Roles for Leading Ladies: Investigating the influence of ovarian hormones on performance anxiety and vocal impairment in elite singing

by

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Dissertation submitted to Dublin City University in partial fulfilment of the requirements for the degree of

Doctor in Music Performance

Royal Irish Academy of Music

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September 2017

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In loving memory of Mary Drumm Lynch and Jim Drumm

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Abstract

Professional singing in the classical western tradition is a highly stressful occupation. Training requires many years to gain proficiency. The vocalis muscle is influenced by fertility hormones. Unlike men, women experience regular variations in reproductive hormones impacting emotions and vocal quality. Illness, medications and menstrual oedema risk damage to the instrument during robust singing. Events, such as pregnancy and menopause may cause audible change. Motherhood can intensify stress due to gender roles at home and at work.

Music performance anxiety (MPA) is reported by most all career performers. Constant travel and performing can interfere with home life. Regular elevated stress impacts physical and mental wellbeing and overtime may alter the body's response to fighting infection, influencing the acquisition of depressive disorders and compromised immunity.

Previous performance research has documented heightened stress reporting from women. The incidence of injury, illness, depression and MPA amongst vocal soloists is largely unknown due to the sensitive nature of the research and the geographical dispersion of these individuals.

This study investigates these concerns, with specific focus vis-à-vis the influence circulating hormones (demonstrably ovarian hormones) may exert on the activation stress response in performance. Particularly, whether perceived stress may be due to hormonal influences affecting the operation of the singing voice, or distinct from sensations regarding vocal impairment.

The research contains quantitative and qualitative analysis of five self-administered questionnaires. Quantitative measurements regarding perceived state/trait anxiety, musical performance anxiety, singing voice impairment, and hormonal disruption are examined using four previously validated, amended psychometric research instruments. Additional quantitative and qualitative analysis is performed on multiple choice and open-ended responses which are obtained from a supplementary informal mixed methods survey designed by the researcher.

Findings suggest that lifecycle fertility hormones influence performance anxiety and singing voice impairment. The actions of fluctuating fertility hormones, oral contraceptives, assisted fertility, pregnancy, chemical abortion and hormone replacement therapies, including post-menopausal androgens particularly in relation to anxiety sensitivity, require further research.

Acknowledgements

For her unfailing support during the writing of this thesis, I thank my supervisor Dr Denise Neary who brought her ever vigilant eye to bear on the contents. Her friendship and encouragement over the last few years is deeply appreciated.

To all my colleagues who gave their time to complete my research questionnaires, and did so with so much grace and good humour, despite computer glitches and my nagging reminders, my sincere and heartfelt thanks.

My sincere thanks to Elizabeth Bishop, Health and Safety Officer at Welsh National Opera, Cardiff, United Kingdom and Professor Gerald Tomkin, Diabetes/Endocrinology MD FRCP (lond) FRCPI FRCP (ed.) FACP for their assistance and advice.

To my family, especially my mother, Johanna. It's done Mam! I love you. To Laura and Rachel, my beautiful daughters, who put up with me either being constantly absorbed in a book or writing. You make my life worthwhile and Mum is back!

For most of my life, there have always been constants, friends on whom I can rely when I am in trouble or in need–special folk to whom I can go for support. I am so lucky to have Bill Lynch; if in need, ask Bill. For all the maths and statistical advice, for the proof-reading and hours of help, with only soup as thanks. Thank you Bill.

To my students. You know who you are. For putting up with the madness!

CHAPTER 1

Introduction

Research on singing is diverse and varies in purpose, methodological approach and method. The present investigation attempts to consolidate the various strands of research relevant to anxiety in professional singing. The study enquires, via a mixed methods informal survey involving text box, graded response and open-ended questions, into the occupational and personal experiences of female free-lance performers and utilises four previously validated research instruments to observe self-reported, ovarian life-cycle hormonal disruption in relation to trait/state anxiety, singing voice impairment and anxiety in performance.

Issues relating to professional performing are multi-dimensional. This study is framed within the broader scope of gender research; it focuses on matters affecting female singers. In this chapter, concepts are defined and outlined within this framework. Chapter two consists of a series of literature reviews commencing with occupational concerns. Hormonal interference in the production of the professional female voice over life-course is explored including sex specific hormone involvement in stress accumulation. Life duration involving 'relentless high stress activation' due to professional or personal concerns, may have either minimal or serious consequences for health. The review includes developments in arts medicine, and matters concerning stress-related disease. Investigations regarding distress in music performance are outlined. Differences in high task mastery between students and professional performers illustrate gaps in the literature. Research involving

scientific studies investigating the actions of ovarian and stress hormones on the body and brain illustrate the rationale for investigating any consequences arising from differences in female situational hormones during high stress activities such as performing. This review of the literature is not intended to be all-encompassing or exhaustive, but illustrative of how specialist studies in medicine, psychology and other disciplines, illuminate the consequences of high stress lifestyles. Breakdown in performance due to stress overload is pertinent to all professional performers.

Professional soloists are the focus of this study. Soloists encounter the most stress according to Kenny (2011).[1] However, professional experience is also relevant. Experts, demonstrate specificity of activation of certain brain regions different to novice performers, Milton et al. (2007).[2] Expert performers are likely to have developed motor skills that preclude distraction or intrusion along with extensive personal methods of coping, Ben-Zur (2009).[3] Buma, Bakker and Oudejans (2015) describe the thoughts and processes of experienced musicians who demonstrate the opposite of anxiety, that is, a state of 'flow' or peak performance.[4] The present research involves 'ordinary coping-as best-as possible singers' as advocated by Brodsky (1996).[5] It was considered that this type of sample provided the best

[1] Dianna T. Kenny *The Psychology of Music Performance Anxiety* (New York: Oxford University Press, 2011), 63.
[2] Milton et al., (2007) in Kenny (2011), 137.
[3] Lazarus (1999) in Hasida Ben-Zur, 'Coping Styles and Affect', *International Journal of Stress Management* 16 (2009), 87; Note: Page numbers; for example, 129.e21- 129.e23 represent electronic 'versions' where the number after the 'e' represents the page number location in the electronic version and the number '129' references the location in the Journal. Page numbers; for example, S3-S9 (supplement) pages contained in the electronic editions are location identifiers describing the location and number of pages which appear in supplemental or amended articles in the electronic version of journals.
[4] Flow is described as a state of optimal performance characterised by total absorption in a task and a feeling often described as 'high' (Csikszentmihalyi, 1990; Kirchner, 2011) in Lori A. Buma, Frank C. Bakker and Raôul R. D. Oudejans, 'Exploring the thoughts and focus of attention of elite musicians under pressure', *Psychology of Music* 43 (2015), 468.
[5] Warren Brodsky, 'Music Performance Anxiety Reconceptualized: A Critique of Current Research Practices and Findings', *Medical Problems of Performing Artists* 11 (1996), 92.

opportunity to reflect the actual norms of mental and physical health, representative of the general population. The study is largely exploratory and elicited responses in relation to state/trait anxiety and three other variables, music performance anxiety, singing voice impairment and hormonal disruption. The participants were asked to self-report how they felt across all tests. The women had regular monthly cycles or were using either oral contraceptives (OCs) or hormone replacement therapy (HRT), two were pregnant, and the remainder were pre-menopausal or menopausal. Two women reported experiencing hormonal dysfunction from the time they were teenagers.

Background

The motivation for this study began nearly twenty years ago when the author witnessed a colleague suffer a vocal haemorrhage onstage, early in proceedings, during a live operatic performance. No-one present fully understood what had occurred, least of all the singer herself. There was no understudy, as company policy was such, that all 'covers' were routinely released from remaining in the theatre upon curtain up. This left the principal singer, who could produce no more than a gurgle of sound, obliged to walk the role and attempt to continue with the performance, all the while in extreme distress. The number of singers who sustain vocal injury whilst at work remains elusive.

This woman was unable to sing for some months and was replaced by her understudy for the remaining performances. The implications for her were far reaching. As a consequence of this onstage injury, she lost all the income she was expecting for that contract. She had to seek expensive medical assistance arising from the injury, and was obliged to cancel future work whilst she physically

recovered. She was burdened with residual psychological trauma from the event. It is not known what effects, if any, occurred due to of word of mouth involving her injury or how this may have had impact her subsequent levels of employment.

Some years later, we had occasion to reprise the same production together. In the interim she had performed other roles with success. Although, physically, her voice sounded whole and completely repaired, mentally, her confidence was considerably undermined. Especially it seemed, with regard to this particular role, and chiefly with regard to the memories connected to the production. The set and costume appeared to return her mentally to the time when she had sustained her injury. So much so, that she remained in obvious distress throughout the rehearsal period and was unable to complete the full number of performances scheduled for the revival. Soon afterwards, it transpired that this elite singer chose to retire from public performance, her career curtailed (much earlier than might reasonably have been expected) not, it is suspected, as a direct result of her injury, but due to subsequent issues with untreated and persistent performance related anxiety.

The author, has been described as having a stage persona which is ‘calm as a cucumber’. Indeed, after some high profile consecutive performances of the title role of Carmen, fulfilling her own solo commitments and those of the alternate soloist in the same role, colleagues marvelled at her ‘cords of steel’. However, on other occasions she noticed, especially in demanding soprano roles, such as, Brangäne in Wagner’s, Tristan und Isolde, (usually not a concern vocally), that there was, sometimes, a loss of focus in the top of her range, (most noticeably on the second day of her menstrual period) which caused her to experience some concerns with regard to ‘floating the voice’ during those performances. Certainly, the uncertainty about whether the voice would respond when asked, was one key aspect relating to

the increased stress. However, simultaneously on those occasions, she also noticed that mentally she felt uncharacteristically lacking in focus and was perceptibly on edge. Physically, she felt unusually shaky, as if, she had just suffered some trauma. Thankfully, the writer describes what were rare occurrences confined to specific roles on occasional months, not something which was regular or ongoing. It is an observation about herself as a performer which she mentally noted, due to circumstances of work which resulted in frequent performing. Thus, when afforded the opportunity to do further research, the author selected a topic she felt would be of benefit not only to herself, but could prove of use to other singers, teachers of singing, educational institutions and the wider music industry as a whole.
What follows is this singer's journey to discover what may have been occurring regarding changes in the levels of her fertility hormones (oestrogen and progesterone) which could have temporarily had such a disruptive impact, not only on her voice, but also on her mental faculties and her physical self.

Rationale for the research

Elevated stress reporting from women provides argument for focus on genetic and environmental concerns of women. Sex, inherited genes, hormone levels, and life experience all contribute to how perceived stress accumulates in the body. Although this study specifically seeks to investigate biological interactions in relation to stress, vocal impairment and music anxiety, it serves to remember that these investigations remain framed within feminine scholarship and the broader concerns of women in this career. Female singers are employed in a fast-changing, dynamic occupational climate where both exogenous and personal influences operate with regard to stress accumulation. For this reason, the research instruments are augmented with a survey

soliciting personal experiences. When thinking in terms of the intellectual, political and musical difficulties women encounter as part of a solo singing career, feminist musical scholarship asks us to consider the benefits derived from focusing on matters which purely female voices can illustrate. For example, female concerns in musical performance and matters relating to power relations and cultural politics embedded in western societal and musical traditions. Female experiences within musical practice represent important contributions to musicological discourse. This is not to say that the male perspective is not equally as important; it is. Cusick (2001) says men and women are affected equally, but differently by their gender. She states: 'gender somehow marks a woman–as not a man, not the norm, not the universal'; being male can empower behaviours and expectations which, on occasion, might be considered 'unavailable' to women.[6]

According to Michael Foucault (1976), inherited expectations and perceptions relating to gender and roles assumed at work, and at home–as children, siblings, parents, friends–all influence how individuals understand the world, and how the multitude of other persons they meet within it are contextualised.[7] Within the context of philosophy and scholarship, the writings of Foucault suggest that the concept of 'problematizations' formulate the fundamental issues and choices through which individuals confront their existence. In this way, individuals may contextualise or define themselves. However, these problematizations were considered from the implied male perspective. Gary Cutting (2005) comments that Foucault suggests women in western society, even today, are regarded as 'marginalised' whereby they

[6] Suzanne G. Cusick, 'Gender, Musicology and Feminism' in Nicholas Cook and Mark Everist (eds.), *Rethinking Music* (Oxford: Oxford University Press, 2001), 474.
[7] Michael Foucault, 'Part Four: The Deployment of Sexuality', in Michael Foucault *The Will to Knowledge* (London: Penguin, 1976), 92-102.

are under the strongest constraints that a society could exercise on them as individuals. And, although women are capable of engaging (and succeeding) in revolutionary movements against that which dominates them, they can only define themselves through their struggles with power.[8] It is also worth considering that, for western musicians, occupation is central to identity. Thus, according to Oakland, Mac Donald and Flowers (2012), the artist's concept of 'social identity' constitutes a large part of the identity of 'the self', something that may involve multiple renegotiations over a lifetime.[9] Professional singing careers are rarely for life. When voices age, singers often migrate towards other occupations; for example, lecturing or vocal teaching. Gender studies, therefore, are useful for exploring and investigating issues relating to female roles within music, music practice and musical scholarship. Studies like the one being undertaken here, which investigates female concerns relating to perceptions of stress in performance, serve to further develop our understanding of the interactions between women and western music. It is beyond the scope of the current study to examine male concerns. Male voices are not influenced by fluctuating hormones. The focus of the current study investigates female issues and ovarian hormones, testosterone and male concerns could be the focus of future studies.

The biological connection to disease arising from prolonged elevated stress, Cohen et al. (2012)[10] provides compelling argument for incorporating research from other

[8] Gary Gutting, *Foucault A Very Short Introduction* (Oxford: Oxford University Press, 2005), 103-104.
[9] Jane Oakland, Raymond A. MacDonald and Paul Flowers, 'Re-defining 'Me': Exploring career transition and the experience of loss in the context of redundancy for professional opera choristers', *Musicae Scientiae* (2012), 1. [Accessed 17 March 2012]
[10] Sheldon Cohen et al., 'Chronic stress, glucocorticoid receptor resistance, inflammation, and disease risk', *Journal of PNAS* 109 (2012), 5595.

fields of study within the occupational performance context. Sex, inherited genes, hormone levels, and life experience all contribute to how perceived stress both develops and accumulates amongst individuals. As Mc Ewen and Wingfield (2010), explore, 'What causes allostatic load and overload?'[11] Focused biological research such as that by Dhabhar, Malarkey, Neri and McEwen (2012) investigates 'how stress hormones orchestrate a large-scale redistribution of immune cells in the body',[12] whilst Smith, De la Rosa and Daniels (2015), investigate Exposomics– studies of environmental exposures from diet, lifestyle and all endogenous sources, including socioeconomic status, pregnancy and/or other potential vulnerabilities such as, exposure to large amounts of chemical toxins:

> 'Under the exposome paradigm all non-genetic factors contributing to disease are considered to be 'environmental' including chemicals, drugs, infectious agents and psycho-social stress, these can be considered collectively as environmental stressors.'[13]

With regard to the profession of elite singing, inherited genes, personality traits and social concerns–including traditional gender roles–may exert considerable influence over how women acquire stress. In respect of social issues, it is worth considering that often-times limits or constraints on personal freedoms may be self-imposed as a result of social conditioning. For singers, performance careers can span many important personal and biological events, for example, marriage and pregnancy. This is where psychological and biological research may overlap. The plasticity and

[11] Bruce S. McEwen and John C. Wingfield, 'What's in a name? Integrating homeostasis, allostasis and stress', *Journal of Hormones and Behavior* 57 (2010), 111.
[12] Firdaus Dhabhar et al., 'STRESS-INDUCED REDISTRIBUTION OF IMMUNE CELLS – FROM BARRICKS TO BOULEVARDS TO BATTLEFIELDS: A TALE OF THREE HORMONES – CURT RICHTER AWARD WINNER', *Journal of Psychoneuroendocrinology* 37 (2012), 1346.
[13] Martyn T. Smith, Rosemarie de la Rosa, and Sarah I. Daniels, 'Using Exposomics to Assess Cumulative Risks and Promote Health', *Journal of Environmental and Molecular Mutagenesis* 56 (2015), 715.

remodelling of the female brain upon delivery of a baby is in biological terms, unprecedented. Research by Glynn et al. (2016), documents 'persisting associations between postpartum hormone profiles and human maternal behaviour'. This research highlights the peri-natal period as one of critical neurodevelopment in the lifespan of human females.[14] Huge hormonal surges facilitate behavioural changes and according to Pawluski et al., (2016), this serves to ensure the survival of the infant.[15] Motherhood is a prime example of when increases in metabolic energy are demanded.[16]

Social expectation and environmental conditioning may have increased relevance to the accumulation of stress load for women in demanding careers. Separation from babies can arouse feelings of guilt, most especially in careers like professional singing which require extensive travel. Parental responsibilities involved in caring for an infant whilst maintaining work, can challenge individuals', not only with regard to developing layers of organisational structure in the home, but may impact day to day activities, for example, attaining adequate sleep. Over-time, it is not unreasonable to consider that caring for a partner, home, children, and perhaps extended family such as elderly parents, whilst attempting to maintain previous levels of work might impact individuals' perceptions regarding personal freedoms.

