton Score (BS)	8	2	5	8	8	5	4	1	2	7	7	5	6	9	9	9	5	3	5	5	3	4	4	4	5	7	5	7	8	5	4	5	7	3	2	0			
positive or negative BS	+	-	+	+	+	+	-	-	-	+	+	+	+	+	+	+	+	+	-	+	+	-	-	-	+	+	+	+	+	+	+	-	+	+	-	-	-		
F, female; M, male; n.a, 'I do not wish to say' ; TM, Transgender male																																							
Y, positive test; N, negative test; -, 'I don't know'; H, 'no, but I could as a child'																																							

Of the nine joints tested in the Beighton Scale, only three affect the alignment of the musculoskeletal system: the right and left knee and the spine. These were proportionately more affected in those with a positive Beighton score than those without (figure 7), highlighting the significant impact of hypermobility on alignment within vocal lessons.

Figure 7

Hypermobility vs non Hypermobility musculoskeletal points in Positive Vs negative Beighton Score (BS)



Injury prevalence in the questionnaire sample

Reuter (2021) surveyed to explore the relationship between joint hypermobility and the risk of musculoskeletal injury in the same age population as this study's sample. Reuter found that injury prevalence in athletically active participants with a Beighton score of 5 or higher is 38.8% higher than in non-athletically active participants with a Beighton score of 5 or more. Similar to this study, Stephens et al. (2021) performed a longitudinal study of three musical theatre undergraduate cohorts and found an injury prevalence of 1.46 injuries per 1000 hours of training. Though injury occurs with or without hypermobility in physically active university-aged populations, the literature suggests that musical theatre training paired with hypermobility increases the risk of injury.

Within this study, only four participants had not experienced any trauma to the knee, ankle, or shoulder (figure 8). These three measurements are important for alignment and are used as criteria in other hypermobility diagnostic tools (Hakim & Grahame, 2013). Participants with a Beighton score of 5-9 reported a mean average of 1.6 out of 3 possible injuries, higher than the 1 out of 3 mean average injuries of 0-4 Beighton score participants.

Figure.8
Injury prevalence of the knee, ankle and shoulder in the sample

points of testing	Participants																																					Total (%)
Participants no.	1	2	3	4	5	6	7	9	10	11	12	13	14	15	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37			
Sex	F	M	n.a	M	F	F	F	F	F	F	F	M	F	F	F	F	F	F	F	TM	M	F	M	F	F	F	F	F	F	F	F	F	F	M	F	27F/6M/1TM/1n.a		
Ankle Trauma	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	N	-	N	Y	N	Y	N	N	N	-	Y	N	Y	21/35 (60%)		
Knee Trauma	Y	N	N	Y	Y	Y	N	N	N	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	25/35 (71%)		
Shoulder Trauma	N	N	N	N	-	N	N	N	-	N	N	N	N	N	N	N	N	N	N	Y	N	N	N	N	N	Y	N	Y	N	N	N	Y	Y	N	N	5/35 (14%)		
Beighton Score (BS)	8	2	5	8	8	5	4	1	2	7	7	5	6	9	9	9	5	3	5	5	3	4	4	4	5	7	5	7	8	5	4	5	7	3	2	0		
positive or negative BS	+	-	+	+	+	+	-	-	-	+	+	+	+	+	+	+	+	-	+	+	-	-	-	+	+	+	+	+	+	+	-	+	+	-	-	-		
F, female; M, male; n.a, 'I do not wish to say' ; TM, Transgender male																																						
Y, positive test; N, negative test; -, 'I don't know'; H, 'no, but I could as a child'																																						

Performance Anxiety and Proprioception

Anxiety has been linked comorbidly to hypermobility, and it has been found that hypermobile people are up to sixteen times more likely than the general population to suffer anxiety or panic disorders (Eccles et al., 2012). Of the 35 participants who responded to the questionnaire, only one stated they do not suffer from performance anxiety; this shows that irrespective of their Beighton score, musical theatre undergraduates experience performance anxiety. This showed the researcher that it was imperative to include some skills for participants to use to combat this due to a hypermobile person's sensitivity to anxiety (Sharma, 2024).

Respondents were asked if 'they would describe themselves as clumsy' to collate the potential for proprioception deficit in the sample. Clumsiness is a manifestation of hypermobility as poor proprioception (Clark & Whitehall, 2011), which warps the brain's ability to sense where it is in space, which often leads to 'bumping into door frames' and 'coffee tables'. Of the participants who scored five or higher, 83% described themselves as clumsy compared to the 58% who scored four or lower.

Vocal manifestations of hypermobility

Participants were presented with seven statements regarding vocal health and function from the literature review, allowing them to express varying degrees of agreement or disagreement. These statements are;

1. I experience ‘breaks and cracks’ in my voice regularly whilst singing.
2. I have a wide vocal range.
3. I have at times lost my voice without the presence of illness

4. I have a distinct breaking in my vocal range.
5. I experience jaw tension.
6. I experience vocal fatigue after prolonged periods of talking
7. I experience vocal fatigue after prolonged periods of singing.