[14] Laura M. Glynn et al., 'Gestational hormone profiles predict human maternal behavior at 1- year postpartum', *Journal of Hormones and Behavior* 85 (2016), 19.
[15] Jodi L. Pawluski, Kelly G. Lambert and Craig H. Kinsley, 'Neuroplasticity in the maternal hippocampus: Relation to cognition and effects of repeated stress', *Journal of Hormones and Behavior* 77 (2016), 86.
[16] Mc Ewen and Wingfield (2010); 'It is important to bear in mind that changes in morphology, physiology and behavior associated with life cycle events such as lactation or migration also alter the responsiveness of the individual to unpredictable, and potentially stressful events. Usually a process such as lactation or migration results in the individual becoming more susceptible to perturbations of the environment, and adjustments in the stress response are made in anticipation of this.

The concept of independence according to Miller et al. (1986), is considered an important factor in this branch of medical science involving the epidemiology of life events and the personal regulation of stress and disease.[17]

Soloist singers are an ideal population for investigative research purposes concerning anxiety. Singing is a 'whole body' activity. The physical disturbance in breathing, excessive perspiration and loss of saliva due to emotive anxiety can be highly distressing. This study investigates the concerns of free-lance professional performers, a population which is difficult to research because of issues which can be encountered when you try to enlist sufficient numbers. Sandgren and Ericsson (2007) argued that:

> The pressure of performing on stage as a soloist and at a consistently high level throughout one's career should be further studied, not only in terms of performance anxiety, because anxiety is expressed in the daily life of opera singers by excessive health promoting strategies, vocal testing, worries about receiving criticism and stress during singing lessons. Further research is necessary to pinpoint the degree of psychological symptoms that are related to work-related issues or traits of neuroticism.[18]

Successful musicians are understood to have developed certain personality traits in order to achieve success. For example, they are likely to have cultivated perfectionistic tendencies which have both positive and negative associations. Stoeber and Corr (2016) state that 'not all dimensions of perfectionism undermine

[17] Miller et al., 'The epidemiology of life events and long-term difficulties, with some reflections on the concept of independence', *British Journal of Psychiatry* 148 (1986), 693.
[18] Maria Sandgren and K. Anders Ericsson 'The complexity of artistic strivings and anxiety among opera singers', in K. Maimets-Volt, R. Parncutt, M. Marin and J. Ross (eds.) Proceedings of the third Conference on Interdisciplinary Musicology (CIM07), Tallinn, Estonia, 15-19 August (2007), 3 <http://www-gewi.uni-graz.at/cim07/> [Accessed 31 Oct 2013].

flourishing and that it is important to differentiate perfectionistic strivings and concerns when observing the perfectionism–flourishing relationship'.[19]

Selye (1974) argued that virtually all human activity involves some type of stress, but that some stress is healthy or health promoting 'good stress'(eustress), whilst excessive or unvaried stress may become 'bad stress' which can cause (distress).[20] Indeed, Weinstein et al. (2016) found that the activity of singing can be health promoting in low stress conditions and can contribute to social bonding.[21] However, repetitious high stress experiences, according to Fancourt, Aufegger and Williamon, (2015), may have the opposite effect.[22] Prolonged maladaptive stress can interfere with sleep and memory, and eventually may impact performance quality. In terms of biology, McEwen (2015) describes the energy required for maintaining health using the biological allostasis model.[23] Jennie Morton (2015) a retired performer, advises all performing professionals to be vigilant concerning the development of symptoms of physical inflammation within the body, as inflammation may predicate the onset of illness and disease.[24]

Trauma, most especially for singers may precipitate immediate performance issues. For example, the urge to cry can lock the vocal apparatus, cause difficulties with memory and concentration, and may instigate other problems, including music performance anxiety (MPA). MPA according to Salmon (1990) can be described as:

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[19] Joachim Stoeber and Philip J. Corr, 'A short empirical note on perfectionism and flourishing', *Journal of Personality and Individual Differences* 90 (2015), 50.
[20] Hans Selye, *Stress Without Distress* (New York: Signet, 1974).
[21] Daniel Weinstein et al., 'Group music performance causes elevated pain thresholds and social bonding in small and large groups of singers', *Journal of Evolution and Human Behaviour* 37 (2016), 152-158.
[22] Daisy Fancourt, Lisa Aufegger and Aaron Williamon, 'Low-stress and high-stress singing have contrasting effects on glucocorticoid response', *Journal of Frontiers in Psychology* 6 (2015), 1-5.
[23] Allostasis is described as the active process of maintaining homeostasis see Glossary of terms; Bruce Mc Ewen, Jason D. Gray and Carla Nasca, 'Redefining neuroendocrinology: Stress, sex and cognitive and emotional regulation', *Journal of Endocrinology* 226 (2015), T69.
[24] Jennie Morton, *The Authentic Performer: Wearing a Mask and the Effect on Health* (Oxford: Compton Publishing, 2015), 3.

> Experience of persistent, distressful apprehension about and/or actual impairment of, performance skills in a public context, to a degree unwarranted given the individual's aptitude, training and level of preparation.[25]

MPA may become persistent if left untreated. Research by Kenny (2014) and Vaag et al. (2015), suggest that the prevalence of depression among professional musicians is notably higher than in other western occupations.[26] MPA is categorised as a social phobia–to many music professionals an unpalatable term. Sternbach (1993) commented that few musicians want to admit to suffering from any indisposition.[27] Income is dependent on maintaining reliability in performance, and as Nagel (2009) reports:

> Artists often commence lessons in childhood and devote nearly a lifelong pursuit to the learning their craft which also represents a considerable investment of personal ego, yet leave the workforce in higher percentages than in any other profession.[28]

This makes professional performers different from other professionals in similarly demanding occupations. In a precarious job market such as the arts, where unemployment is 'rampant', it is perhaps not surprising that occupational anxiety as well as MPA concurrently exist amongst performers.

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[25] Paul G. Salmon, 'A Psychological Perspective on Musical Performance Anxiety: A review of the literature', *Journal of Medical Problems of Performing Artists* 5 (1990), 3.
[26] Dianna T. Kenny et al., 'Psychological well-being in professional orchestral musicians in Australia: A descriptive population study', *Psychology of Music* 42 (2014), 210-232; Jonas Vaag et al., 'Symptoms of anxiety and depression among Norwegian musicians compared to the general workforce', *Psychology of Music* 43 (2015), 1-15.
[27] D. Sternbach, (1993) states that musicians have historically disguised all their pains, injuries, illnesses and anxieties, because they perceive if they were too candid and this were passed on to conductors or management grave consequences for employment might ensue. D. Sternbach in Warren Brodsky, *Medical Problems of Performing Artists* 11 (1996), 92.
[28] Julie. J. Nagel (2009) in Peter Iltis, 'Medical and Scientific Issues Music Performance Anxiety', *Journal of the International Horn Society* (2012), 53.

Whilst men and women engaged in professional performing share similar occupational uncertainty, disruptive ongoing hormonal influence on the voice is something which men do not experience throughout their careers. The male body is regulated by testosterone produced in the testes. Males suffer from more extreme vocal changes at puberty, but once the voice is established and technique secured, male singers endure little further disruption to the vocal apparatus from sex hormones until advanced in age. According to Markus Gugatschka et al. (2010), 'In contrast to a dramatic fall of estrogens during menopause in women, testosterone concentrations in men decline gradually with aging'.[29]

Females experience ongoing monthly disruption from ovarian hormones (oestrogen and progesterone) which can cause pain in the abdominals, affecting airflow, and may result in increased laryngeal tension. The vocal chords themselves can experience oedema (swelling). The layer of mucus protecting and lubricating the cords changes in viscosity and consistency over the monthly menstrual cycle. This means that, during robust singing female singers are more vulnerable to vocal related injury. This is not to say that male singers do not experience considerable difficulties during their careers or in performance due to vocal issues or performance stress merely that, the male body and vocal instrument are not regularly indisposed due to fluctuating hormones. Lacking ovaries, they are not subject to monthly reproductive cycles, premenstrual syndrome (PMS), pregnancy or menopause. Upon initial review of the literature it was considered that given the absence of regular hormonal

[29] Markus Gugatschka et al., 'Sex Hormones and the Elderly Male Voice', *Journal of Voice* 24 (2010), 371.

disruption occurring in relation to the voices of male singers, it was appropriate to limit the focus of this study exclusively to female concerns.

In relation to stress and brain processing we are beginning to understand that gender is also important as regards how the body interprets and responds via hormonal interaction in neural networks to stressful stimuli, therefore males and females process stress differently. According to McEwen et al. (2015):

> Taken together with the fact that estrogen, as well as androgen effects are widespread in the central nervous system, findings indicate that there are likely to be many more examples of sex × stress interactions related to many brain regions and multiple functions, as well as developmentally programmed sex differences that affect how the brain responds to stress.[30]

Therefore, when considering the overall health of professional singers it is useful to use the biopsychosocial model. According to Gick (2011), in the field of health psychology this multi-dimensional model considers it insufficient to understand health in relation to biological factors alone, such as, the absence of disease. Health of the individual is inclusive of psychological and emotional states and also social well-being. However, important biological factors include the immune system which defends the body against attack by disease or injury by way of either fast- or slow-acting immune response. The sympathetic nervous system is stimulated during stress, and action activation and the parasympathetic is initiated during resting states such as, sleep and digestion. Individual differences include variables of psychological factors, such as negative (anxiety, depression) and positive (joy) moods and emotions, the ability to appraise potential stressful events, problem solving, engagement of emotion regulation (distraction or relaxation), and coping.

[30] Bruce S. McEwen et al., 'Recognizing resilience: Learning from the effects of stress on the brain', *Neurobiology of Stress* 1 (2015), 4.

Psychological variables also involve health behaviours, both positive (exercise), and negative (substance abuse). Social factors include variables such as social support, measured by the number of people in a person's social network, the kinds of support –whether informational or emotional–and broader macro social factors like socio-economic status, ethnicity and culture. Well-being is described as optimal experience and psychological functioning. Measures include, hedonic (pleasure, positive mood, life satisfaction) and eudaimonic, those concerned with maximising human potential, such as autonomy, environmental mastery, self-acceptance, personal growth, life purpose, positive interpersonal relationships, and personal vitality.[31]

Statement of the problem

Ascertaining the relevant factors which cause expert female performers to report consistently higher levels of stress than males is what is of concern. The reasons for experiencing anxiety when performing are complex. There are many variables which may affect singers' perceptions of anxiety levels. These include, but are not limited to, stage experience, difficulties in musical content, preparedness and memory, perceived importance of the performance related to significance and size of the audience or venue, relationship with peers (including other singers and conductors), voice functioning, and individual differences in coping styles, including differences relating to personal levels of operating stress.

The researcher appreciates that fluctuating hormones can result in vocal indisposition, which may in turn, escalate perceptions of stress. Under stressful conditions 'stress hormones' are released which interact with fertility hormones in

[31] Mary L. Gick, 'Singing, health and well-being: A health psychologist's review', *Psychomusicology: Music, Mind & Brain* 21(2011), 177.

the body. The problem for the researcher is to observe how levels of fertility hormones, or different hormonal situations, might interrelate with self-reported perceived stress and vocal indisposition. For singing professionals, vocal function is clearly prioritised; therefore, perceptions relating to singing voice impairment are essential. However, it remains to be seen in the case of professional singers whether impaired vocal function is at all times positively correlated with anxiety in performance. Certain hormonal situations may mitigate stress perception regardless of perceptions relating to the functioning of the voice. It is possible that high stress might be reported in the absence of perceived vocal problems or that vocal indisposition may not result in the reporting of elevated stress.

Aims of the research

Against the obvious complexity concerning factors which influence stress perception, the aim of the present study is to consolidate previous research whilst providing a qualitative and quantitative investigation of the concerns of women in this occupation. In addition, the study investigates what is best described as a 'common denominator' relative to females which is implicated in the stress response: the interaction of female fertility hormones and stress. The brain is the meditator of all circular instructions regarding feedback and processing of stressors. Observing perceptions regarding hormone disruption in relation to stress amongst preforming singers in a performance context (day of performance) may provide further insight into the workings of female stress behaviours. Principally, whether life-cycle fluctuations in levels of fertility hormones or situational hormonal states (for example the use of contraceptives) influence physical sensations with regard to

the instrument and/or the processing of stressful stimuli by the brain; if so, whether this is observed in the self-reporting of stress.

Gap in the literature

The influence of ovarian hormones, voice function and stress (stress hormone response) observed together is perhaps underexplored in the current literature regarding the physical and psychological factors influencing music performance anxiety (MPA) in expert singers. To the best knowledge of the researcher this study is the first of its kind undertaken with a group of classically trained professional freelance soloists. The literature in performance does suggest consistently higher levels of stress reporting amongst women performers: (Kokotsaki and Davidson (2003),[32] Bennett et al. (2005),[33] Kenny and Osborne (2006),[34] Boucher and Ryan (2011),[35] Thomas and Nettelbeck (2013),[36] Çirakoğlu, and Coşkun Şentürk (2013).[37] To date, no data are currently available on how many ordinary professional singers might be suffering from stress-related debilitating health issues.

Gabrielsson (2003) compiled a comprehensive review of research in music performance at the millennium.[38] Kenny et al. (2004) identified the difficulties in obtaining access to large enough samples of elite performers in order to permit the

[32]Dimitra Kokotsaki and Jane W. Davidson, 'Investigating Musical Performance Anxiety among Music College Singing Students: a quantitative analysis', *Music Education Research* 5 (2003), 45-59.
[33] David S. Bennett et al., 'Gender differences in adolescent depression: Do symptoms differ for boys and girls?', *Journal of Affective Disorders* 89 (2005), 35-44.
[34] Dianna T. Kenny and Margaret S. Osborne, 'Music Performance anxiety: New insights from young musicians', *Advances in Cognitive Psychology* 2 (2006), 103.
[35] Hélène Boucher and Charlene Ryan 'Performance Stress and the Very Young Musician', *Journal of Research in Music Education* 58 (2011), 329.
[36] Jason P. Thomas and Ted Nettelbeck, 'Performance anxiety in adolescent musicians', *Psychology of Music* 42 (2013), 624-634.
[37] Okan Cem Çirakoğlu, and Gülce Coşkun Şentürk, 'Development of a Performance Anxiety Scale for Music Students', *Medical Problems of Performing Artists* 28 (2013), 199.
[38] Alf Gabrielsson, 'Music performance research at the millennium', *Psychology of Music* 31 (2003), 221-272.

appropriate statistical tests relating to MPA to be performed.[39] Sandgren and Ericsson (2007) describe the complexity involved in the acquisition of the skills required to be an expert operatic singer.[40] The scarcity of data relating specifically to MPA in solo professional singers is reiterated by Spahn et al. (2010).[41] Phyland, Oates and Greenwood (1999) investigate vocal indisposition, although the research design does not specify singing style and music theatre singers are also included.[42] Kenny (2011) represents an important work on the psychology of MPA which reviews and advances MPA definitions.[43] Gick (2011) recommends further research on potential linkages amongst biological, psychological and social processes associated with singing.[44] The development of interest in 'biological' research is referenced in singing performance research by Gick (2011) as Taylor (2006) in Gick points out, 'oxytocin may reduce biological stress responses in supportive social situations but exacerbate them in unsupportive interactions, especially in women'.[45]

Thus, gaps exist in the literature involving expert performers concerning the multidimensional aspects of acquiring music performance anxiety. The precise function of ovarian and testicular hormones is yet unknown regarding influences on

[39] Dianna T. Kenny et al., 'Music Performance Anxiety and occupational stress amongst opera chorus artists and their relationship with state and trait anxiety and perfectionism', *Journal of Anxiety Disorders* 18 (2004), 773.
[40] Maria Sandgren and K. Anders Ericsson, 'The complexity of artistic strivings and anxiety among opera singers', in Maimets-Volt K., Parncutt R., Marin M., and Ross J. (eds.) Proceedings of the third Conference on Interdisciplinary Musicology (CIM07) Tallinn, Estonia, 15-19 August (2007), 1-8 <http://www-gewi.unigraz.at/cim07/ > [Accessed 26 May 2015].
[41] Claudia Spahn et al., 'Music Performance Anxiety in Opera Singers', *Logopedics Phoniatrics Vocology* (2010), 177, 'We have no epidemiological data on how many professional solo singers suffer from the pathological form of MPA and therefore would need treatment'.
[42] Debra Jean Phyland, Jennifer Oates and Kenneth Mark Greenwood, 'Self-Reported Problems Among Three Groups of Professional Singers', *Journal of Voice* 13 (1999), 602-611.
[43] See chapter two for definition of MPA, Dianna T. Kenny (New York: Oxford University Press, 2011).
[44] Mary L. Gick, 'Singing, Health and well-being: A health psychologist's review', *Journal of Psychomusicology: Music, Mind & Brain* (2011), 177.
[45] S. E. Taylor (2006) in Mary L. Gick, 'Singing, Health and well-being: A health psychologist's review', *Journal of Psychomusicology: Music, Mind & Brain* (2011), 201.

the plasticity of brain and brain controlled behaviour. This indicates that investigations such as this one (observing ovarian hormonal influence) which elicits self-reporting of stress and hormone disruption in relation to singing voice functioning (on a day of performance) and compares these responses to perceptions relating to musical anxiety may represent important contributions to performance research and investigations concerning stress acquisition within the broader western female population.

Purpose of the study

The study assembles research from specialist disciplines outside of mainstream performance to contribute to knowledge regarding the influences of gender and sex which may be involved in stress acquisition. Understanding what influences stress load is important for tailoring treatments for those suffering from debilitating symptoms of anxiety. The research engages in a qualitative and quantitative assessment of female soloists' personal and occupational experiences and records amounts of performance anxiety, occupational injury and disease. The research investigates how differences in levels of ovarian hormones, or different hormonal situations, might interrelate with self-reported perceived stress and vocal indisposition in the context of performance. As regards fluctuating versus relatively stable states of hormone, the research explores under which circumstances high stress might be reported in absence of perceived vocal concerns and under which circumstances vocal indisposition might not result in the reporting of elevated stress.