Below is a table concerning the responses from the 21 participants with a positive Beighton score who were 18 years of age or older.

Figure 9.

Reactions to statements regarding vocal function from participants with a positive Beighton score. (≥5)

Vocal function and health statements	Strongly Disagree	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1	0%	5%	24%	24%	29%	10%	10%
2	0%	5%	14%	14%	38%	29%	0%
3	5%	19%	0%	10%	29%	33%	5%
4	5%	5%	10%	14%	29%	19%	19%
5	0%	0%	0%	5%	10%	43%	43%
6	5%	0%	10%	14%	29%	33%	10%
7	0%	0%	0%	5%	24%	43%	29%

Each of the vocal function statements showed varying percentages of responses; however, each statement's highest grossing percentage was a degree of agreement.

The most common response across all statements was 'Agreed' at 30%, whilst 'strongly disagree' was the least common at an average of only 5%. Notably, 95% of participants experienced jaw tension and vocal fatigue after prolonged periods of singing to some degree, and jaw tension had the highest 'strongly agree' response among all statements. Of the twenty one participants only three agreed with every statement, showing there is variation in vocal complaints amongst hypermobile singers. 52% of participants disagreed to some degree or expressed neutrality regarding the occurrence of breaks and cracks in their singing voices. This response represented the highest percentage of this kind across all the statements.

Figure 10.

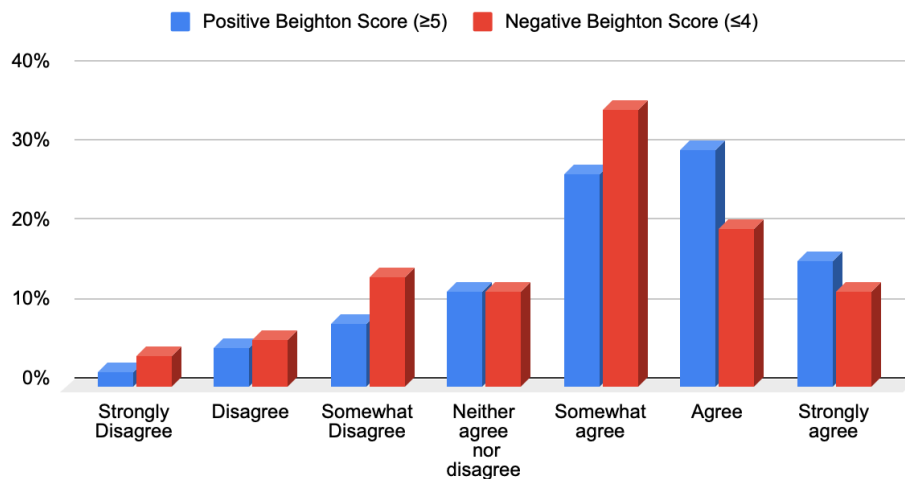
Reactions to statements regarding vocal function from participants with a Negative Beighton score. (≤4)

Vocal function and health statements	Strongly Disagree	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
1	0%	17%	25%	17%	25%	17%	0%
2	0%	0%	8%	25%	42%	17%	8%
3	17%	8%	0%	17%	17%	42%	0%
4	0%	8%	33%	17%	42%	0%	0%
5	0%	0%	8%	0%	42%	8%	42%
6	8%	8%	17%	0%	25%	33%	8%
7	0%	0%	8%	8%	50%	25%	8%

The average score of participants with a negative Beighton Score (four or lower) for each degree of disagreement was higher than that of the positive Beighton scorers, but neutral statement averages were the same between the two samples (see Figure 10.). Only the 'somewhat agree' response had a higher average of 35% in comparison to the 27% of positive BSs, suggesting that those with a lower Beighton score may still feel the effects of

Figure 11.

Average % of opinion responses across vocal manifestations statements of +&- BSs



higher mobility but to a lesser extent. Those who agreed more strongly with the statements were still less than those with a positive Beighton Score (see Figure 11.).

For analytic purposes, the degrees of responses were given numerical values, as seen in Figure 12. The results indicate that participants experienced vocal manifestations of their hypermobility. An average taken across all responses at each Beighton score (BS) showed a slight correlation between BS and perception of vocal manifestations of hypermobility (see Figure 12). The average response of participants with a Beighton score of two or less was 'neither disagree nor agree'. For participants with a BS of three to seven, the average result was 'somewhat agree', and for the highest scoring participants, it was 'agree'. Though this result gives us insights into overall perceptions across the severity of an individual's hypermobility, as detailed by Beighton (1969), it is highly generalised and neglects to acknowledge individual nuances in the sample. The Beighton scoring system has been criticised as too simplistic because it only considers 9 out of the over 300 joints of the body (Malek, Reinhold, Pearce, 2021). When given the opportunity to give further details concerning hypermobility's positive and negative impacts on the body, one participant with a negative BS disclosed hypermobility in both ankles and wrists and another with hypermobility in the shoulders. These findings resulted in the decision to begin the course

with an interview, looking further into each chosen participant's response to give further data a chance to emerge.