Research questions

This research investigates the broad professional and personal experiences of expert singers and seeks to discover the salient aspects concerning career or lifestyle which

influence stress load over a life-course. These questions involve education, voice use, personality, personal fertility, social interactions with colleagues, friends and family, lifestyle, adverse life events, illness and disease and other occupational and life-related stress including awareness of medical or alternative therapies and the use of these measures by female singers to alleviate stress symptoms. The research investigates the possibility that variations in levels of ovarian hormones may be involved in the elevated levels of self-reporting of stress by females which is observed in performance and other psychological research literature.

The measures employed are further discussed in Chapter 3 Method. Briefly, they include a mixed methods survey comprising of an informal survey designed by researcher, Spielberger et al. (1970), STAI (state/trait anxiety inventory), Kenny (2009), K- MPAI, (music performance anxiety inventory) Heinemann (2009), SHE, (short term hormone effect inventory) and Cohen et al. (2007), S-VHI, (singing - vocal injury/impairment inventory). The mixed methods survey and research instruments are presented in Appendix B, along with letters detailing the consent required of respondents.

Glossary of Terms – Definitions for this study include

- **Adaption** is any alteration in the structure or function of an organism or any of its parts that results from natural selection and by which the organism becomes better fitted to survive and multiply in its environment.

- **Allostasis** refers to the active process of maintaining/re-establishing homeostasis via output of hormones and autonomic nervous system activity. Because the mediators of allostasis interact and affect each other's activity and because each

mediator system has biphasic effects (i.e., having two phases) in dose and time, the network of allostasis is nonlinear. When one mediator system changes the others adjust. A principal feature of allostasis is that there are large differences in levels of activity of those mediators involved in adaption. Elevated heart rate, blood pressure, cortisol, adrenaline may be needed short-term to help, but may occur chronically and lead to disease. When this happens, the resulting output can become distorted, with effects such as hypertension, chronic inflammation, or flat cortisol caused by depression or sleep deprivation.

- **Allostatic load and overload** refers to the cumulative and potentially damaging, as well as protective, effect of stressors on the brain and the body. When mediators that normally help the body and brain to adapt to stress become distorted, they can contribute to cumulative pathophysiological change; for example, obesity and diabetes. To describe allostatic load using the energy concept: if allostatic load is greater than the ability to synthesise the energy to cope, or if allostatic load persists at a level sustainable by the available energy then the actions of the mediators are designed to provide protection until the allostatic load declines (time critical) and the individual can proceed with normal daily and seasonal routines ('The show must go on' mode). However, if increased load occurs more frequently or overload occurs or persists for longer periods, then prolonged actions of the mediators (cortisol among others) results in wear and tear type damage rather than protection (illness and breakdown). The body may thus extend sickness behaviours in attempts to get the individual to rest in order to restore equilibrium (depression).

- **Anti-Inflammatory Corticoids** adrenocortical hormones which inhibit inflammation, such as cortisone or cortisol. They have a marked effect upon glucose and are also known as glucocorticoids.

- **Autonomic nervous system**, (ANS) comprises the sympathetic nervous system which is stimulated during stress or action, and the parasympathetic nervous system which is active during resting states such as digestion, relaxation, and sleep.

- **Biological response to stress** involves the release of neurotransmitters in the sympathetic nervous system which stimulate the individual to fight or flee. The stress hormone cortisol reduces inflammation in the short-term, allowing the body to respond to stress. However, if the production of cortisol remains heightened long-term this may negatively affect health by interfering with the body's immune response.

- **Brain**: a soft, wrinkled organ that weighs about 3 pounds, and is located inside the cranial cavity, where the bones of the skull surround and protect it. The approximately 100 billion neurons of the brain form the main control centre of the body. The brain is the seat of higher mental functions such as consciousness, memory, planning, and voluntary actions; it also controls lower body functions such as the maintenance of respiration, heart rate, blood pressure, and digestion. The brain and spinal cord together form the central nervous system, or CNS. The CNS acts as the control centre of the body by providing its processing, memory, and regulation systems. The CNS takes in all of the conscious and subconscious sensory information from the body's sensory receptors to stay aware of the body's internal and external conditions. Using this sensory information, it makes decisions about both conscious and subconscious actions required to maintain the body's homeostasis and ensure its survival. The CNS is also responsible for the higher functions of the nervous system such as language, creativity, expression, emotions, and personality.

- **Brain plasticity** refers to neurogenesis (growth and development of neurons): the capacity of the brain to remodel dendrites, turnover synapses and create new cells. Chronic stress can cause shrinkage of dendrites. Glucocorticoids and excitatory amino acids are both involved in the stress induced suppression of neurogenesis; however, oxytocin appears to play an important role in its mediation. Whilst the brain can recover from stress episodes, acute challenges or toxins leave a permanent imprint of past stress which is thought to alter future reactivity at a molecular level. For example, RU 486 is a strong progesterone antagonist and strong anti-glucocorticoid and weak anti-androgen, medication/toxin used on women obtaining hormonal abortions (see Renate Klein et al., RU 486 (Australia: Spinifex, 1991), 56-71).

- **Circadian Rhythm** The daily light-dark cycle that governs rhythmic changes in the behaviour and/or physiology of most species. Studies have found that these changes are governed by a biological clock, which in mammals is located in two brain areas called the suprachiasmatic nuclei. The circadian cycles established by this clock occur throughout nature and have a period of approximately 24 hours. In addition, these circadian cycles can be synchronized to external time signals but also can persist in the absence of such signals. Studies have found that the internal clock consists of an array of genes and the protein products they encode, which regulate various physiological processes throughout the body. Disruptions of the biological rhythms can impair the health and well-being of the organism

- **Circulating Hormones** Chemical substances released into the blood by endocrine glands–Hypothalamus, Pineal, Pituitary, Thyroid and Parathyroid, Thymus, Adrenal, Pancreas, Ovaries (female only), Testes (male only) –to stimulate and co-ordinate distant organs. Bodily growth, metabolism, resistance to stress,

remodelling brain architecture, inflammation as well as sexual functions are largely mediated (facilitated) and regulated (synchronised) by circulating hormones. Stress activation involves simultaneous secretions from more than one endocrine gland, after which follows a complex feedback loop as the brain and body adjusts levels of each hormone until the stressor has passed. For the purposes of this study, all respondents are female. The hormonal state (or level) of circulating ovarian hormones (oestrogen and progesterone) combined with other hormonal secretions (dependant on the brains assessment of the stressful stimuli), given the baseline stress level of the individual (the overall pervading stress level, for example, coping or not coping) is what is being considered.

- **Corpus luteum** means yellow body in Latin; it is what is left of the follicle after a woman ovulates; it becomes inactive after 10–14 days, and menstruation occurs. The function of the corpus luteum is secretion of the hormone progesterone to sustain pregnancy.

- **Distress**: Harmful, unpleasant stress. Bad stress, maladaptive stress or distress, is when stress becomes too much to bear or cope with. Tension builds, there is no longer any fun in the challenge, there seems to be no relief, no end in sight. This is the kind of stress that leads to poor decision making. Physiological symptoms of distress include an increase in blood pressure, rapid breathing and generalized tension. Behavioural symptoms include either overeating or loss of appetite, drinking, smoking and negative coping mechanisms. Characteristics of this type of stress include feelings of anxiety or concern. It can be short- or long-term; it is perceived as outside of coping abilities; it feels unpleasant; it can decrease performance; and it can lead to mental and physical problems.

- **Endocannabinoid system** (ECS) is a group of endogenous cannabinoid receptors located in the mammalian brain and throughout the central and peripheral nervous systems, consisting of neuro-modulatory lipids and their receptors. Known as ‘the body’s own cannabinoid system’ the ECS is involved in a variety of physiological processes, including appetite, pain-sensation, mood, and memory, and in mediating the psychoactive effects of cannabis. The ECS is also involved in voluntary exercise and may be related to the evolution of the runner's ‘high’ in humans and related aspects of motivation or reward for locomotor activity in other animals. Two primary endocannabinoid receptors have been identified: CB1, first cloned in 1990; and CB2, cloned in 1993. CB1 receptors are found predominantly in the brain and nervous system, as well as in peripheral organs and tissues, and are the main molecular target of the endocannabinoid ligand (binding molecule), Anandamide, as well as its mimetic phyto-cannabinoid, THC. One other main endocannabinoid is 2-Arachidonoylglycerol (2-AG) which is active at both cannabinoid receptors, along with its own mimetic phyto-cannabinoid, CBD. Both 2-AG and CBD are involved in the regulation of appetite, immune system functions and pain management.

- **Energy concept in homeostasis/allostasis** refers to all of the energy/nutrients that are needed to go about daily and seasonal routines as the life cycle progresses, enabling the individual to deal with unpredictable events from the physical and social environment that have potential to cause stress. Interactions from food, (energy gained) against (energy required) which involves the sum of daily routines plus extra energy to cope with weather, toxins, age, injury, infection, social status, and enable life-cycle events like reproduction is what is understood by this concept. As regards humans, certainly the western population, may not suffer from

regular starvation (calorie counting may in fact prolong life). In western populations situations of prolonged excess calories, overconsumption, may lead to pathologies in the longer term. Therefore depending on the experience of an individual in its environment, energy may be stored for future contingencies or used immediately. This supply vs demand of energy to maintain homeostasis is constantly being adjusted over the life-cycle.

- **Enteric Nervous System** The enteric nervous system (ENS) is the division of the ANS that is responsible for regulating digestion and the function of the digestive organs. The ENS receives signals from the central nervous system, through both the sympathetic and parasympathetic divisions of the autonomic nervous system, to help regulate its functions. However, the ENS mostly works independently of the CNS and continues to function without any outside input. For this reason, the ENS is often called the 'brain of the gut' or the body's 'second brain.' The ENS is an immense system—almost as many neurons exist in the ENS as in the spinal cord.

- **Epigenetics** is a system that describes the influence of the social and physical environment on the brain and body; how good and bad habits, or life events, like stress, cause persistent changes in the brain and brain behaviour. Thus, it can better explain how disorders like anxiety and depression occur, because epigenetic change offers a possible explanation about how individuals sharing the same or similar genes might show large differences in disease susceptibility and resilience. The term epigenetics encompasses a number of mechanisms by which biological information is transmitted above the level of genetic code. Socioeconomic status, adverse life experiences in early life (quality of maternal care), individual differences, genetic endowment, exposure to toxins, gender, and over-life experiences are included.

Health behaviours or a lack of good health-promoting habits, food intake, exercise, smoking, alcohol, physical activity, quality of social connections and interactions, (meaning and purpose in life) all feed into allostasis and allostatic load.

- **Epigenetic allostasis** introduces another feature to allostatic load that of early life-experiences (like maternal care) which effect how the individual copes with allostatic load.

- **Eustress** is ‘good stress’ that motivates you to continue working. This stress can provide incentive; this "good stress" can be enjoyable. Some stress is required in life in order to be happy, motivated, challenged and productive. This type of stress is said to motivate and focus energy, is short-term, is perceived as within coping abilities, can be exciting and improves performance. It is when this stress is no longer tolerable and/or manageable that distress may occur.

- **Homeostasis** refers to how all living things adjust morphology, physiology, and behaviour as they go about their life cycles. For humans these adjustments occur in the form of daily as well as seasonal routines. Superimposed on predictable life-cycle are unpredictable events, many stressful that require immediate physiological and behavioural adjustments in order to cope. Added to these are disease, infection, age, old injuries, toxins, social status, and gender, which all influence how an individual goes about its life-cycle and responds to unpredictable perturbations. Some predictable life-cycle events, like reproduction, change susceptibility and sensitivity to perturbations temporarily, by adjusting secretions of mediators like glucocorticoids that help maintain homeostasis. However, the trade-off is a reduced immune response and potentially permanent damage, due to the failure to respond immediately to a stress trigger that would promote adaptation.

- **Immune system** defends the body against attack by disease or injury through natural fast-acting immune responses as well as by means of more specific slow-acting immune responses.

- **Nervous System** consists of the brain, spinal cord, sensory organs, ganglia, and the motor and sensory nerves and their endings–all the nerves that connect these organs with the rest of the body. Together, these organs are responsible for the control of the body and communication among its parts. The brain and spinal cord form the control centre known as the central nervous system (CNS), where information is evaluated and decisions are made. The sensory nerves and sense organs of the peripheral nervous system (PNS) monitor conditions inside and outside of the body and send this information to the CNS. Efferent nerves in the PNS carry signals from the control centre to the muscles, glands and organs to regulate their functions.

- **Nervous Tissue** The majority of the nervous system is tissue made up of two classes of cells: neurons and neuroglia.

- **Neurons**: also known as nerve cells, communicate within the body by transmitting electrochemical signals. Neurons look quite different from other cells in the body due to the many long cellular processes that extend from their central cell body. The cell body is the roughly round part of a neuron that contains the nucleus, mitochondria, and most of the cellular organelles. Small tree-like structures called dendrites extend from the cell body to pick up stimuli from the environment, other neurons, or sensory receptor cells. Long transmitting processes called axons extend from the cell body to send signals onward to other neurons or effector cells in the

body. There are 3 basic classes of neurons: afferent neurons, efferent neurons, and interneurons.

- **Neurons (Afferent)** Also known as sensory neurons, afferent neurons transmit sensory signals to the central nervous system from receptors in the body.

- **Neurons (Efferent)** Also known as motor neurons, efferent neurons transmit signals from the central nervous system to effectors in the body such as muscles and glands.

- **Neurons (Interneurons)** form complex networks within the central nervous system to integrate the information received from afferent neurons and to direct the function of the body through efferent neurons.

- **Neuroglia** also known as glial cells, act as the 'helper' cells of the nervous system. Each neuron in the body is surrounded by anywhere from six to sixty neuroglia that protect, feed, and insulate the neuron. Because neurons are extremely specialized cells that are essential to body function and almost never reproduce, neuroglia are vital to maintaining a functional nervous system.

- **Neuroendocrinology** is a field of study that investigates two-way brain communication via the neuro-endocrine, autonomic, immune and metabolic systems. It is the science and study of the brain which involves observing the actions of circulating hormones on brain function, to include genomic, indirect genomic and non-genomic actions of hormones encompassing the entire central nervous system as aging occurs. This research has discovered the remodelling of brain architecture mediated by circulating hormones working together with other mediators.

- **Oedema** is a build-up of fluid in the body which causes the affected tissue to become swollen. As regards the menstrual cycle, the beginning of the menstrual

cycle, the follicular phase, is marked by increased amounts of oestrogen and lower levels of progesterone; this combination is responsible for oedema and increased blood flow to the structures–polysaccharides break down and bind water more rapidly, causing fluid build-up.

- **Oestrogen/estrogen** is the main female sexual hormone, which is responsible for the regulation and development of the female reproductive system, along with secondary sexual characteristics. Oestrogen is a hormone which is secreted by the ovaries. In female reproduction it has two primary functions: it stops the production of FSH (follicle stimulating hormone) to ensure that only one egg matures during the normal 28 day fertility cycle, and it is also responsible for stimulating the luteinizing hormone LH (causing the development of the corpus luteum whose function it is to produce progesterone in order to sustain pregnancy). Oestrogen is generated primarily in the ovaries; however it is also created by fat cells as well as by the adrenal gland. It has emerged that oestrogen is also implicated in brain signalling, particularly in relation to fear processing.

- **Oxytocin** is a neuropeptide which is implicated both in prosocial behaviour and the central nervous control of neuroendocrine responses to stress. It is considered to enhance the buffering effect of social support on stress responsiveness. It is implicated in social bonding, and involved in sexual reproduction in both sexes. It was previously labelled as the pregnancy hormone because it plays numerous roles during and after childbirth.

- **Perfectionism** is a common personality characteristic that may affect all domains of life. Perfectionism can undermine flourishing and stand in the way of emotional, psychological and social well-being. An accepted model of perfectionism

has identified three basic forms of perfectionism: self-orientated, other-orientated, and socially prescribed. However, not all dimensions of perfectionism undermine flourishing. Perfectionistic strivings, when the motivations come from self-oriented perfectionism, can motivate the individual. Socially prescribed perfectionism which occurs as a result of perfectionistic concerns is negatively related.

- **Perfectionism (Self-orientated)** reflects beliefs that striving for perfection and being perfect are important. It is a mixed adaptive-maladaptive form of perfectionism which is often associated with negative characteristics but may also show positive relationship with positive characteristics, functional processes and psychological adjustment.

- **Perfectionism (Other-orientated)** reflects beliefs that it is important for others to be perfect. This is also a mixed adaptive-maladaptive form of perfectionism.

- **Perfectionism (Socially prescribed)** reflects beliefs that striving for perfection and being perfect are important to others. Socially prescribed perfectionists believe that others expect them to be perfect. Only socially prescribed perfectionism is identified as purely maladaptive and is consistently associated with negative characteristics and dysfunctional processes and indicates psychological maladjustment.

- **Peripheral immune system** responds to infection by producing pro-inflammatory cytokines which act on the brain to cause individuals to feel ill, thereby inducing sickness behaviour so that the body receives the rest it needs to recover from the peripheral infection.

- **Presbyphonia** is a term used to describe structural changes of the larynx caused by aging, which may account for voice alterations as a person gets older.