Figure 12.

Average degrees of opinion to vocal manifestaion statments

Beighton Score	0	1	2	3	4	5	6	7	8	9
Highest average of individual responses	4	4	5	6	6	6	5	5	7	6
Lowest Average of individual responses	4	4	3	5	5	4	5	5	5	5
Average response across each Beighton Score	4	4	4	5	5	5	5	5	6	6

1 = Strongly Disagree, 2= Disagree, 3= Somewhat Disagree, 4= Neither agree nor Disagree, 5= Somewhat Agree, 6 = Agree, 7= Strongly Agree

Though this is a small sample and further research should be undertaken to give cause for generalizability in the population, these findings do reflect the results of Jefferys (2021).

Hypermobile focused vocal pedagogy.

Six participants underwent the weekly sessions of thirty minutes for eight weeks. All six participants were female, had a mean age of 19.6 years of age and the overall attendance for the course was 97%

Session 1

In the first session each participant underwent an interview concerning their questionnaire results (see appendices M for session 1 interviews.). Each participant had their Beighton score checked by the researcher and it was found that one participant who had reported a Beighton score of eight was in fact a nine as she was unable to test her little finger at the time of response due to a broken bone. Interviews were inductively coded and underwent thematic analysis (Braun & Clarke, 2006).

Qualitative themes

Three themes were identified from the initial interviews. The first was musculoskeletal complaints, 'I wasn't aware that my standing pain wasn't normal' (P5), 'I have a lot of pain and tension; It's so painful' (P11). Participants described experiencing instability, pain and physical trauma of the body and muscular tension (See subcategories in appendices N). The second theme identified was Vocal manifestations of hypermobility, 'I feel I need to take

vocal naps' (P18), 'I'd wake up and I just couldn't talk' (P17), 'I always have a fear that I'm gonna crack when I'm singing. It never feels stable, and I know what I'm trying to sing but it just doesn't come out that way.' (P5). Participants described lack of vocal stamina and their voices easily tiring and not having full vocal control. The final theme was the further implications of Hypermobility, '[I was so nervous] I used to be like literally convulsing' (P17), 'I have no spatial awareness' (P11). Participants had experience of comorbid conditions with hypermobility (Sharma et al., 2023), described proprioceptive deficits and their struggles with the clinical lack of awareness of hypermobility.

Musculoskeletal complaints

Five out of the six participants had suffered from serious injuries such as broken bones or a tear in muscles or ligaments. The most common place to experience trauma was the ankles closely filled by the knees. 50% of participants expressed that their ankles felt unstable and 83% spoke of 'rolling' their ankle on flat surfaces, showing a high prevalence of instability in the ankle. Four participants had experienced dislocation or subluxations to at least one knee, two of which had experienced this more than one to the same knee. Pain as a result of standing for long periods of time was reported by 50% of participants and 67% had regular pain in the knees. The researcher ensured seating was always available for participants should they need it and believes this is a compensation that should be made for all hypermobile students.

Although only one participant had suffered an injury of the shoulder, 50% felt their shoulders were unstable. The researcher observed that 100% of participants whilst relaxed in conversation had an anterior thrust of the head and shoulders. This may be linked to the fact that 100% of participants experience Jaw tension, particularly participant no11 whose jaw did not open evenly. All participants were very aware of their jaw tension and were already performing self massage and manipulations of the Masseter muscle, though it had not relieved their pain. Of all participants, 83% had had physio therapy for various hypermobile related issues to varying degrees of success.

Vocal Manifestations of Hypermobility

The initial interview showed that participants were particularly aware of their hypermobile joints but not aware of hypermobility affecting their voice (P11 see appendix M) despite many similarities across their vocal complaints. However, four out of six felt they had a wide vocal range, showing there may also be positives to hypermobility in the voice. Although there is

no scientific agreement on vocal singing registers (Chapman, 2006), most sources state a range of between 2-3 octaves (Fisher & Kayes, 2016) or 25 to 37 semitones. All participants had a vocal range sitting at the upper end of this bracket except one who had a range of 38 semi-tones. All participants stated they had a distinct break in their range of which four were able to describe the break at a point where their vocal folds move from thick to thin body-cover (Hirano, 1974), showing they struggle with transitioning smoothly across the passagio from Mechanism 1 to Mechanism 2 (Henrich, 2006). Half of the participants described their voice as feeling unstable. *'It never feels stable, and I know what I'm trying to sing, but it just doesn't come out that way'* (P5).

Participants regularly struggle with vocal fatigue and lack of stamina. Vocal fatigue is experienced by 100% of participants after prolonged periods of talking and 67% of participants after prolonged periods of singing, which has resulted in full vocal loss at some time for 50% of participants. *'It's not because I'm using the wrong technique. It's just not there. It just goes. P1'*. Participant 1 found that this happens on a regular basis. P11 and P30 described suffering voice loss due to speaking in a loud environment. One participant found the only way to combat these effects was to take regular vocal breaks (P18).