- **Progesterone** is a steroid hormone secreted by the corpus luteum, the adrenal glands and, in the case of an established pregnancy, the placenta. It acts on the lining of the uterus, the myometrium (smooth muscle of the uterus), the cervix, as well as the fallopian tubes, the vagina, the ovaries, the breasts and, importantly, the hypothalamus.

- **Pro-inflammatory corticoids** are also hormones of the adrenal cortex, known also as mineralocorticoids.

- **Psychological factors** include variables associated with individual differences in negative (anxiety, depression) and positive (joy) moods and emotions, the ability to appraise potential stressful events, problem solving, engagement of emotion regulation (distraction or relaxation), and coping. Psychological variables also involve behaviours, both positive (exercise) and negative (substance abuse).

- **Psychoneuroimmunoendocrinology** (mind-body medicine) describes an approach to medicine which considers that our biology and psychological states are deeply linked and between them serve to develop and maintain our health to ensure survival. Psyco- the study of psyche and emotions; neuro- the nervous system, our electrical wiring and messaging; immuno-the immune defence system; and endocrinology- the hormonal chemical messaging system.

- **Resilience** means, to most people, ‘achieving a positive outcome in the face of adversity’. This can involve ‘bending and not breaking’, that is, recovering from a bad experience, or it can involve ‘active resistance’ to adversity through coping

mechanisms that operate at the time of trauma Karatsoreos and McEwan (2011).[46] This does not, by itself, indicate flexibility in successful adaptation to new challenges over the life-course. The personal traits that allow more flexible outcomes undoubtedly depend on a foundational capacity of the individual which is built upon experiences in the life course, particularly early in life, that promotes healthy brain architecture. A healthy brain provides the basis for good self-esteem and a locus of control for effective self-regulation, not only in behaviour but in the physiological responses to stressors which are regulated in the central and peripheral nervous systems according to McEwan, Gray and Nasca (2015).[47]

- **Social factors** include variables such as social support (measured by the number of people in a person's social network), the kinds of support (whether informational or emotional), and broader macro social factors like socio-economic status, ethnicity and culture.

- **Steroid hormone** is a steroid that acts as a hormone. Steroid hormones can be grouped into two classes: corticosteroids (typically made in the adrenal cortex) and sex steroids (typically made in the gonads or placenta). Within those two classes are five types according to the receptors to which they bind: glucocorticoids, mineralocorticoids (corticosteroids), androgens, oestrogens, and progestogens (sex steroids). Vitamin D derivatives are a sixth closely-related hormone type with homologous receptors. They have some of the characteristics of true steroids as receptor ligands. Steroid hormones help control metabolism, inflammation, immune functions, salt and water balance, development of sexual characteristics, and the

[46] Karatsoreos and McEwen, (2011), in Bruce S. McEwen, Jason D. Gray and Carla Nasca, 'Recognizing resilience: Learning from the effects of stress on the brain', *Journal of Neurobiology of Stress* 1(2015), 1.
[47] Bruce S. McEwen, Jason D. Gray and Carla Nasca, 'Recognizing resilience: Learning from the effects of stress on the brain', *Journal of Neurobiology of Stress* 1(2015), 1-11.

ability to withstand illness and injury. The term steroid describes both hormones produced by the body and artificially produced medications that duplicate the action for the naturally occurring steroids. (Note: The author observes from gaps in the research that it is as yet unknown whether artificially produced medications fully duplicate the entire range of actions involving multiple organ locations, encompassed by naturally occurring hormones in the body).

- **Stress (in biological terms)** is any source that causes the body to react with more physical or mental tension than the physical or mental energy that is needed to perform a task. Hans Selye (1974) maintained that the only way to avoid stress is to do nothing at all, or be actually dead (that is to say, it is impossible to avoid stress). Stress can also be positive or motivating. Good stress is called eustress. Bad stress is the feeling of being under too much mental or emotional pressure. Pressure turns into maladaptive stress when the individual feels unable to cope. This can cause the individual distress. People have different ways of reacting to stress, so a situation that feels stressful to one person may in fact be motivating to another. There are three types of stress:

- **Stress (Acute)** is the most common form of stress. It comes from demands and pressures of the recent past and anticipated demands and pressures of the near future. Acute stress can be thrilling and exciting in small doses, but too much is exhausting. Skydiving could be seen as an exciting example of this sort of stress. Overdoing it on short-term stress can lead to psychological distress, tension headaches, upset stomach and other symptoms. Because it is short term, acute stress doesn't have enough time to do the extensive damage associated with long-term stress. The most common symptoms are: Emotional distress–some combination of anger or irritability, anxiety and depression, the three primary stress emotions.

Physical problems associated with acute stress include muscular problems, (such as tension headache, back pain, jaw pain and the muscular tensions that lead to pulled muscles and tendon and ligament problems), stomach, gut and bowel problems (such as heartburn, acid stomach, flatulence, diarrhoea, constipation and irritable bowel syndrome). Transient over-arousal leads to elevation in blood pressure, rapid heartbeat, sweaty palms, heart palpitations, dizziness, migraine headaches, cold hands or feet, shortness of breath, and chest pain. Acute stress can crop up in anyone's life, and it is highly treatable and manageable.

- **Stress (Episodic Acute)** applies to those who suffer acute stress frequently, whose lives are so disordered that they are in chaos and crisis mode. Another form of episodic acute stress comes from ceaseless worry. The symptoms of episodic acute stress are the symptoms of extended over-arousal: persistent tension headaches, migraines, hypertension, chest pain, and heart disease. Treating episodic acute stress requires intervention on a number of levels, generally requiring professional help, which may take many months.

- **Stress (Chronic/Habitual)** this is the grinding stress that wears people down, day after day, year after year. Chronic stress destroys bodies and minds. It can be the stress of poverty, of dysfunctional families, of being trapped in an unhappy marriage or in a despised job or career. It is the stress of unrelenting demands and pressures for seemingly interminable periods of time. It becomes ingrained. Some chronic stresses stem from traumatic, early childhood experiences that become internalized and remain forever painful and present. Some experiences profoundly affect a personality, creating a view of the world, or a belief system, that causes unending stress for the individual (that is, you must be perfect at all times). When personality or deep-seated convictions and beliefs must be reformulated, recovery

requires active self-examination, often with professional help. Chronic stress kills through suicide, violence, heart attack, stroke and on occasion, cancer. The individual suffers breakdown. Because physical and mental resources are depleted through long-term attrition, the symptoms of chronic stress are difficult to treat and may require extended medical as well as behavioural treatment and stress management.

- **Total stress quotient** relates to the factors present in the lives of, in this case, professional performers which contribute to or generate an aggregate amount of stress beyond what might be expected, contributing to a lifestyle of overwhelming stress unique to the music profession.

- **Well-being** is described as optimal experience and psychological functioning. Measures include, hedonic (pleasure, positive mood, life satisfaction) and eudaimonic, those concerned with maximising human potential, such as autonomy, environmental mastery, self-acceptance, personal growth, life purpose, positive interpersonal relationships, and personal vitality.

CHAPTER 2: A Series of Literature Reviews

The occupation of elite singing

Abbate and Parker (2012) discuss the origins and development of classical singing which endures as an acoustic experience.[1] Elite male and female soloists exert considerable vibratory effort, especially in opera where the size of the modern orchestra and auditoria can be considerable. Skålevik (2013) describes the corresponding history and development of performance spaces in relation to sound requirements through the field of acoustic research.[2] Success in relation to acoustic design in modern theatres and other performance venues and the variance in 'signal to noise ratio' create challenges for singers with regard to vocal strain, according to Sataloff (2010).[3]

Modern entry to the singing profession and how free-lancers (self-employed solo singers) conduct their careers is different to the days when financing consisted of grand patronage in aristocratic homes. A performing career could (almost) be considered much like any other specialist occupation; for example, those who are employed in consultancy roles. Allvin (2008) notes that specific work conditions might be conceptualised as boundaryless work, suggesting:

> Work conditions are becoming more individualised, unpredictable, geographically dispersed as contemporary work life is going through structural changes with the

[1] Carolyn Abbate and Roger Parker, *A History of Opera: The Last 400 Years* (London: Penguin Group, 2012).
[2] Magne Skålevik, 'The Origin of the (performance) spaces', *akuTEK research* <www.akutek.info/concert_hall_accustics_files/origin_of_spaces.htm > [Accessed 4 November 2013].
[3] Robert T. Sataloff, 'Acoustics: What We Need To Know About Our Environment', *Journal of Singing* 66 (2010), 430.

consequence that, for example, fewer individuals can rely on finding permanent employment. Boundaries in time and space are broken down.[4]

Occupational strain

Professional performance is an occupation uniquely difficult to maintain because of certain factors. According to Sternbach (1993), musicians generate a 'total stress quotient' (beyond what might be expected relative to other stressful occupations).[5] Brodsky (1996) reports constant performing and other stressors–including separation from family, monotony, irregular hours and regular travel–contribute to a lifestyle of overwhelming stress.[6] Occupational stress according to Kenny and Cooper (2003) recognises the link between worker strain and ill health.[7] According to Kenny (2005), performance anxiety relates to a group of disorders that affect individuals in a range of endeavours, not just in musical performance, for example, in test taking, maths, sport, sexual performance, public speaking, acting, dance, with 'females being 2 to 3 times more likely to experience anxiety than males'.[8] Vaag, Bjørngaard, and Bjerkeset (2015) identify higher occurrences of anxiety and depression among

[4] M. Allvin, 'New rules of work: exploring the boundaryless job', in K. Näswall, J. Hellgren and M. Sverke (eds.), *The Individual in the changing working life* (Cambridge: Cambridge University Press, 2008), 18.
[5] D. Sternbach, (1993) in Warren Brodsky, 'Music Performance Anxiety Reconceptualized', *Medical Problems of Performing Artists* 11(1996), 89.
[6] The top four stressors reported by professional musicians were Separation from family, irregular hours, monotony of rehearsals, and travel see, Warren Brodsky, 'Music Performance Anxiety Reconceptualized', *Medical Problems of Performing Artists* 11(1996), 91.
[7] Dianna T. Kenny and Cary L. Cooper, 'Introduction: Occupational Stress and Its Management', *International Journal of Stress Management* 10 (2003), 275-279.
[8] Dianna T. Kenny, 'Performance Anxiety: Multiple Phenotypes, One Genotype? Introduction to the Special Edition of Performance Anxiety', *International Journal of Stress Management* 12 (2005), 307- 311.

music professionals compared to the general workforce.[9] Kenny (2011) clarifies factors influencing the acquisition of overwhelming fear.[10] She states:

> There is no consensus regarding the definition of music performance anxiety. The term 'stage fright' has been used interchangeably, somewhat unsatisfactorily, with the term 'music performance anxiety'. In attempting to capture the essence of the condition, current conceptualizations of music performance anxiety are viewed as a dimensional construct, as occupational stress, as a focal anxiety disorder, as social anxiety or social anxiety disorder (social phobia), and as a panic disorder. The comorbidity of music performance anxiety with other disorders is also considered, in particular social anxiety disorder. A number of frequently observed characteristics of people who suffer performance anxiety include trait anxiety, neuroticism, negative affectivity, introversion, and behavioural inhibition; fear of negative evaluation; low self-concept, self-esteem, self-efficacy, and locus of control; perfectionism; narcissism and shame.[11]

The occupation includes frequent displacement which involves regularly having to negotiate between home, and abroad, between native culture and adopted culture and, whilst western music is a universal language, according to Trin T. Minh-ha (1994), every journey could be said to embroil the individual in an inner re-setting of internal boundaries.[12] New countries involve perhaps new languages and new cultures; new companies involve assimilating processes, perhaps unspoken or not overtly acknowledged, which first involve comprehending the inherent hierarchy. This adjustment on the part of the singer must occur on a regular basis for work;

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[9] Jonas Vaag, Johan Håkon Bjørngaard, and Ottar Bjerkeset, 'Symptoms of Anxiety and Depression among Norwegian Musicians Compared to the General Workforce', *Psychology of Music* 43 (2015), 1-15.
[10] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (2011), 73-74.
[11] Ibid.81-82.
[12] Trin T. Minh-ha, 'Other than myself/my other self', in George Robertson et al. (eds.), *Travellers' tales: Narratives of Home and Displacement* (London: Routledge Press, 1994), 8-26.

therefore, the personality of the singer must be flexible enough to cope with this constant upheaval.

Training

Voice training is an activity that requires many years of concentrated focus in order to reach what is considered a professional standard. It is widely recognised that vocal ability is only one element involved in training. Other abilities include musicality, intellect, visualisation, language skills, physical agility, appearance, personality, and application to learning. According to Davidson (2002), success in training involves repetition, requiring traits of persistence, mental flexibility and a willingness to accept correction.[13] J. B. Steane (1974) chronicles great historical singers through the development of recording technology dating from before electricity, and charts the schools of thought and changes in vocal aesthetics through these recordings.[14] Great singers and teachers of singing have passed down their thoughts regarding voice and career which in turn influence the singers of today. Miller (1977) investigated the tonal preferences in the different schools of singing. Whilst the nature of contemporary classical singing is at its core international, Miller cautions that it would be false to consider that all international artists share the same techniques or indeed the same tonal ideas as a result of the globalisation of the industry.[15] However, consistent standards in the teaching of classical singing, and certainly the misuse of so called 'scientific information' according to Miller (2011), is to be cautioned against.[16] McCoy (2016) also raises concerns about what he considers a

[13] Jane Davidson, 'Developing the ability to perform', in John Rink, *Musical Performance* (Cambridge: Cambridge University Press, 2002), 89-101.
[14] J. B. Steane, *The Grand Tradition: Seventy years of Singing on Record* (London: Duckworth 2nd edn 1978).
[15] Richard Miller, *English, French, German and Italian Techniques of Singing: A Study in National Tonal Preferences and How They Relate to Functional Efficiency* (USA: Scarecrow Press, 1977), 196.
[16] Richard Miller, *On The Art of Singing* (New York: Oxford University Press, 2011), 249-252.

troubling aspect in current singing and teaching of singing, that is, the proliferation of 'trademarked teaching methods'. Singing, he argues, is widely accepted to be a physiologic function, the canons of which are well documented and ought to be universally understood.[17] Clark and Lisboa (2013) point out that 'a musician's training rarely addresses the physical and psychological attributes or skills needed to sustain a professional career'.[18] The decline in longevity of singing careers and the reduction in security of singing technique have been attributed to a combination of factors. These include frequent travel, movement away from the Italian school towards differing schools of thought in vocal pedagogy, changing musical aesthetic in singing (loss of adherence to connected air flow by regular use of sustained portamento, for example), increased emphasis on the visual aesthetic and athleticism (singing from positions that hinder breath support) and increasing focus on the acting ability of singers which is currently required to mirror cinematic production styles (video production and live internet streaming), coupled with contemporary musical composition styles (the loss of the lyrical vocal line), increased orchestrations and larger auditoria. These problems were observed by Will Crutchfield (1986):

> We have more attractive, efficient, adaptable, versatile operatic team players than in the past. But, though nature has continued to produce beautiful voices in abundance, there can be no question that the level and soundness of their cultivation–their preparedness to function beautifully and reliably in difficult music, to retain quality

[17] Scott Mc Coy, 'Optimal Singing With PMS', *Journal of Singing* 73 (2016), 171.
[18] Clark and Lisboa (2013) in Jane Oakland, Raymond MacDonald and Paul Flowers, 'Musical disembodiment: A phenomenological case study investigating the experiences of operatic career disruption due to physical incapacity', *Research Studies in Music Education* 36 (2014), 40.

> under stress and over length of career, to encompass the fine points of vocal art and to maintain a consistent standard–have, with brilliant exceptions, suffered badly.[19]

External and internal pressure to sing to perfection as well as to look perfect in roles has placed added burden on elite singers. Many singers routinely lie or conceal information about their ages.[20] According to Spalla and Sataloff (2011), singers are more regularly undergoing cosmetic procedures.[21] Briquelet (2015) describes the challenges of renowned artist Deborah Voigt, who experienced problems with excess weight throughout her career.[22] Visual aesthetics are important. Increasingly, operatic productions are streamed live to cinemas or disseminated over the internet.[23] However, those who are the most attractive do not always have the best voices or securest singing techniques. Casting decisions made as a result of visual aesthetics might place some singers in roles which are too heavy, large, or demanding, too soon. This puts young singers at risk of injury. The implications of injury due to singing the wrong repertoire, added to post-educational instability for aspiring soloists, is commented upon by Lebrecht (2013),[24] and Lebrecht (2014): [25] 'the short duration of residencies and young artist programmes, increased travel and cost

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[19] William Crutchfield, 'Vocal Burnout at the Opera', *The New York Times* (1986) <http://www.nytimes.com/1986/09/21/magazine/vocal-burnout-at-the-opera.html > [Accessed 20 February 2015].
[20] Many singers contacted for this study refused to provide information regarding date of birth.
[21] Thomas C. Spalla and Robert T. Sataloff, 'Facial Plastic Surgery in Singers', *Journal of Singing* 67 (2011), 551-560.
[22] Kate Briquelet, 'An Opera singer on life after she was fired for being too fat', *New York Post*, 11 January 2015 <http://www.nyp.st/1AD4T3F > [Accessed 16 January 2015].
[23] An Irish example of such an arts streaming platform is available at <www.Platformireland.ie> [Accessed 21 May 2016]; See Also Opera Platform, at <www.theoperaplatform.eu.> [Accessed 21 May 2016]; Met live in HD global streaming locations for new productions from the Metropolitan Opera, New York <http://www.metopera.org/metopera/liveinhd/international_locations.aspx> [Accessed 21 May 2016].
[24] Norman Lebrecht, 'The Opera Companies that Charge Young Singers to Audition', *Slipped Disc, Arts Journal blog*, 20 March 2013 <www.artsjournal.com/slippeddisc/2013/03/the-opera-companies-that-charge-young-singers-to-audition> [Accessed 31 December 2013].
[25] Norman Lebrecht, 'Opera Star: Young Artists Programs are ripping off young artists', *Slipped Disc, Arts Journal blog*, 25 November 2014 <http://slippedisc.com/2014/11/opera-stalwart-young-artist-programs-are-ripping-off-young-artists/ > [Accessed 26 January 2015].

factors of funding vocal teaching, coaching, partaking in competitions and even auditioning' has meant the financial cost versus the reward of pursuing a career in singing can be prohibitive.

Concerns about the vocal instrument and physical fitness pre-occupy singers, according to Sandgren (2002).[26] Sandgren (2009) suggests that singers are more concerned with health anxiety than with performance anxiety.[27] Kennedy (2013) reports that operatic singers have been the subject of critique for frequent performance cancellations in the prestigious opera houses.[28] However, brief short-term contracts and the seasonal nature of this career mean that soloists experience underemployment and face relentless pressure to prove themselves repeatedly to each new company, production team, and audience throughout their performing life. With the priorities of training focused elsewhere, according to Chapman (2011),[29] little or no instruction given in the music academy regarding the fees of musical agents or, as mentioned in Fleming (2004), the business of operating essentially as a sole trader.[30] Professional interactions may be highly complex. Considering the length of time spent studying, the years spent trying to establish a reputation as a soloist, the ongoing pressure of auditioning, being in constant competition for work with peers–these issues, irrespective of whether involved in any other occupation, make for an intensely challenging working environment.[31]

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[26] Maria Sandgren, 'Voice, Soma and psyche: A qualitative and quantitative study of opera singers', *Medical problems of performing artists* 36 (2002), 11-21.
[27] Maria Sandgren, 'Health Anxiety Instead of Performance Anxiety Among Opera Singers', Paper presented at the 7th triennial Conference of European Society for the Cognitive Sciences of Music, Jyväskylä, Finland (2009), 468-474.
[28] Maev Kennedy, 'Royal Opera music director rails at young opera stars' 'weakness' *The Guardian* 13 March 2013 < www.theguardian.com › Arts › Music › Opera> [Accessed 19 March 2013].
[29] Janice L. Chapman, 'Priorities in developing the young adult classical singer at music college', *Logopedics Phoniatrics Vocology* 36 (2011), 28-31.
[30] Renée Fleming, 'Business' *The Inner voice* (New York: Penguin, 2004), 111-134.
[31] Clifton Ware, *Basics of Vocal Pedagogy*: *The Foundations and Process of Singing* (USA: University of Minnesota, McGraw-Hill, 1998), 244-247.

The dwindling mentoring system that once provided financial assistance to performing artists by wealthy patrons has all but vanished in recent times. Whilst government funding is key to many artists, during periods of economic recession these budgets are substantially reduced. According to Mazelis (2013),[32] and Higgins (2013), [33] bankruptcy involving major operatic houses on both sides of the Atlantic illustrates that the last recessionary period has been especially difficult because of its global nature. Economic recession has implications for all arts endeavours and classical singing is no exception. Recessionary periods according to Ünal-Karagüven (2009), create psychological stress and changes in behaviours.[34] Audience numbers attending live theatre fall sharply when disposable incomes decline, as do voluntary artistic contributions. The growth sector which is live streaming, according to Burton-Hill (2015), may have had a role to play in declining audiences for opera in theatres over the last decade.[35]

Underemployment – Teaching singing to supplement income

Free-lance singing is unlikely ever to generate constant income streams due to the seasonal nature of operatic endeavours. Barnes-Burroughs and Rodrigues (2012) discuss issues of underemployment, particularly difficulties experienced attaining adequate incomes which frequently require freelancing singers to engage in

[32] Fred Mazelis, 'New York City Opera announces Bankruptcy', *World Socialist Web Site* 2 October 2013 <www.wsws.org/en.articles/2013/10/02/nyco-o02.html> [Accessed 5 November 2013].
[33] Charlotte Higgins, 'Arts Council considers opera shakeup as ENO posts £2.2m loss', *The Guardian* 16 January 2013 <www.theguardian.com/music/2013/jan/16/arts-council-opera-eno-loss/print> [Accessed 5 November 2013].
[34] Hülya M. Ünal-Karagüven, 'Psychological Impact of an Economic Crisis: A Conservation of Resources Approach', *International Journal of Stress Management* 16 (2009), 177-194.
[35] Clemency Burton-Hill, 'Is watching opera in the cinema just as good?', BBC Culture *COUNTERPOINT* 14 January 2015 <http://www.info@operaamerica.org> [Accessed18 January 2015].

supplemental employments.[36] Many teach singing or undertake other work, and this has implications for habitual voice use. Titze (2007) observes that when the voice is used to teach and demonstrate to students in lessons for long hours every week, this can impact the functional voice, affecting levels of tiredness and freshness when subsequently performing in singing engagements.[37] Teaching also requires that the voice is used differently to rehearsing or performing. Nelson et al. (2002) observe vocal problems and injury amongst teachers.[38] Norris (2006) explains that sitting whilst teaching for long periods can impact general fitness.[39] According to Morrow and Connor (2011), music teachers are over four times more likely than classroom teachers to develop voice disorders and are more than eight times more likely than the general public to have voice-related problems.[40] Other part-time employments reduce the personal rehearsal time required in order to sufficiently memorise performing repertoire. Adequate recovery time, according to McHenry, Evans and Powitzky (2016), is advised after taxing vocal performances, for example, singing an operatic role, and necessary to aid laryngeal recovery.[41] However issues regarding sufficient recovery time may occur when engaged in multiple employments. Bartlett and Wilson (2016) identify the mis-use or overuse of the speaking voice necessitated by 'day jobs' as being instrumental in professional vocal problems, not the misuse of

[36] Kathryn Barnes-Burroughs and Michael C. Rodrigues, 'The Teaching Performer: A Survey of Assets Versus Choices in Voice Use', *Journal of Voice* 26 (2012), 642-655.
[37] Ingo R. Titze, 'Vocal demands on Teachers', *Journal of Singing* 64 (2007), 67-69.
[38] Roy Nelson et al., 'Voice Amplification Versus Vocal Hygiene Instruction for Teachers With Voice Disorders: A Treatment Outcomes Survey', *Journal of Speech, Language and Hearing Research* 45 (2002), 625-638.
[39] Richard N. Norris, 'Seating problems of Vocalists' in Robert T. Sataloff (ed.), *Vocal Health and Pedagogy* (San Diego: Plural Publishing 2nd edn 2006), 95-98.
[40] S. L. Morrow and N. P Connor, (2011) in Claudia Manfredi & Philippe H. Dejonckere, 'Voice dosimetry and monitoring, with emphasis on professional voice diseases: Critical review and framework for future research', *Journal of Logopedics Phoniatrics Vocology* (2016), 53. http://dx.doi.org/10.3109/14015439.2014.970228 [Accessed 21 April 2017].
[41] Monica McHenry, Joseph Evans and Eric Powitzky, 'Vocal Assessment Before, After, and the Day After Opera Performance', *Journal of Voice* 30 (2016), 186.

the singing voice.[42] Brinton, Fujiki and Sivasankar (2016) review the literature on vocal loading and fatigue. They comment that measurements of vocal loading, vocal loading tasks VLTs operate in a way which is multifactorial. Intrinsic and extrinsic factors interact in such a way that optimal laryngeal functioning during these tasks might no longer be possible. As a result, different VLTs interact differently between individuals making them difficult to standardise for research purposes. They advise that further research is required in this area.[43] Sandgren (2005) differentiates between what are described as functional as opposed to psychogenic voice disorders.[44] Sandgren and Ericsson (2007) point out that vocal problems may arise due to anxiety amongst professional singers which originates from complex personality and psychological stressors associated with individual history, learning, and expectations.[45]

According to Bennett (2008), the narrow definition of a musician as performer does not take into account the number of multiple roles which are involved in freelancing.[46] For example, these roles might include self-promotion, working with third parties such as casting control, agents, accountants, conductors, designers or publicists. These roles require development of skills in communication and negotiating, including responsibility for personal taxes, other part-time employments (for example, teaching, event organising, recording), and in other areas requiring

[42] Irene Bartlett and Pat H. Wilson, 'Working 9-5: Casual Relationships Between Singers' "Day Jobs" and Their Performance Work, With Implications for Vocal Health', *Journal of Voice* (2016), 1; http://dx.doi.org/10.1016/j.jvoice.2016.04.003 [Accessed 24 April 2017].
[43] Robert Brinton Fujiki and M. Preeti Sivasankar, 'A Review of Vocal Loading Tasks in the Voice Literature', *Journal of Voice* (2016), 1; http://dx.doi.org/10.1016/j.jvoice.2016.09.019 [Accessed 21 April 2017].
[44] Maria Sandgren, 'Becoming and being an opera singer: Health, Personality and skills' (PhD dissertation, Stockholm University, 2005), 44.
[45] Maria Sandgren and Anders K. Ericsson, 'The Complexity of artistic strivings and anxiety among opera singers', in K. Maimets-Volt, R. Parncutt, M. Marin, and J. Ross (eds.) Proceedings of the third Conference on Interdisciplinary Musicology (CIM07) Tallinn, Estonia, 15-19 August (2007), 1-8 <http://www-gewi.uni-graz.at/cim07/ >[Accessed 31 October 2013]
[46] Dawn Bennett, (2008), 95.

considerable administration, for example, in copyright and the legalities surrounding contracts and intellectual property. Sandgren (2012) confirms that 'working part-time and being active in more than one profession as well as experiencing pressure to perform' means that classical singing professionals cope with many different roles, resulting in highly complex working conditions.[47]

Work/home-life balance and burnout

Occupational roles, including repetitive performing and roles assumed at home, create a total 'life stress' which ensures that a performer's hormonal stress response remains elevated over long periods; the brain and the body interact via complex mechanisms involving feed-back and control, this may eventually lead to ill health due to dysregulation of bodily systems. Cardenas, Major and Bernas (2004) investigate the antecedents and outcomes of time spent in one role whilst distracted or preoccupied by another. Work role overload was found to be positively related to work distractions at home, and traditional gender-role expectations were positively related to family distractions at work.[48] Westman, Etzion and Gortler (2004) explore how travel interacts with work and family conflict and burnout. There were significant differences according to gender. Among women, work family conflict (WFC) decreases between pre-trip and mid-trip but increases significantly upon returning home. For men, the least (WFC) was experienced at this time. Feelings of burnout for women are the same as for men before and during the trip, but decreased

[47] Maria Sandgren, 'Work Attitudes, Role Stress and Health among Professional Singers and Call Centre Employees', paper presented at the 12th Annual Conference on Music Perception and Cognition and the 8th Triennial Conference of the European Society for the Cognitive Sciences of Music, Thessaloniki, Greece, 23-28 July 2012, 883-888 <https://icmpc-escom2012.web.auth.gr/sites/default/files/papers/883_Proc.pdf> [Accessed 31 October 2013]
[48] Rebekah A. Cardenas, Debra A. Major and Karyn H. Bernas, 'Exploring Work and Family Distractions: Antecedents and Outcomes', *International Journal of Stress Management* 11 (2004), 346-365.

significantly upon returning home.[49] Peeters et al. (2005) seek to make clear the distinctions between work and home domains in the explanation of burnout. It was found that job demands and home demands both have direct and indirect effects through work/home interface (WHI) and home/work interface (HWI) respectively, on burnout.[50]

Free-lance singers can experience short-term and touring contracts for their entire career duration. This may cause considerable ongoing home-life disruption and pressure on spousal and familial relationships. Bennett (2008) observes 'female musicians would be more likely to teach, and women traditionally would be less likely to sustain performance positions because of the difficulties with managing a family.'[51] Miller et al. (1986) recognise that long-term difficulties and dependent and independent life situations together with gender independence impact the psychological health of women.[52] Wilhelm, Parker and Dewhurst (1998) state that a greater prevalence of non-melancholic mood disorder is experienced by women in both community and clinical situations. Their study investigates dependency in life situations, and measures of anticipation versus actual life events were solicited from both men and women.[53] According to Vitale (1999), [54] this is the 'lived' experience of women who juggle jobs, children, money, and personal freedom in the fast-paced western world. Throsby and Hollister (2003) observe that 'a substantially larger

[49] Mina Westman, Dalia Etzion and Efrat Gortler, 'The Work Family Interface and Burnout', *International Journal of Stress Management* 11 (2004), 413-428.
[50] Maria C. W. Peeters et al., 'Balancing Work and Home: How Job and Home Demands Are Related to Burnout', *International Journal of Stress Management* 12 (2005), 43-61.
[51] Dawn Bennett, 'A gendered study of the working patterns of classical musicians: implications for practice', *International Journal of Music Education* 26 (2008), 89. [Accessed 24 January 2013]
[52] M. P. Miller et al., 'The epidemiology of life events and long term difficulties, with some reflections on the concept of independence', *The British Journal of Psychiatry* 148 (1986), 686-696.
[53] K. Wilhelm, G. Parker and J. Dewhurst, 'Examining sex differences in the impact of anticipated and actual life events', *Journal of Affective Disorders* 48 (1998), 37-45.
[54] S. M. Vitale (1999) in Dawn Bennett, 'A gendered study of the working patterns of classical musicians: implications for practice', *International Journal of Music Education* 26 (2008), 89.

proportion of females rather than males believe that caring for children restricted their careers as artists'.[55] For those women who struggle to continue to perform at previous rates after the arrival of children, the separation from family may impact social supports and may increase feelings of social isolation. Soloists are not full-time employees within most operatic companies (with the exception of the German system), but are regarded as temporary visitors; as such, they may not be aware of company supports.[56] It is also likely that the treatment of visiting artists may vary considerably between companies.

Identity

Barker et al. (2009) report that artists experience societal devaluation for work, which has implications for underselling, stigma, injury, and unrealistic expectations, and that underemployment seriously impacts these musicians.[57] This study also recognises that, in western culture, occupation is central to identity; thus the artist's ideas of 'social identity' constitutes a large portion of the identity of 'the self'.[58] Nagel (2009) points out that, often, musicians commence training in early childhood, a circumstance which represents considerable ego investment and means that career identity is closely connected to the development of the identity of the self.[59] Unfortunately, a career in music often involves renegotiation of an individual's musical identity, as Oakland, MacDonald and Flowers (2012), describe in their study of six opera choristers who were unexpectedly made redundant. They report that,

[55] D. Throsby and V. Hollister, (2003) in Dawn Bennett, (2008), 91.
[56] Interview with, Elizabeth Bishop, Health and Safety Supervisor at Welsh National Opera, Wales Millennium Centre, Cardiff, Wales, 2015.
[57] Keegan K. Barker et al., 'Occupational strain and professional artists: A qualitative study of an underemployed group', *Arts and Health* (2009), 136-137.
[58] Ibid. 146.
[59] Julie. J. Nagel (2009) in Peter Iltis, 'Medical and Scientific Issues Music Performance Anxiety', *Journal of the International Horn Society* (2012), 53.

subsequent to redundancy, these individuals struggled to develop new areas of 'the self' and restore the 'established self'.[60] Professional choristers, however, usually can enjoy full-time employment, in contrast to the experiences of most solo, freelance artists. Kenny, Davis and Oates (2004) found lack of confidence and issues with perfectionism among professional operatic choristers, and suggest that occupational stress makes a separate contribution to the quality of working life experienced by elite artists.[61]

Oakland, MacDonald and Flowers (2013) comment that, for singers–who communicate through their bodies–identity of the voice is highly salient to self-identity and this is distinct from other musicians who play externally produced instruments: 'The instrument of the voice grows with the body and dies with the body.'[62] Oakland, MacDonald and Flowers (2014) comment on the importance of generating a flexible approach to identity formation for career longevity in singing. Otherwise, issues such as breakdown in the relationship with music, career disappointment and burnout resulting from perhaps idolised, unrealistic or unsustainable career expectations may occur.[63]

[60] Jane Oakland, Raymond MacDonald and Paul Flowers, 'Re-defining 'me': Exploring career transition and the experience of loss in the context of redundancy for professional opera choristers', *Journal of Musicae Scientiae* (2012), 1-13, http://msx.sagepub.com/content/early/2012/03/06/1029864911435729 [Accessed 24 May 2017].
[61] Dianna T. Kenny, Pamela Davis and Jenni Oates, 'Music performance Anxiety and Occupational Stress Amongst Opera Chorus Artists and Their Relationship with State Trait Anxiety and Perfectionism', *Journal of Anxiety Disorders* 18 (2004), 757-777.
[62] Jane Oakland, Raymond MacDonald and Paul Flowers, 'Identity in crisis: The role of work in the formation and renegotiation of a musical identity', *British Journal of Music Education* 30 (2013), 262.
[63] Jane Oakland, Raymond MacDonald and Paul Flowers, 'Musical disembodiment: A phenomenological case study investigating the experiences of operatic career disruption due to physical incapacity', *Journal of Research Studies in Education* 36 (2014), 40.