Further Implications of Hypermobility

Poor proprioception is commonly reported in hypermobile individuals and within the university-aged hypermobile population (Antonio & Magalhaes, 2018); this research found 100% of participants to have a proprioception deficit, and all participants described themselves as clumsy. Hypermobility has been closely connected to anxiety and depression in many studies; it negatively impacts social function and well-being (Atwell, 2021). This study explored if participants' performance ability was negatively impacted by anxiety. All six participants felt they experienced performance anxiety, three of which described physically shaking when they perform, *'my legs would be uncontrollably shaking'* (P11).

One participant suffers from Gastrointestinal issues that are Comorbid of Hypermobility (Birchall, LAm & Wood, 2021) and described having acid reflux as a regular part of her day and having to wait *'an hour before I can have a conversation'* (P30) each morning, impacting their training. The researcher noted that all participants were very aware of their hypermobility in a physical sense and had strategies in place for the physical aspects of their training but not for the vocal aspects of their training. One participant explained that they had felt frustrated at the lack of acknowledgement of their hypermobility with singing teachers in the past and had spent years *'trying to find an answer'* (P18) to their singing difficulties.

Vocal Exercise 1

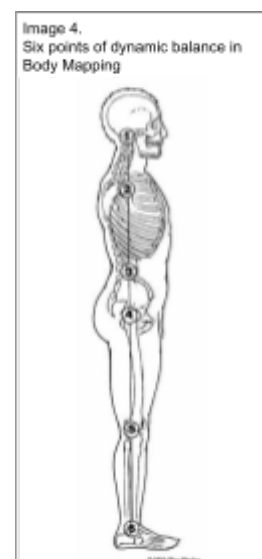
To conclude season one participants were given an exercise to practise for a minimum of 10 minutes a day for the coming week. This exercise was constructed to cover a large expanse of their vocal range to intentionally work over the passaggio. Students were asked to perform this exercise with closed lips, a relaxed jaw, on [a]. Each student was given recordings start a third higher than the lowest note in their range to avoid working in the extremes of their range.

Figure no. 13
Vocal Exercise 1.



Session 2 - An introduction to Body Mapping

Body mapping is a technique that focuses on six body points, which stack directly on top of each other to achieve dynamic balance and correct musculoskeletal alignment in the body (Conable, 1992). Body mapping acknowledges that individuals have their internal body map created during cognitive development and can be altered or warped through life. Due to proprioceptive deficits in those with hypermobility, the body map can be misinterpreted; in this session, each participant was taught to discover and explore their body map. They were then coached through exercises to place each point of balance correctly and implemented exercises to increase proprioception at each point with the aid of mirrors to increase kinesthetic feedback.



The Six points of balance as shown in Image 4. Are;

1. The Atlanto-Occipital joint (AO)
2. The Shoulder Joint
3. The Lumbar Spine

4. The Hip Joints
5. The Knees
6. The Ankles

Of the six points of balance, 100% of participants had an incorrect map for the AO joint, mapping it at least an inch lower and up to three inches further back sagittally. All participants were unaware of the joint's existence, location and anatomy. This anatomical misinformation leads to participants struggling to align their heads with their bodies. After alteration (see appendix J), five of six participants noticed a positive impact on their ability to produce vocal exercise 1 (see image 3.), reporting a feeling of 'ease' or relaxation and 'boosted resonance'. Participant n30, who displays extreme hyperextension of 45 degrees in both elbows, was visibly surprised at the change it had to their ability to produce sound at the top of their range: *'that's mad, it came out!'*. This was the joint which had the most significant positive impact overall on the participant's vocal production.

Figure. 14

Correct mapping of points of balance in participants

Participants no	AO Joint	Shoulders	Lumbar	Hips	Knees	Ankles
11	No	Yes	Yes	No	Yes	No
30	No	Yes	Yes	Yes	Yes	Yes
17	No	Yes	No	No	Yes	Yes
5	No	No	No	Yes	Yes	Yes
18	No	No	No	Yes	Yes	No
1	No	Yes	No	Yes	Yes	No

Although all participants had hyperextension of the knees, each had a correct map of their knee joint location and anatomy. Showing a substantial proprioceptive deficit in this joint, which could explain why this is a highly researched hypermobile joint in the body (Jensen et al., 2013; Johansson et al., 2000; Nicolas, 1970; Sahin et al., 2008; Söderman et al., 2001; Stillman et al., 2002) over an extensive period, as the change in diagnostic criteria in 2017 did not affect this joint. However, 67% of participants had incorrectly mapped their lumbar spine, which, when corrected, placed the pelvis into alignment and unlocked the knees.

The most significant variation in results came from shoulder alterations. Only 33% of participants had a correct map for the shoulder joints, as all other participants mapped them too wide. The correctly mapped participants felt a feeling of ease in their voice whilst singing Figure 13 and performing the exercise to align the shoulders (see Appendix J). Of the incorrectly mapped participants, one felt the voice become more resonant, but the other

three felt it hard to focus on vocal sensation as so much cognitive effort was being put into remaining aligned. This may be because these three participants (P1, P17, P18) were particularly hypermobile in their shoulders.