Gender bias in music management

Producers, managers and conducting professionals are generally accepted as holding the power of hiring and firing within today's classical employment environment and, in particular, the recording industry.[64] With these professionals being predominantly male, the gender imbalance in classical western music, especially in the conducting profession, continues to create some controversy.[65] The social factors affecting women including the dominance of male conductors (many of whom have casting control with regard to hiring and firing) who may hold artistic positions within companies, determines how singers experience hierarchy within this profession. Kennedy (2013) comments on accusations of 'weakness', from the director of Royal Opera Covent Garden against young singers for frequent performance cancellations.[66] Labels delivered in such fashion are not helpful; however, they serve as reminders that the classical music industry is self-regulated and is thus open to abuses.

Professional Issues – legal, tax, communications, insurance

Singers, as self-employed professionals, are responsible for all declarations to revenue and this means complexity and time involved in preparing submissions, a task which often requires the help and expertise of professional accountants. The nature of freelancing means that, often, singers may also require agent representatives to advise and negotiate on their behalf with international companies.

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[64] David Patmore, 'Recording and the Rattle Phenomenon' in Amanda Bayley (ed.), *Recorded Music: Performance, Culture and Technology* (Cambridge: Cambridge University Press, 2010), 125-145.
[65] Ivan Hewett, 'Gender Should Have Nothing To Do With Conducting', *The Telegraph* 4 September 2013 <www.telegraph.co.uk/culture/classicalmusic/10284689/Gender-should-have-nothing-to-do-with-the-art-of-conducting.html> [Accessed 3 November 2013].
[66] Maev Kennedy, 'Royal Opera music director rails at young opera stars' 'weakness', *The Guardian* 13 March 2013 < www.theguardian.com › Arts › Music › Opera> [Accessed 19 March 2013].

Technological advances mean that singers frequently partake in multimedia recordings.[67] According to Cottrell (2010), conductors continue to dominate positions of influence in sound recording.[68] Historically (early nineteen hundreds) when recording was new, singers recorded best and this area was the domain of vocal artists, remarks Day (2000).[69] According to Toronto and Wood (2013),[70] possessing knowledge of copyright and being internet savvy in the fields of mass communications and social media is essential to protecting a career in music. Given the frequency of recording, it is understandable that establishing ownership and rights to reproduction of images and performance material might become domains of issue.[71] When thinking in terms of advances in multimedia recording technology, dissemination of musical and visual product via the internet over the last decade, according to Cooper (2015),[72] the amount of opera being streamed puts into context the changing environment of musical financial management. Financial issues likely occur if an individual suffers injury. The number of performers purchasing personal injury insurance is unknown. It is unlikely that free-lance soloists, even if they have affiliation to a performing arts union, such as Equity in Ireland or the United Kingdom, would seek redress for a stage injury, whether vocal or physical, due to

[67] Gregory Berg, 'Met Opera on Demand: Metoperafamily.org', *Journal of Singing* 70 (2013), 127-130.
[68] Stephen Cottrell, 'The rise and rise of Phonomusicology' in Amanda Bayley (ed.), *Recorded Music: Performance, Culture and Technology* (Cambridge: Cambridge University Press, 2010), 15-16.
[69] Timothy Day, *A Century of Recorded Music: Listening to Musical History* (New Haven: Yale University Press, 2000), 9.
[70] Emily Toronto and Stephen G. Wood, 'Copyright Unplugged: Informed Copyright Behaviour in Recording and Performing Music for the Voice', *Journal of Singing* 70 (2013), 21-29; Emily Toronto and Stephen G. Wood, 'A Call for Copyright Reform', *Journal of Singing* 70 (2013), 173-180.
[71] See 'Intellectual property and Copyright' <www.internetsociety.org/protecting-rights-performers-internet-society-speaks-wipo-diplomatic-conference> [Accessed 8 November 2013].
[72] Michael Cooper, '15 European Opera Houses to Offer Free Online Streaming', *New York Times* 8 May 2015.

concerns regarding damage to reputation by word of mouth impacting future employment.[73]

Other exogenous concerns - onstage hazards

According to Craig (1978), flaws in set building or processes involved when set changing occurs can be hazardous[74] falls from raised platforms, stumbles in dark lighting conditions, lighting rig failures. In addition realism, may sometimes involve artists singing onstage in bare feet. Set building requires the use of many hundreds of small screws and nails; human error in sweeping the stage for these objects has been the cause of many a trip to A&E for stage artists. Aside from physical accidents, vocal injuries are also of considerable concern for singers. Increased production complexity, according to Spandorfer and Pratt Curtiss (2004), brings with it many other potential onstage hazards.[75] These hazards, according to Richter et al. (2002), can range from choking due to the excessive use of dry ice, to allergic reactions derived from chemicals used to treat fabric in order to make it fire retardant. Such chemicals have been known to cause skin and respiratory damage. Some chemicals may be carcinogens.[76] Operatic productions are becoming increasingly more extravagant, and Craig et al. (2011), discuss the stage use of pyrotechnics. Evidence

[73] 'Anon', 'Irish Equity, SIPTU and Equity UK meet to campaign to advance rights for actors', *SIPTU Press Release* 22 May 2013 <http://www.siptu.ie/media/pressreleases2013/featurednews/fullstory_17307_en.html> [Accessed 22 January 2014].
[74] David Craig, *On Singing Onstage* (New York: Applause Theatre Book Publishers, 1978.
[75] Merle Spandorfer and Deborah Pratt Curtiss, 'Health Hazards in the Arts–Can They Affect Singing?', *Journal of Singing* 61 (2004), 55-61.
[76] Bernhard Richter et al., 'Harmful Substances on the Opera Stage: Possible negative Effects on Singers' Respiratory Tracts', *Journal of Voice* 16 (2002), 72-80.

shows, that even short-term exposure to particulate matter can be detrimental to health.[77]

Research regarding sex hormones and the voice

Harries et al. (1996) state that male voices undergo more significant physical changes at puberty (fundamental frequency may drop as much as an octave), making these voices initially more difficult to train.[78] However, once a stable hormonal balance has been established and technique secured, male singers endure little further disruption to the vocal apparatus, excepting those resulting from injury or natural aging. According to Berghs et al. (2013), the main symptom of age-related decline in professional singers is a decrease in highest fundamental frequency.[79]

Puberty and the female voice

Of the research reviewed that relates to observations regarding pubescent female voices, it is widely understood that female voices experience less audible upheaval than male voices at puberty–changes in fundamental frequency vary typically from about a third in female voices in comparison with alterations of perhaps as much as an octave in male voices. Consequently, these changes are discernibly less dramatic than those experienced by male singers.[80] Weiss in Gackle (1991) observes that 'the female larynx increases more in height than width, thus becoming distinctly different from that of the adolescent male'.[81] Gackle (1991), reports that 'insecurity of pitch,

[77] Crystal A. Craig et al., 'Pyrotechnics in the Entertainment Industry: An Update', *Journal of Singing* 67 (2011), 303-309.
[78] M. L. L. Harries et al., 'Changes in the male voice during puberty: speaking and singing voice parameters', *Logopedics Phoniatrics Vocology* 21 (1996), 95-100.
[79] Geert Berghs et al., 'A lifetime of professional singing: Voice parameters and age in the Netherlands Radio Choir', *Logopedics Phoniatrics Vocology* 38 (2013), 59-63.
[80] M. L.L Harries, 'Changes in the male voice during puberty: speaking and singing voice parameters', *Logopedics Phoniatrics Vocology* 21 (1996), 95-100.
[81] Weiss in Lynne Gackle, 'Adolescent Female Voice: Characteristics of Change and Stages of Development', *Choral Journal* (1991), 19.

development of discernible register breaks, increased huskiness, decreased and inconsistent range capabilities, voice cracking, hoarseness and difficulty with phonation are symptomatic with female adolescent voice change'.[82] Decoster et al. (2008) describe findings which suggest that the developmental range available amongst teenage girls may be greater than that which had previously been estimated by Gackle.[83] However, Willis and Kenny (2011), establish that girls who receive voice training can register higher frequencies and appear more confident in voice use than untrained girls.[84] Gackle (2011), explains the nature of the maturing female voices in relation to gradual 'shades of change' which she describes as color variances (in four distinct stages) occurring during adolescence.[85] Research by Elena Blyskal (2012), discusses the issues concerning 'breaks' in young voices. It is widely known that, as well as alterations in the length of the trachea, laryngeal muscles grow and vocal folds thicken in adolescence; thus 'many adolescent females observe more volume for less effort in their lower range, while their higher range may suddenly be difficult to access.'[86]

Pabon et al. (2013) comment that among the goals of voice training is to produce an equalised, consistent, and conventional quality of vocal production. As a result of singing training, voice range profile (VRP) can change in shape, size and quality.[87] However, it should be noted that, when training such voices, Meurer et al. (2009)

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[82] Ibid. 18.
[83] Wivine Decoster et al., 'Great talent, excellent voices–no problem for pubertal girls?', *Logopedics Phoniatrics Vocology* 33 (2008), 104.
[84] Elizabeth C. Willis and Dianna T. Kenny, 'Voice Training and Changing Weight–Are They Reflected in Speaking Fundamental Frequency, Voice Range, and Pitch Breaks of 13-Year-Old Girls? A Longitudinal Study', *Journal of Voice* 25 (2011), e233.
[85] Lynne Gackle, *Finding Ophelia's Voice, Opening Ophelia's Heart: Nurturing the Adolescent Female Voice* (Daton, OH: Heritage Music Press, 2011), 13-15.
[86] Elena Blyskal, 'The Female Primo Passaggio: A Survey of Its Physiology, Psychology and Pedagogy', *Journal of Singing* 69 (2012), 11-19.
[87] Peter Pabon et al., 'Effects on Vocal Range and Voice Quality of Singing Voice Training: The Classically Trained Female Voice', *Journal of Voice* 28 (2013), 36-51.

advise that as well as direct vocal issues, other variables such as fine motor control, fluency, mood, aggressiveness, behaviour, concentration, mental alertness and well-being are also influenced by the secondary effects of oestrogen at this time. Therefore, the combined impact of these variables may be in evidence when developing the voices and mental skills of adolescent females.[88]

Menstrual cycle

Research by Abitbol et al. (1989), identifies that oestrogen target cells are to be found in the larynx, and that fluctuations in levels of oestrogen and progesterone cause laryngeal water retention, oedema of interstitial tissue and venous dilation.[89] Abitbol (2006) charts the voice in terms of history, science and philosophy, synthesising the medical advances regarding the burgeoning understanding of hormonal voice effects.[90]

Newman et al. (2000) reports the presence of androgen, oestrogen and progesterone receptors in the human vocal fold which showed statistically significant differences in age and gender distribution, suggesting that changes in voice due to age could be from hormonal influence.[91]

Amir and Biron-Shental (2004) reveal that thyroid hormone receptors are located in the larynx and therefore are also associated with vocal changes; starting at puberty, fluctuating through the reproductive years and declining at menopause, these

[88] Elisea M. Meurer et al., 'Menstrual Cycle Influences on Voice and Speech in Adolescent Females', *Journal of Voice* 23 (2009), 109-113
[89] Jean Abitbol et al., 'Does a hormonal Vocal Cord Cycle Exist in Women? Study of Vocal Premenstrual Syndrome in Voice Performers by Videostroboscopy-Glottography and Cytology on 38 Women', *Journal of Voice* 3 (1989), 157.
[90] Jean Abitbol, *Odyssey of the Voice* (San Diego: Plural Publishing, 2006).
[91] Scott Robert Newman et al., 'Preliminary Report on Hormone Receptors in the Human Vocal Fold', *Journal of Voice* 14 (2000), 78.

hormones are also thought to directly affect voice and, in particular, the aging process.[92]

Brunings et al. (2013) identify six areas which tested positive for oestrogen receptors and three areas positive for progesterone receptors in the human larynx including one area which tested positive for both oestrogen and progesterone receptors. The function of these receptors is as yet unknown; however, oedema[93] was found to be present at these locations.[94]

Menstrual cycle, health and adverse mood

Davis and Davis (1993) report that symptoms of premenstrual tension include laryngeal joint stiffness, abdominal cramping, anxiety, irritability, and depression. Changes in mood are reported as possible dysfunctions pertaining to the central nervous system (CNS); this suggests that hormone level changes during the menstrual cycle have effects on brain chemistry.[95] Precilla Choi (1999) postulates that the biological disabling symptoms of premenstrual syndrome (PMS) interact with psychosocial symptoms; 'women *feel* more stressed premenstrually and are sure this affects their behaviour'.[96]

[92] Ofer Amir and Tal Biron-Shental, 'The impact of Hormonal fluctuations on female vocal folds', *Current opinion in otolaryngology & head and neck surgery* 12 (2004), 181.
[93] Oedema is swelling due to fluid retention in the tissues. At the beginning of the menstrual cycle, the follicular phase, is marked by increased amounts of oestrogen and lower levels of progesterone. This combination is responsible for swelling or oedema and increased blood flow to the structures. Polysaccharides break down and bind water more rapidly causing fluid build-up. In the second half of the menstrual cycle, the luteal phase, progesterone levels increase to a greater degree than oestrogens. Progesterone promotes sloughing of the Laryngeal epithelium and works against proliferation, it also makes glandular secretions more viscous, it is thought to increase cell damage; (Kadakia, Carlson and Sataloff, 2013, 571).
[94] Jan W. Brunings et al., 'The Expression of Estrogen and Progesterone Receptors in the Human Larynx', *Journal of Voice* 27 (2013), 376.
[95] Clarissa Behr Davis and Michael Lee Davis, 'The Effects of Premenstrual Syndrome (PMS) on the Female Singer', *Journal of Voice* 7 (1993), 341.
[96] Precilla Choi, 'Why I study the menstrual cycle', *The Psychologist* 12 (1999), 338.

Meurer et al. (2009) report that the most common mental symptoms of PMS experienced by adolescents were: pronounced anxiety, sensitivity, agitation, nervousness and emotional instability, depressed mood, feelings of uselessness, greater self-censorship, and increased conflicts with others. Physical symptoms include heavy and swollen breasts, headache, joint pain, muscle pain, swelling sensation, weight gain; and change in appetite, increased hunger and higher food intake.[97]

Weis et al. (2011) whose study excluded women who had taken OCs during the previous six months, reports changes in functional brain organisation in women during the menstrual cycle.[98] Accortt, Kogan and Allen (2013) examined premenstrual dysphoric disorder (PMDD) and women with depression. PMDD is a disorder that places an added burden and predicts a more severe depressive disease trajectory and reduced quality of life.[99] Ossewaarde et al. (2013) observed the menstrual cycle in relation to brain changes and stress sensitivity. Their results show increased grey matter volume in the dorsal part of the left amygdala of the brain during the premenstrual phase when compared to the late follicular phase. This volume increase was positively correlated with the premenstrual increase in stress-induced negative affect. This is the first study showing structural plasticity of the amygdala in humans that is associated with both endogenous gonadal hormone fluctuations and stress sensitivity. It is clear that fluctuating hormonal influences observed during the menstrual cycle are important clues to understanding brain

[97] Elisea M. Meurer et al., 'Menstrual Cycle influences on Voice and Speech in Adolescent Females', *Journal of Voice* 23 (2007), 110.
[98] Susanne Weis et al., 'Dynamic Changes in Functional Cerebral Connectivity of Spatial Cognition During the Menstrual Cycle', *Journal of Human Brain Mapping* 32 (2011), 1551.
[99] Eynav E. Accortt, Anya V. Kogan and John J.B. Allen, 'Personal history of major depression may put woman at risk for premenstrual dysphoric symptomatology', *Journal of Affective disorders* 150 (2013), 1234-1237.

behaviour. The increase in grey matter is thought to be caused by new connections and dendrite spine growth. Furthermore, the association of amygdala and blood pressure reactivity to stress is thought to be mediated by individual differences in amygdala volume.[100] However, researchers are still trying to understand the delicate mechanisms involved in processing of stress stimuli and the brain. Studies involving brain processing have sometimes presented contradictory findings. For example, according to Baur et al. (2013), there is reduced volume connectivity of left and right white-matter fiber tracts in patients with social anxiety disorder (SAD), suggesting deficient structural connectivity between higher-level control areas in the orbitofrontal cortex and more basal limbic areas like the amygdala.[101] However, Brühl et al. (2014), point to hyperactivity in functional processing regions concerned with emotion regulation during episodes of SAD; in particular, increased cortical thickness in the frontoparietal network.[102] In relation to what this might mean in real terms for enabling the design of treatments for these conditions, of particular note is a study by Holzel et al. (2010) referenced within the research of Ossewaarde (2010), which describes a decrease in the volume of amygdala grey matter after a mindfulness-based, stress-reduction intervention.[103]

[100] Lindsey Ossewaarde et al., 'Menstrual Cycle-Related Changes in the Amygdala Morphology are Associated with Changes in Stress Sensitivity', *Journal of Human Brain Mapping* 34 (2013), 1191.
[101] Volker Baur et al., 'Evidence of Frontotemporal Structural Hypoconnectivity in Social Anxiety Disorder: A Quantitative Fiber Tractography Study', *Journal of Human Brain Mapping* 34 (2013), 437.
[102] Annette Beatrix Brühl et al., 'Increased Cortical Thickness in a Frontoparietal Network in Social Anxiety Disorder', *Journal of Human Brain Mapping* 35 (2014), 2966.
[103] Holzel et al., (2010) in Lindsey Ossewaarde et al., 'Menstrual Cycle-Related Changes in the Amygdala Morphology are Associated with Changes in Stress Sensitivity', *Journal of Human Brain Mapping* 34 (2013), 1191-1192.

Menstrual cycle and voice change

Chernobelsky (1998) reports decreases in laryngeal muscular tension during menstruation, which requires increases in effort from singers as a compensatory mechanism.[104] Abitbol, Abitbol and Abitbol (1999) identify that premenstrual vocal syndrome affects around 33% of women and is characterised by vocal fatigue, decreased range, a loss of power and a loss of certain harmonics.[105] According to Won Chae et al. (2001), singers notice changes in voice more readily than nonsingers, because they employ greater range and because of occupational vocal cord abuse. Those affected by the emotional, physical and behavioural changes of PMS were advised to take care not to strain their voices in the premenstrual phase.[106]

Lã and Davidson (2005) conduct a review of the relationship between hormones and western singing so as to draw attention to issues regarding hormonal factors or dysfunction which might precipitate voice problems.[107] Ryan and Kenny (2007) investigate the effects of the menstrual cycle on young female singers. They report that only singers, and not expert listeners, could discern differences in vocal quality during menstruation. However, the study includes those taking oral contraceptives. Singers not taking oral contraceptives report lower voice quality, but their mood was higher than those taking the contraceptive pill.[108] Oberlander (2010) points to the unwillingness of the American classical music system to recognise PMS, either for

[104] Semyon Chernobelsky, 'Effect of the menstrual cycle on laryngeal muscle tension of singers and nonsingers', *Journal of Logopedics, Phoniatrics, Vocology* 23 (1998), 132.
[105] Jean Abitbol, Patrick Abitbol and Béatrice Abitbol, 'Sex Hormones and the Female Voice', *Journal of Voice* 13 (1999), 424.
[106] Sung Won Chae et al., 'Clinical Analysis of Voice Change as a Parameter of Premenstrual Syndrome', *Journal of Voice* 15 (2001), 283.
[107] Filipa M. B. Lã and Jane W. Davidson, 'Investigating The Relationship Between Sexual Hormones And Female Western Classical Singing', *Research Studies in Music Education* (2005), 75-87.
[108] Maree Ryan and Dianna T. Kenny, 'Perceived Effects of the Menstrual Cycle on Young Female singers in the Western Classical Tradition', *Journal of Voice* 23 (2007), 99.

its effects on laryngeal function or emotionally. She observes that belief may have arisen within the industry that PMS represents imagined rather that real difficulties in singing occurring to women over the menstrual cycle.[109]

Çelik et al. (2013) investigate voice and speech changes across the menstrual cycle using acoustic and subjective clinician-based (GRABAS) and self-evaluation (VHI-10) scales. Whilst there were no statistically relevant measures from the acoustic, as had occurred in previous studies perceptual voice assessment showed significant differences among phases in the menstrual cycle.[110]

Kadakia, Carlson and Sataloff (2013) describe further actions of hormones which affect singers including 'dilation of vessels in the nasal passages resulting in changes in patency and the singers' perception of voice'. Included in this report are concerns regarding the influence of pituitary hormone dysfunction with regard to, changing voice effects.[111] Gunjawate et al. (2016) review the literature relating to voice changes in the menstrual cycle. This review omits pubertal, contraceptive and menopausal studies. It recommends that further studies are necessary to observe voice changes during the menstrual cycle. The review advocates sampling more diverse singing populations and using different assessment measures.[112]

[109] Erin Oberlander, 'Premenstrual Syndrome and its Effects on Laryngeal Functionality: An Approach for Singers and Pedagogues', *Journal of Singing* 67 (2010), 27.
[110] Öner Çelik et al., 'Voice and Speech Changes in Various Phases of Menstrual Cycle', *Journal of Voice* 27 (2013), 625.
[111] Sameep Kadakia, Dave Carlson and Robert T. Sataloff, 'The Effect of Hormones on the Voice', *Journal of Singing* 69 (2013), 571-572; These pituitary hormones include growth hormone GH, prolactin, vasopressin, adrenocorticotropic hormone (ACTH), thyroid stimulating hormone (TSH), follicle stimulating hormone (FSH, Luteinizing hormone (LH) and Oxytocin.
[112] Dhanshree R. Gunjawate et al., 'The Effect of Menstrual Cycle on Singing Voice: A Systematic Review', *Journal of Voice* 31 (2016), 188.

Ovulation

Higgins and Saxman (1989) report that ovarian hormones could aggravate or alleviate both neuromotor disorders and sensory threshold, (alterations in sensitivity to pressure, muscle stretch and joint position which has implications regarding laryngeal feed-back control).[113] The study found that there was notable variation in the magnitude of frequency at ovulation.[114] Puts et al. (2013) observe patterns of female attractiveness during peak fertility and report that, during the ovulatory phase, levels of oestrogen and progesterone drive changes in vocal attractiveness.[115] According to Shoup-Knox and Pipitone (2015), the human voice transmits pertinent information regarding health and age. Their study finds that normally cycling females recorded during a high fertility phase were rated more attractive and produced the greatest galvanic skin response (GSR) and Heart Rate (HR) response amongst listeners. It may be significant that there were no differences in response ratings from listeners evaluating the vocal attractiveness of females who were using OCs.[116]

Oral contraceptives and the voice

Amir, Kishon-Rabin and Muchnik (2002) present preliminary observations on the effect of oral contraceptives on the voice and suggest that OCs might increase voice stability associated with hormonal variance.[117] Lã et al. (2006) investigate oral

[113] B. Wyke, (1974), (1979) and (1981) in Maureen B. Higgins and John H. Saxman 'Variations in Vocal Frequency Perturbation Across the Menstrual Cycle', *Journal of Voice* 3 (1989), 234.
[114] Higgins and Saxman, *Journal of Voice* 3 (1989), 239.
[115] David A. Puts et al., 'Women's attractiveness changes with estradiol and progesterone across the ovulatory cycle', *Journal of Hormones and Behavior* 63 (2013), 13.
[116] Melanie L. Shoup-Knox and R. Nathan Pipitone, 'Physiological changes in response to hearing female voices recorded at high fertility', *Journal of Physiology & Behavior* 139 (2015), 386.
[117] Ofer Amir, Liat Kishon-Rabin and Chava Muchnik, 'The Effect of Oral Contraceptives on the voice: Preliminary Observations', *Journal of Voice* 16 (2002), 267. Note this study is limited because of the sample size. It observed five women taking oral contraceptives (OC) and five women not taking OC.

contraceptives in relation to voice stabilisation in operatic singers. They conclude that the OC 'Yasmin' decreased vocal irregularity, was safe and that singers might benefit from it, as they could continue singing rather than being obliged to refrain from singing during the menstrual phase as is advised by laryngologists.[118] Sataloff (2006) states that it should be noted that any medication requires careful individual monitoring, and some combinations of contraceptives for example, those that cause extremely low levels of oestrogen are not recommended to be taken by singing professionals.

> Depo-Provera (medroxyprogestroneasetate, Pharmacia, and Upjohn) is a long-acting progestational agent that is administered by injection every 3 months. Provera causes adverse changes in lipoprotein profile, probably accelerates osteoporosis and has been associated with depressive episodes. Depo-Provera induces a hypoestrogenic state and may cause voice changes similar to those encountered during menopause.[119]

However, due to individual differences, it is difficult to determine which medications will cause adverse vocal effects. Morris et al. (2009) oppose the previous findings of Amir, Kishon-Rabin and Muchnik (2002), and Amir and Biron-Shental (2006); their research subject did not exhibit greater stability in acoustic signal of her voice when using a triphasic OC. This study was fairly limited in scope; however, they advocated the use of spectrally based acoustic measures and blood assays in future studies to enable more accurate associations between levels of oestrogen and

[118] Filipa M.B. Lã et al., 'The Effects of a Third Generation Combined Oral Contraceptive Pill on the Classical Singing Voice', *Journal of Voice* 21 (2006), 760.
[119] Robert T. Sataloff (ed.), *Vocal health and Pedagogy* (San Diego: Plural Publishing 2nd edn 2006), 73; Stet. Janet Baker, 'A Report on Alterations to the Speaking and Singing Voices of Four Women Following Hormonal Therapy With Virilising Agents', *Journal of Voice* 13 (1999), 496-507.

progesterone and voice disturbance.[120] Lã et al. (2009) present a further study on the OC 'Yasmin' with other types of professional voice users: music theatre, jazz, choir singers and school teachers, and again conclude that this preparation does not affect vocal quality and resonance.[121] Lã et al. (2012) investigate pitch control in singers under normal menstrual cycling conditions and using OCs. Given that intonation is dependent on several concomitant factors–prephonatory, kinesthetic and auditory and given that previous studies suggested complex effects on the auditory system as a result of multifaceted interactions between oestrogens and progesterone, the study found OC use had significant effect on octave size and sustained notes, with slower vibration than that observed during the natural menstrual cycle on notes within the passaggio range. It is concluded that these effects are due to concomitant impacts of sex steroid hormones on vocal fold vibratory patterns, auditory and cognitive functions, and neural excitability.[122] Meurer et al. (2014) present findings which indicate that OCs may interfere with vocal range.[123] Rodney and Sataloff (2016) review the research regarding OCs and the singing voice. They state that whilst OC use likely has no effect on the speaking voice, the review points to various inconsistencies in methods employed heretofore in the research regarding OCs and singing. New evidence suggests that there may be hormone mediated changes with regard to connected speech.[124] They state that, in previous studies many of the

[120] Richard J. Morris et al., The Effect of Initiating Oral Contraceptive Use on Voice: A Case Study', *Journal of Voice* 25 (2009), 228.
[121] Filipa M. B. Lã et al., 'Oral contraceptive pill containing drospirenone and the professional voice: An electrolaryngographic analysis', *Logopedics, Phoniatrics, Vocology* 34 (2009), 17. However, there were some issues with the research design, OCP use was limited to one month, it was not a double blind randomized placebo-controlled trial, the singing task was less vocally demanding and it is possible no effects of OCP use were seen.
[122] Filipa M. B. Lã et al., 'Effects of the Menstrual Cycle and Oral Contraception on Singers' Pitch Control', *Journal of Speech Language and Hearing Research* 55 (2010), 258-259.
[123] Eilséa M. Meurer et al., 'Speech Articulation of Low-Dose Oral Contraceptive Users', *Journal of Voice* 29 (2014), 749.
[124] Jennifer P. Rodney and Robert T. Sataloff, 'The effects of Hormonal Contraception on the Voice: History of Its Evolution in the Literature', *Journal of Voice* 30 (2016), 728.

physical attributes of the singers were either not controlled or not factored into the analysis including Fach, vocal ability, age or weight. Hormonal alterations regarding auditory feedback have not been assessed as they relate to OCs. The review concludes that emergency contraception and the effects on the voice have not been fully studied.[125] Kunduk et al. (2016) investigate the effect of menstrual cycle on vibratory characteristics of the vocal folds with high-speed digital imaging. Of the thirteen participants, six were OC users. Whilst no interaction effects were observed across the menstrual cycle, the researchers found OC use may have influence on the spectral richness of vocal fold vibration.[126]

Oral contraceptives, health and adverse mood

Along with the obvious benefits such as regulating fertility and treatment for menstrual problems like PMS, and certainly, regarding treatment for those women who suffer from endometriosis, according to Nezhat et al. (2012),[127] oral contraceptives also have health risks associated with them. The most common side effects are irregular vaginal bleeding or spotting, problems with libido, headaches, weight gain, vaginal infections and depression. However, serious health risks include blood clots, heart attack and strokes. OCs are implicated in increased risk for breast and cervical cancer, although they are also said to decrease the risk of ovarian and uterine/endometrial cancers. Segebladh et al. (2009) found that combined oral contraceptives (COCs) induced adverse mood in some women; these women, tended

[125] Ibid. 729.
[126] Melda Kunduk et al., 'The Effects of the Menstrual Cycle on Vibratory Characteristics of the Vocal Folds Investigated With High-Speed Digital Imaging', *Journal of Voice* 31 (2016), 182.
[127] Camran Nezhat et al., 'Endometriosis: ancient disease, ancient treatments', *Journal of Fertility and Sterility* 98 (2012), S1-4 <http://dx.doi.org/10.1016/j.fertnstert.2012.08.0001> [Accessed 9 March 2013], Endometriosis is where the lining of the womb spreads beyond the uterus and becomes attached to other abdominal organs causing pelvic pain at the time of menses. It is a disease which can result in infertility.

to suffer more often from mood disorders. Women who had discontinued the use of COCs due to adverse mood had, more frequently than not, obtained a legal abortion in the past.[128] The impact of hormonal abortion on the female brain and subsequent susceptibility towards depressive states may prove increasingly relevant to future research regarding episodic events or toxins according to Klein et al. (1991), as these medications may cause permanent brain effects.[129] Wiréhn et al. (2010), conducted a nationwide population-based study in Sweden regarding different hormonal contraceptives and anti-depressant therapy. They report that progesterone-only contraception users resort to anti-depressants more often than users of the combined pill. This was particularly pronounced amongst teenagers. They advise that the young woman's mental history be reviewed when prescribing contraceptives, and vice versa: that contraceptive history be taken into account when prescribing anti-depressants. According to Pletzer et al. (2010) menstrual cycle phase and hormonal contraceptive use have considerable influence on human brain structure.[130] Women showed larger grey matter volumes in the prefrontal cortex, pre- and postcentral gyri. These sex-dependent effects were modulated by menstrual cycle phases and OCs. Women using OCs showed significantly larger prefrontal cortices, pre- and post-central gyri, parahippocampal and fusiform gyri and temporal regions, compared to women not using OCs. Menstrual cycle effects on hippocampal volumes have been related to performance variations in hippocampus dependent memory, especially spatial working memory, as affected by oestrogen decline during ovulation.[131] De

[128] Birgitta Segebladh et al., 'Prevalence of psychiatric disorders and premenstrual dysphoric symptoms in patients with experience of adverse mood during treatment with combined oral contraceptives', *Journal of Contraception* 79 (2009), 52-54.
[129] Renate Klein et al., RU 486 (Australia: Spinifex, 1991), 56-71; RU 486 is a strong progesterone antagonist and strong anti-glucocorticoid and weak anti-androgen, medication/toxin used on women obtaining hormonal abortions).
[130] Belinda Pletzer et al., 'Menstrual cycle and hormonal contraceptive use modulate human brain structure', *Journal of Brain Research* 1348 (2010), 55.
[131] Protopopescu et al., (2008) in Pletzer et al., (2010), 59.

Bondt et al. (2013) carried out research to measure regional grey matter volume changes as a function of the cycle phase and use of hormonal contraceptives in relation to blood concentrations of sex hormones. They discovered highly significant negative correlation of regional grey matter volume in the anterior cingulate cortex with estradiol concentrations. (The anterior cingulate cortex is involved in emotion processing).[132] Only very recently, approximately fifty years after the introduction of OCs have investigators focused their attention on the effects of OCs on the female brain and behaviour. Hormonal concentrations are significantly altered in women using OCs and, therefore, an effect on brain function is to be expected. De Bondt et al. (2013) also advocate controlling for menstrual cycle phase and OCs in order to avoid obtaining heterogeneous data sets, leading to significant loss of accuracy and precision.[133] Brötzner et al. (2014) investigated intrinsic brain activity in resting, but awake, humans; this is dominated by alpha oscillations. In women, volume increase in the areas of the temporal lobe correlate with elevated estradiol levels. In general, estradiol increases and progesterone decreases neuronal excitability.[134] Estradiol or menstrual cycle phases having elevated levels of estradiol correlate positively with performance in verbal memory tasks, working memory, and paired-associate learning, but negatively with performance in spatial tasks.[135] According to Pletzer et al. (2014), those taking OCs resemble follicular women in their behavioural performance, but show male-like brain activation patterns during both tasks. The analysis suggests that OC users differ from naturally cycling women in the way they

[132] T. De Bondt et al., 'Regional grey matter volume differences and sex-hormone correlations as a function of menstrual cycle phase and hormonal contraceptive use', *Journal of Brain Research* 1530 (2013), 22.
[133] Ibid. 23.
[134] Finocchi and Ferrari, (2011) in Christina P. Brötzner et al., 'Resting state alpha frequency is associated with menstrual cycle phase, estradiol and use of oral contraceptives', *Journal of Brain Research* 1577 (2014), 37.
[135] Hamson (1990); Hamson and Kimura (1992); Philips and Sherwin (1992); Hausmann et al., (2000); Rosenberg and Park (2002); Maki et al., (2002) in Christina P. Brötzner et al. (2014), 37.

recruit their neural resources to deal with challenges and tasks. They conclude that OCs, which are used by 100million women worldwide, may have profound effects on cognition that have not thus far been recognised.[136] Petersen et al. (2015) found that OC use was associated with significantly lower cortical thickness measurement in the lateral orbitofrontal cortex and the posterior cingulate cortex. These regions are believed to be important for responding to rewards and evaluating internal states/incoming stimuli, respectively. In every comparison where a significant result emerged, the direction of the relationship was the same; normally cycling (NC) women had significantly larger brain regions than did OC users.[137] Dragoman et al. (2016) presented a report for the world health organisation identifying research gaps with regard to recommendations for contraceptive use.[138] In relation to oral contraceptives, it is apparent that their influence is not confined to the reproductive organs or the voice. Oral contraceptives also have profound effects on the female brain, with associated risks to ovaries and genetic reproduction, the consequences of which need to be further investigated.