Once all six points had been mapped, exercised and corrected, vocal exercise 1 (Figure 13) was performed in perfect alignment. Despite all participants reporting vocal tiring and mental fatigue by this point in the session, they performed vocal exercise 1 with freedom and described it as feeling vocally 'easy' (P1, P18, P30). Some participants felt the new posture uncomfortable; P1 reported 'feel[ing] like a lego man' or faced difficulties due to external factors; P17 felt their core was difficult to relax after a heavy day of dance training. Participants were asked to spend ten minutes of mindful practice a day on Body mapping and alignment over the coming week and to place it into their training at any point that they remembered to do so.

Participant perspectives after two weeks of body mapping

After a two-week break from sessions to implement body mapping, five out of five participants reported that the body mapping exercises had had a positive impact on their posture and alignment (see Appendix O) (P5 was unable to attend the session) and one reported a distinct change in their vocal tone, *'It's much clearer and smoother' (P18)*. Both P17 and P30 found that AO alignment was the most useful as they implemented this exercise most often. P17 reported that they felt a change in their alignment within the week, having to consciously change the position of the AO joint as the week went on. P30, their knowledge and understanding had improved due to the AO exercise, *'I understand so much more where my head is supposed to be now.'*

Three of the five participants noticed an increased awareness of alignment and mismapping and were able to isolate their most impacted points. P11 found that they were aware of their alignment whilst sitting and found the lumbar exercise the most effective for correcting their alignment as did P18. However, P11 struggled the most with correctly mapping their shoulders without the aid of the exercise. Sadly, participant 1 was a little distressed to learn how ineffective their posture had been and reported implementing a correct body map as;

'So hard! I'm noticing it now whilst I'm just out and about and walking, so I have been trying to change it but it's really uncomfortable.'

They felt this was easing slowly and reported that since implementing the body mapping strategy, they had noticed reduced hip pain and less breathing restriction.

Lastly, three participants actively used body mapping while rehearsing songs for class performances or during one-to-one singing lessons.

*'if there was a bit I was struggling to do, I would do this *performs the exercise for AO joint* and it would be easier to do.'* (P30).

'Yeah, and now that I'm aware, if I can't hold a note now, I think, oh, maybe it's this or that, rather than just getting annoyed.' (P11)

Session Three - Jaw tension prevention

In session three, participants were coached through two breathing exercises and four tongue exercises to release and prevent jaw tension (Appendix K). The session began by looking at the structure and function of the jaw. All five participants had a good knowledge of the jaw's anatomy, but they were unaware that hypermobile people are more at risk of jaw subluxations (lockjaw), which occur when the jaw is extended over 50mm. Both P11 and P1 showed hyperextension of the jaw when singing.

The first exercise was to minimise the use of the neck muscles as compensatory respiratory muscles. This involved participants laying on the floor and placing their feet on the wall to create a tabletop with their legs, lifting the weight of the pelvis off the floor. Participants found this effective for relaxing the neck, but all but one found it hard to relax their core in this position. All participants responded positively to the second exercise used to explore correct breathing techniques and stimulate the nervous system to help lower performance anxiety; many found that this exercise was performed in semi-supine more comfortable than the previous exercise. Participants were then coached through a series of four tongue exercises used to release and prevent jaw tension. At this point, P11 revealed they had scar tissue of the tongue and a tongue tie; due to this, they could only comfortably perform Exercises One and Two. All other participants performed each exercise.

Participant perspectives after a week of Jaw tension prevention exercises.

During the fourth week of interviews, the researcher observed that participants had difficulty understanding the use of proactive exercises to prevent jaw tension (Appendix P.).

'That's really good when I'm on the floor because I can focus on my breathing but I can't get it into my singing yet.' P11.

Instead, they were more accustomed to reactive strategies, such as self-massage of the masseter muscles, which they had been encouraged to practice during their training. Participant One assumed they had been doing the exercise wrong as they could not *'feel the difference'*. The researcher went through the exercise again, assuring P1 that they were conducting it correctly and reinforcing the aim of the exercise. Participant 30 found each exercise helpful and noticed an ease of pain in their jaw over the week. They also found it heightened their awareness of jaw tension, helping them to lessen chewing the inside of their mouth.

All participants reported using the thoracic breath exercise most favourably. This exercise was reported as *'feeling lovely'*(P1), and Participant 18 found that they were able to focus on the breath due to it being performed in semi-supine, and Participant 11 found the visual aid of moving the hands along with the target area for the breath helpful. One participant found the exercise helped them to understand elements of their voice training and apply the technique during class. Participant 17, who had previously stated they became so nervous singing in front of the class that they *'would practically convulse'* (appendix M), used the thoracic breathing exercise to calm their nervous system before class and completed a vocal performance without shaking for the first time in their training.

Most participants described executing the tongue exercises as uncomfortable or had avoided the exercises entirely. Participant Eleven could not complete exercises 1, 3 and 4 due to having a tongue tie (appendix P) and did not feel any release in tension of the jaw. This outcome was similar for participants 17 and 18, who felt no change in the tightness of the jaw before the exercise and a week into using the exercise; although it wasn't the intended impact, P17 reported more mobility in their tongue. Only P1 reported a direct sensation of jaw release from practising the tongue exercises.

An interesting perspective was given from P11 during this interview concerning their experience with body mapping over the previous two weeks. P11 expressed their frustration in finding their alignment hard to maintain and having to readjust their six points of balance regularly.

'Yeah I feel like that's the hardest thing for me so far. That's really hard to maintain, I'm constantly having to think about it and it isn't a quick fix.' (P11).

Although the participant found this difficult, it showed the researcher that body mapping was having its intended impact, not only correcting alignment but also bringing awareness to the body to help strengthen the participant's proprioception.

Session four - Vocal Stamina and Strength

During session four, participants were taught and guided through a series of vocal exercises aimed at strengthening the Thyroarytenoid (TA) muscles (see Appendix L). The researcher believes that the wide vocal range, tendency for quick vocal fatigue, and the need for regular breaks in phonation observed in hypermobile singers may be linked to hypermobility in the TA muscles. These exercises align with principles of exercise physiology by contracting muscles against resistance to build strength and improve stamina (Schnieder & Saxon, 1997).

One exercise involved sustaining a single note on the (ə) sound for as long as comfortable, without creating any tension in the torso or neck. This exercise is referred to as a 'vocal plank' (see Extended tone exercises, image 2, Appendix L). Another exercise followed similar principles but focused on strengthening the TA by employing a descending scale in a thick fold position, using plosive sounds such as /b/, /d/, or /g/ to encourage full adduction of the vocal folds (see images 3-5, Appendix L).

Lastly, participants were given an exercise to engage the Cricothyroid (CT) muscles. Although all participants demonstrated strength in the CT muscles, allowing them to sing comfortably into the 6th octave of the piano, it is important to note that the CT and TA muscles function as antagonist pairs. Therefore, the CT exercise served as a cool-down to help relax and stretch the TA muscles (see image 7, Appendix L). From this session onwards, participants were requested to engage in 10 - 20 minutes of mindful practice a day, consisting of the vocal, breathing and jaw tension prevention exercises whilst continuing to place body mapping into their daily activities as much as possible.

Participant perspectives on practice and application Hypermobile focused pedagogy

At this point in the course, the participants were taught all experimental exercises and aspects of the course. Sessions five to eight included a short interview to gain perspectives as the process continued, to reaffirm the technique and purpose of any exercise, and to execute each exercise under the eye of the researcher to ensure the exercises were being

performed correctly. Over the four-week period, the researcher was able to observe if and how the exercises affected participants' vocal production.

Session five (see appendix Q for transcripts)

The most notable change participants described during week five was a heightened awareness of their alignment, particularly how body mapping highlighted where their hypermobility was affecting their alignment. *'Once I sort my shoulders out, my hips are kind of easier to move, and then my knees fall into place.'* (P1. Appendix Q). Due to the exercises, another had become aware they tended to roll into the inside of their feet (P5). This awareness radiated into other departments as participants described having the confidence to communicate more effectively about their hypermobility. As a result, participant thirty was observed performing an exercise that exacerbated their hypermobile elbows and had alterations made in their dance class (Appendix Q).

Two participants began to experience discomfort and slight pain due to the new positions of their points of balance, whilst another two participants had seen a decrease in pain. Showing body mapping as affecting the alignment of the hypermobile participants, both participants reinforced that despite experiencing pain, they felt that body mapping positively impacted their alignment and vocal production. *'I feel like that's actually really helped my voice.'* (P11. Appendix Q). However, one participant stated they hadn't noticed a difference in their vocal production. This could also be because this participant is in their final year of training, unlike all other participants in their first year, so adjustments were not making as big of an impact.

Over 50% of participants found a positive change in jaw tension, and some expressed that the exercises were becoming easier to perform (P17, 30, 5, 18). Participants notably avoided the neck relaxation exercise as they felt it *'engaged their core'* (P17) too much.

At this point, the participants had not been able to easily incorporate the vocal exercises into their daily routine and struggled with their repetitiveness of the exercises. Participant One found this particularly difficult and requested for a reiteration of the purpose of the exercises. At this stage, no participants saw any change in their vocal production due to the vocal exercise.

Session six (See appendix R for transcriptions)

Session six proved the need for alterations for hypermobile singers in the singing studio. P1 experienced a subluxation of the left knee due to their hypermobility during the week, so in this session, all exercises were performed seated and only points 1-3 were mapped (See image 4).

The researcher observed that the participants' proprioception seemed to be strengthening, as they reported finding correct alignment more naturally and feeling the need to adjust less. Only P18 needed a significant adjustment to their shoulders during body mapping in this session from the researcher, despite practising each day. Participant 17 found that the Thoracic breath benefited them greatly in calming their nerves before they sang. The participants who reported jaw tension decreased from 33% in the previous week to 17% in session six.

In session six, all participants documented a higher amount of practice time, and 50% reported seeing a positive change in their voices.

'I have noticed my mix is smoother and bolder on the way up' (P1)

'It's giving me stability.' (P11)

'I'm definitely getting more projection' (P18)

Session 7 (See Appendix S for transcriptions)

As the course continued and the participants approached the end of the academic term, there were notably more reports of physical pain, discomfort, and fatigue, so exercise alterations had to be made. The researcher used a wall to support one participant's shoulders during body mapping and had one participant conduct the entire session in semi-supine.

The researcher observed that the participants' physical fatigue caused their alignment to weaken and their bodies to revert to old habits. The researcher needed to intervene more frequently during vocal exercises and body mapping for participants to maintain correct alignment. Showing that their proprioception was negatively impacted by fatigue. The researcher was hypervigilant on alignment in this session as fatigue lowers proprioceptive perception and can heighten the risk of injury (Sayyadi et al., 2024). Despite this, one participant was able to perform all vocal exercises without researcher intervention.

Participants needed clarification once more on the purpose and execution of the Jaw tension prevention exercises. Many had stopped performing them, believing them ineffective because they had misunderstood the aim of the exercise. Despite this, two of the six participants still reported an alleviation of their jaw tension.

Session eight (See Appendix T for transcriptions)

In this session, participants reported vocal fatigue at the very end of the academic term. However, unlike in the previous session, participants maintained their practice throughout the week but began adapting exercises to allow continued practice. This gave the researcher confidence that the participants were applying their knowledge and understanding of hypermobility and the exercise they had learnt to their own practice.

‘I still did all my exercises, but I just made them shorter’ (P5)

‘Body mapping has made it easier to figure out where my shoulders should be without having to look in a mirror.’ (P30)

50% of participants reported they had been noticeably *‘walking into less door frames’* and felt a difference in their proprioceptive strength, noting their *‘balance is so much better’* (P30).

Figure 15.
The number of alignment corrections by researcher during Body Mapping, sessions 5-8

Participants no.	Session No.			
	5	6	7	8
1	3	2	n/a	2
5	5	3	2	1
11	4	2	2	n/a
17	3	3	3	1
18	4	3	1	1
30	3	1	4	1

Looking at Figures 15 and 16, it is easy to see that over the period of four weeks, the participants gradually needed less intervention and explanation of body mapping from the researcher. They were almost able to align their bodies

independently by the end of the coached sessions.

Adjustments made by singers to their alignment during vocal exercises followed the same trends. Once correct alignment had been achieved through body mapping,

Figure 16.
The number of alignment adjustments performed by participants during vocal exercises sessions 5-8

Participants no.	Session Numbers			
	5	6	7	8
1	5	3	4	2
5	4	2	3	0
11	3	2	2	n/a
17	3	4	n/a	1
18	3	2	4	0
30	4	3	1	1

participants were able to maintain and implement this into their singing with fewer adjustments as the weeks went on.

Course Feedback

See Appendix U for final interview transcriptions

One month after their final session, the researcher met with the participants again to assess how the exercises and strategies they had implemented for their hypermobility impacted their alignment, jaw tension, performance anxiety, and, ultimately, their voice after four weeks of independent practice. Two participants managed to maintain the rigour at which they conducted their exercises while attending weekly sessions. They managed to maintain their exercises for the first two weeks, and the final two maintained weekly exercises but did them less frequently than when attending sessions. P18 discussed in session five how they found the structure of the body mapping and vocal exercises very useful. They then struggled to maintain this without regular coaching and possibly explaining why P18 felt the least overall change to their voice at the end of the course of all participants. When asked if participants had noticed any difference in their voice from the start of the course to the end, 5 out of the six believed it had positively impacted their singing voice. Reporting;

- a stronger mix
- an ability to move more smoothly through the passaggio
- accessing mix for the first time
- being able to access belt
- having more vocal stamina
- Having more confidence in their voice

Five participants felt their voice was more reliable, experiencing fewer breaks and cracks than before. All participants expressed an interest in continuing their exercises and thought they had gained enough knowledge to do so accurately and safely, especially as 50% felt everything they had learnt was new information to them, and the other 50% had knowledge of alignment but never from the hypermobile perspective. All participants felt that their performance anxiety had slightly lessened, but 33% stated they would have liked a dedicated session on performance anxiety. Two participants also stated elements they would

have liked to explore in the course, such as implementing the strategies in situ or having a piece of repertoire to revisit every session.

Participants felt the length of each session and the overall course was good. One participant occasionally felt a little rushed and would have liked slightly longer in some sessions. The researcher was unable to collect opinions on the usefulness of the handouts as participants relied on their own recordings and did not relate to the handouts. Of all the exercises, the participants found the breath for neck relaxation the least helpful (exercise 2, appendix K) because they are dancers and found it encouraged the core muscles to engage, impeding the breath. Participants stated that extended tones, body mapping, and plosive exercises are the most useful (appendix J and K). Since finishing this study one participant has gone on to explore a diagnosis for Ehlers Danlos Syndrome.

Study Limitations

With only thirty respondents to the initial questionnaire and six participants undertaking the trialled pedagogy, the sample size of this research is relatively small, which limits the study's generalisability to broader population. Furthermore, the sample was gender biased, as all course participants were female, meaning this study neglected to explore the hypermobile experiences of men. This study depended upon self-reported questionnaires and self-assessment of generalised joint hypermobility via the Beighton scoring system. This gives way to potential inaccurate data from misinterpretation or even falsified data for personal gains of participants. This method may introduce bias as each participant's personal experience may be interpreted differently. This study was conducted over a relatively short period of time, whereas a longitudinal study would garner more data on this pedagogies affect on the hypermobile singer over time. This study is unable to analyse any confounding variables that the participants experienced. Including how the multidisciplinary elements of their musical theatre training impacts their hypermobility. Especially given that students of the Brighton academy receive an hour of one to one vocal training a week. This study is only able to analyse very early empiric observations and data of the exercises on the hypermobile voice, resulting in research in its infancy.

Personal Reflections and Recommendations

This study shed light on the fact that many performers (including the researcher) may not be aware of the potential impacts of hypermobility on the voice despite being aware of its impact on the body. The researcher has actively changed their pedagogy to implement elements of this study throughout the research process, as it was a continuing learning cycle between literature and experience.

The researcher recommends that further research be conducted into the strategies for jaw tension, even though the participants appeared to improve over the twelve weeks. Many of the participants ceased to perform the exercises because they were confused over their purpose.

The researcher believes that the main elements that differ between hypermobile and non-hypermobile pedagogy are strengthening singers' proprioception to better their alignment and reduce injury risk and the isolated strengthening of the Thyroarytenoid muscles. This is reflected in the elements that participants found most beneficial within the course feedback. The final exercise favoured by participants was the thoracic breath for jaw tension and anxiety. Given the correlation between hypermobility and anxiety, the researcher believes they should broaden their knowledge and understanding of performance anxiety before incorporating this more prominently in the pedagogy. In the interim, reach out to specialists in this area for support to aid in developing strategies for this unexpected element of the hypermobile performer. The researcher wishes to create a forum in which continued research and dialogue will encourage more research in this area of inquiry in the performing arts and will help practitioners better understand the intricate relationship between hypermobility and voice production.

Conclusion

In conclusion, many of the findings of this study reflected the themes found within the literature review. Each participant saw a positive impact on the voice from at least one of the hypermobile pedagogy exercises throughout the course. Five of the six participants felt they had seen an improvement in their singing voice across the period of the course. The study noticeably heightened awareness of hypermobility within the college, primarily due to the ongoing and collaborative dialogue among colleagues and participants. This positive impact

is evident in the increased awareness of hypermobility among participants in their dance classes and in the case of one first-year student who did not participate in the research, who is now exploring literature concerning hypermobility for their academic practice essay.

Participants found the exercises helpful to varying degrees, highlighting the crucial need for diversity in pedagogy for hypermobile singers. Despite the exercises' positive impacts, participants still needed reasonable adjustments to their teaching environment, such as options to sing while seated or in a semi-supine position. This alleviates pain they experienced when their bodies became too tired from the high demands of their training. While this framework shows promise, it requires further testing and exploration to establish validity.

Figures

Figure 4.

Distribution of Beighton Score in Sample

Figure 5.

Distribution of Brighton Scores for GJH and Sex

Figure 6.

Distribution of points of hypermobility

Figure 7.

Hyper Vs non Hypermobility musculoskeletal points in Positive Vs Negative Beighton Score

Figure 8.

Injury prevalence of the knee, ankle and shoulder in the sample.

Figure 9. Reactions to statements regarding vocal function from participants with positive Beighton Score

Figure 10. Reactions to statements regarding vocal function from participants with a Negative Beighton Score.

Figure 11. Average percentage of opinion responses across vocal manifestation statements of +&- Beightons Scores.

Figure 12.

Average degrees of opinion to vocal manifestations statements.

Figure 13.

Vocal Exercise 1

Figure 14.

Correct mapping of points of balance in participants

Figure 15.

The number of alignment corrections by research during Body Mapping

Figure 16.

The Number of ALignment adjustments performed by participants during vocal exercise sessions 5-8

Images

Image 1

Samual, L., (2011) *Anatomical Planes*. [png] Interactive Biology

<https://interactivebiology.com/2681/064-anatomical-planes-and-spatial-relationships-in-the-human-body/>

Image 2

Karegeannes, M. (2015) *Hyperextension of the Jaw* [png] TMJ Treatment

<https://www.treatingtmj.com/causes/tmj-hypermobility-how-to-assess/>

Image 3

Gilbert et al. (2014) *Stress-Anxiety-breathing flow chart* [png] Physio-pedia

https://www.physio-pedia.com/Breathing_Pattern_Disorders

Image 4

Phelps, T. (2008) *Places of Balance* [png] University of Rochester

<https://iml.esm.rochester.edu/polyphonic-archive/article/body-mapping-what-every-musician-needs-to-know-about-the-body/index.html>

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Appendices