Assisted Fertility (IVF)

More and more women are leaving it later to begin having a family. Hamdan et al. (2012) investigate vocal symptoms of those undergoing fertility treatments. These are ordinary women, however, and not professional voice users who might have been more aware of vocal symptoms. The most common vocal symptom was throat clearing; other symptoms include (on a gaining in severity scale) vocal fatigue, vocal

[136] Belinda Pletzer et al., 'Hormonal contraceptives masculinize brain activation patterns in the absence of behavioral changes in two numerical tasks', *Journal of Brain Research* 1543 (2014), 133.
[137] Nicole Petersen et al., 'Oral Contraceptive Pill Use is Associated With Localized Decreases in Cortical Thickness', *Journal of Human Brain Mapping* 36 (2015), 2648.
[138] Monica V. Dragoman et al., 'Research gaps identified during the 2014 update of the WHO medical eligibility criteria for contraceptive use and selected practice recommendations for contraceptive use', *Journal of Contraception* 94 (2016), 195-201.

straining, lump sensation, hoarseness and aphonia (voice loss). The report finds that those with vocal symptoms have lower levels of estradiol compared with those with no vocal symptoms.[139] Amir, Lebi-Jacob and Harari (2014) investigate associations between IVF treatment and specific voice properties. The study corroborates the association of rising oestrogen levels and fundamental frequency. In addition, the possibility of a ceiling effect for the influence of oestrogens on the female vocal folds was evident from correlations between fundamental frequency and endometrial thickness.[140]

The role of oxytocin in mating and pregnancy

Multiple research studies are currently being undertaken with regard to the neuropeptide oxytocin (OT) which is a continuation of manifold research conducted over the last decade and since the 1950s. At this point, it seems suitable to mention the role of OT in mating and pregnancy[141] (further OT research is presented in relation to the review section on brain research studies).[142] Borrow and Cameron (2012) report that studies have described activation of OT rich areas of the brain after orgasm and after presentation of visual stimuli of a loved one. While more research needs to be done, oxytocin is implicated in bonding and trust in human relationships. The menstrual cycle and the hormonal changes it underlies seem to influence a woman's recognition of social cues. Oestrogen has the ability to increase OT receptor expression in the brain. Oxytocin and another neuropeptide, Vasopressin,[143] are involved in considerable cross-talk. According to Young and

[139] Abdul-Latif Hamdan et al., 'Vocal symptoms in women undergoing in vitro fertilization', *American Journal of Otolaryngology* 33 (2012), 239.
[140] Ofer Amir et al., 'The Effect of In Vitro Fertilization Treatment on Women's Voice', *Journal of Voice* 28 (2013), 521.
[141] Oxytocin is derived from the Greek word, meaning quick birth.
[142] See Oxytocin and Vasopressin, 141.
[143] Vasopressin derived from the Greek word meaning vessel pressure.

Flanagan-Cato (2011), vasopressin is implicated in the regulation of labour, nursing and water homeostasis. It is understood that oxytocin can activate the vasopressin receptor and vasopressin the oxytocin receptor.[144] According to Veenema (2012), it is thought that social experiences in early life alter vasopressin responsiveness.[145] Vasopressin is also understood to modulate endocrine stress response, involving aggression, social memory and social motivation, according to Stevenson and Caldwell (2012).[146] However, it is not known which specific brain regions or specific molecular mechanisms are involved in vasopressin regulation of social behaviours.[147] It is not known whether intranasal oxytocin affects social cognition through central or peripheral effects. According to Leng and Ludwig (2015), there is some debate as to measures used in previous studies and the reporting of effects concerning intranasal oxytocin, particularly issues relating to penetration of the blood brain barrier.[148] Borrow and Cameron (2012) state that OT has been seen to be involved in the release of prolactin which is vital to sustain pregnancy. It is suggested that prolactin inhibits the release of OT (A feedback loop and control). It is known that twice-daily surges in prolactin (diurnal and nocturnal) implicate both OT and prolactin in circadian rhythms. This suggests that oestrogen contribution along with oxytocin in pregnancy induction is likely to be of greater importance, but this facet of the relationship has not yet been thoroughly investigated.[149]

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[144] Larry J. Young and Loretta M. Flanagan-Cato, 'Editorial comment: Oxytocin, vasopressin and social behavior', *Journal of Hormones and Behavior* 61 (2011), 228.
[145] Alexa H. Veenema, 'Toward understanding how early-life social experiences alter oxytocin- and vasopressin-regulated social behaviors', *Journal of Hormones and Behavior* 61 (2012), 304.
[146] Erica L. Stevenson and Heather K. Caldwell, 'The vasopressin 1b receptor and the neural regulation of social behavior', *Journal of Hormones and Behavior* 61 (2012), 277.
[147] Ibid. 281.
[148] Gareth Leng and Mike Ludwig, 'Intranasal oxytocin: myths and delusions', *Journal of Biological Psychiatry* 79 (2015), 243-250.
[149] Amanda P. Borrow and Nicole M. Cameron, 'The role of oxytocin in mating and pregnancy', *Journal of Hormones and Behavior* 61 (2012), 266-276.

Pregnancy and the voice

Ali and Egan (2007) state that gastrointestinal reflux is common during pregnancy. This causes inflammation and soreness of airways due to stomach acid regurgitation, and is a major vocal concern.[150] Abdul-Latif Hamdan et al. (2009) investigate the vocal symptoms and acoustic changes in pregnant women pre- and postpartum in comparison to controls. They found that pregnant women have more vocal fatigue and a reduction in maximum phonation time (MPT). Immediately after delivery however, there is a significant increase in MPT reported in women involved in this study.[151] Research on the effects of pregnancy and the voice by Lã and Sundberg (2012) demonstrate elevated concentrations of oestrogen and progesterone during pregnancy, which were significantly reduced after the birth. The expected effects of these hormones relating to tissue viscosity and water retention were observable and a perceptible decrease of vocal brightness was noted.[152] Cassiraga et al. (2012) also find pregnancy differences in auditory perceptual evaluation, a higher incidence of gastroesophageal reflux, predominance of clavicular breathing and reduced phonation time.[153] According to Abitbol (2006), pregnancy certainly disrupts abdominal support, but the vocal effects are usually short-term and can bring positive benefits such as additional tonal colours and increased range.[154] Jahn (2013) provides an overview of what to expect as a singer, when pregnant.[155] Hancock and

[150] Raja Affendi Raja Ali and Laurence J. Egan, 'Gastroesophageal reflux disease in pregnancy', *Best practice & Research Clinical Gastroenterology* 21 (2007), 793-806.
[151] Abdul-Latif Hamdan et al., 'Effect of Pregnancy on the Speaking Voice', *Journal of Voice* 23 (2009), 493.
[152] Filipa M. B. Lã and Johan Sundberg, 'Pregnancy and the Singing Voice: Reports From a Case Study', *Journal of Voice* 26 (2012), 431.
[153] Verónica Cassiraga et al., 'Pregnancy and Voice: Changes During the Third Trimester', *Journal of Voice* 26 (2012), 584.
[154] Jean Abitbol, (2006), 223.
[155] Anthony F. Jahn, 'Pregnancy', in Anthony F. Jahn (ed.), *The Singers Guide to Complete Health* (New York: Oxford University Press, 2013), 131-140.

Gross (2014) note the failure of acoustic measures to identify vocal changes during pregnancy and recommend the monitoring and testing of hormone levels, visual analysis of vocal fold mucosa and aerodynamic function, including glottal efficiency, to be used as suggested measures when collecting data on voice function during pregnancy.[156] Saltürk et al. (2015) evaluate vocal changes in pregnancy according to trimesters, both objectively and subjectively. Results describe decreases in MPT during the third trimester, although acoustic parameters did not differ. Vocal handicap VHI-10 results, however, do demonstrate that function deteriorates significantly in the third trimester.[157]

Pregnancy and stress

Brummelte and Galea (2010) note that stress during pregnancy and in the postpartum can influence the well-being of the mother and her offspring. Their study investigates cortisol levels and stress in mice and found that treatment with high levels of the stress hormone cortisol CORT postpartum reduce maternal care, hippocampal cell proliferation and induce depressive-like behaviour in the dam. This study could be considered as an animal model of postpartum/postnatal depression.[158] Around 20% of women worldwide suffer from post-natal depression (PND); however, according to Pawluski et al. (2011), many women also suffer from mood changes during pregnancy. Their research which was undertaken in rats, demonstrates that pregnant females, regardless of stress exposure, have decreased depressive-like behaviours, lower corticosterone levels, and increases in anxiety-like

[156] Adrienne B. Hancock, and Heather E. Gross, 'Acoustic and Aerodynamic Measures of the Voice During Pregnancy', *Journal of Voice* 29 (2014), 53.
[157] Ziya Saltürk et al., 'Objective and Subjective Aspects of Voice in Pregnancy', *Journal of Voice* 30 (2015), 72.
[158] Susanne Brummelte and Liisa A. M. Galea, 'Chronic corticosterone during pregnancy and postpartum affects maternal care, cell proliferation and depressive-like behavior in the dam', *Journal of Hormones and Behavior* 58 (2010), 777.

behaviours during late pregnancy, compared to virgin females. Furthermore this study states that stress, regardless of reproductive state (pregnant versus virgin), significantly increases cell proliferation in the hippocampus of the adult female.[159]

The maternal brain has demonstrated significant plasticity during reproduction Pawluski et al. (2015) note that these changes occur to benefit offspring, and this activity in responsiveness to the infant fundamentally changes the mother's brain architecture for a period of time which extends beyond the reproductive life of the female. Modifications to stress responsiveness and changes in hormone profiles are linked to plasticity in the hippocampus, and this area of the brain plays an important role in stress regulation; it is highly sensitive to steroid hormones and mediates spatial memory performance. Changes in stress responsivity and levels of anxiety may alter the levels of neuroplasticity to coincide with reproduction-induced neurobiological flexibility.[160] This behaviour is both infant-directed, and also involves cognition,[161] although enrichment and remodelling have been observed to be affected by repeated and prolonged exposure to stress.[162] Zelkowitz et al. (2014) investigate the relationship of endogenous OT in women during pregnancy and at eight weeks postpartum in relation to psychosocial stress, maternal symptoms of depression, and maternal sensitive behaviour. According to Brunton and Russell (2011):

> There is evidence that the HPA axis declines in responsiveness at the end of pregnancy, perhaps in part to protect the developing foetus from the deleterious

[159] Jodi L. Pawluski et al., 'Stress and the pregnant female: Impact on hippocampal cell proliferation, not on affective like behaviors', *Journal of Hormones and Behavior* 59 (2011), 579.
[160] Jodi L. Pawluski et al., 'Neuroplasticity in the maternal hippocampus: Relation to cognition and effects of repeated stress', *Journal of Hormones and Behavior* (2016), 89.
[161] Ibid. 89.
[162] Ibid. 94.

> effects of maternal stress. It is possible that the increasing numbers of OT receptors in late pregnancy and the higher levels of endogenous OT in the third trimester may affect the action of OT on the HPA axis.[163]

Results suggest that endogenous OT may act as a buffer against the deleterious effects of stress, protecting (high risk) stressed women[164] from developing depressive symptoms and promoting more sensitive maternal interactive behaviour.[165] Glynn et al. (2016) document persisting associations between prepartum hormone profiles and human maternal behaviour postpartum adding to the growing literature highlighting the peri-natal period as one of critical neurodevelopment in the lifespan of the human female.[166]

The effects of aging on the singing voice

Hazlett and Ball (1996) maintain that the effects of training in singing preserve those voices from deteriorating as noticeably as those who are untrained.[167] Boulet and Oddens (1996) report problems experienced by professional singers around the age of fifty in a sample of both males and females. Female singers in this study report both voice changes and issues with the OC pill.[168] Boone (1997) describes aging as 'a series of decrements in the overall competencies of endocrine, muscular, neural,

[163] Brunton and Russell 2011 in Phyllis Zelkowitz et al., 'Psychosocial stress moderates the relationships between oxytocin, perinatal depression and maternal behavior', *Journal of Hormones and Behavior* 66 (2014), 358.
[164] Ibid. 357. There was no evidence of an association between OT and mood or between OT and sensitive maternal behavior, in women with low levels of psychosocial stress. These findings are consistent with experimental research showing that intranasal OT administration may have differential effects on attitudes and behavior as a function of inter-personal history or psychiatric diagnosis.
[165] Ibid. 351.
[166] Laura M. Glynn et al., 'Gestational hormone profiles predict human maternal behavior at 1-year postpartum', *Journal of Hormones and Behavior* 85 (2016), 22.
[167] Diane Hazlett and Martin J. Ball, 'An acoustic analysis of the effects of ageing on the trained singer's voice', *Logopedics Phoniatrics Vocology* 21 (1996), 103.
[168] M. J. Boulet and B. J. Oddens, 'Female voice change around and after the menopause–an initial investigation', *Maturitas* 23 (1996), 19-20.

skeletal and vascular biosystems'.[169] Ware (1998) discusses vocal aging as a response to thorax shrinkage, concave curvature of the spine, restrictions in the freedom of movement required lifting the ribs, and over-all increased rigidity.[170] Baken (2004) investigates the anatomical changes that occur in the senescent larynx and suggests that increases in nonlinearity (reduced tensional force in structure or amount of stretch) may explain disparate observations regarding the aged voice.[171]

Menopause

Sundberg et al. (1988) conducted a study in commercial sound recordings of twenty singers who had been recorded over a period from their twenties to their sixties; a panel of expert listeners rated the singers over four decades. Correlations were identified between vibrato characteristics and both real age and rated age.[172]

Lindholm et al. (1997) investigate the effect of postmenopause and postmenopausal hormone replacement therapy (HRT) on forty-three women. They find that voices in the early postmenopause could be assisted with HRT. They report that benefits were more pronounced with oestrogen only and not the combination oestrogen-progestin pill.[173] Baker (1999) reports serious voice effects as a result of treatments with the medication *Danazol* which is a virilising agent (also used to treat endometriosis) the study references the masculinising of the female voice.[174] Caruso et al. (2000) investigates the laryngeal cytological aspects of oestrogen therapy on surgically-

[169] Daniel R. Boone, 'The Three Ages of Voice: The Singing/Acting Voice in the Mature Adult', *Journal of Voice* 11 (1997), 161.
[170] Clifton Ware, *Basics of Vocal Pedagogy: The Foundations and Process of Singing* (USA: McGraw Hill, 1998), 268-269.
[171] R. J. Baken, 'The Aged Voice: A New Hypothesis', *Journal of Voice* 19 (2004), 317-325.
[172] Johan Sundberg et al., 'Age and Voice quality in professional singers', *Logopedics Phoniatrics Vocology* 23 (1988), 169-176.
[173] P. Lindholm et al., 'The effect of postmenopause and postmenopausal HRT on measured voice values and vocal symptoms', *Maturitas* 28 (1997), 47.
[174] Janet Baker, 'A Report on Alterations to the Speaking and Singing Voices of Four Women Following Hormonal Therapy With Virilizing Agents', *Journal of Voice* 13 (1999), 496.

induced menopausal women; they conclude that oestrogen therapy was to be recommended.[175]

Sarrel (2002) initiated a study on androgen effects on other body systems, including the brain and the cardiovascular system. He concludes that androgens complement the actions of oestrogens in symptom control and disease prevention in postmenopausal women. However, it should be noted that androgens are implicated in changing vocal effects, including darkening and lowering of fundamental frequency, and are not recommended for use in professional vocalists.[176] Meurer et al. (2004) compare the phono-articulatory characteristics between women in reproductive age and postmenopause. Results demonstrate that the postmenopause group pause pattern was longer, speed of the speech was slower, there was vocal deepening without reduction of the vocal extension, and there was also less vocal stability.[177] Sataloff and Linville (2006) reference medical procedures such as injection of gelfoam, collagen, autologous fat and thyroplasty in relation to remedies for voice degeneration.[178]

Mendes-Laureano et al. (2006) compare the speaking voice fundamental frequency between normally cycling (NC) women and those in menopause, some taking and some not taking HRT. There are no differences obtained by acoustic measures although there are evidences of modulating effects of sex steroids on the human

[175] Salvatore Caruso et al., 'Laryngeal cytological aspects in women with surgically induced menopause who were treated with transdermal estrogen replacement therapy', *Journal of Fertility and Sterility* 74 (2000), 1078.
[176] Philip M. Sarrel, 'Androgen deficiency: menopause and estrogen-related factors', *Journal of Fertility and Sterility* 77 (2002), S63.
[177] Elisea M. Meurer et al., 'Female suprasegmental speech parameters in reproductive age and postmenopause', *Maturitas* 48 (2004), S67.
[178] Robert T. Sataloff and Sue Ellen Linville, 'The Effects of Age on the Voice', in Sataloff (ed.), *Vocal Health and Pedagogy Science and Assessment* (2006), 17-32.

larynx.[179] Mendes-Laureano (2007) addresses the issues occurring within vocal research studies concerning the mapping of acoustic features. Principally, the ability of available acoustic technologies to differentiate and discern changing characteristics of vocal production. She states: 'discrepancies in the literature can be explained by faults in the methodologies applied thus far'.[180]

Heman-Ackah et al. (2008) suggest minimising acid reflux, insuring adequate breath support, and maximising the use of resonance to maintain professional vocal longevity.[181] Firat et al. (2008) investigate the effect of intranasal oestrogen therapy on female vocal quality. According to voice handicap index (VHI), while improvement was not clear in the oral oestrogen group, it was significant in the intranasal oestrogen group. Vocal stability was reported as significantly better among the HRT groups than those who did not take HRT.[182] Siarris (2009) references a 2002, Women's Health Initiative Study which reports a higher rate of breast cancer, heart disease, and strokes in postmenopausal women who took hormones. As a result, she reports that fewer women are being treated with hormones.[183] Evelien D'haeseleer et al. (2009) describe their findings on the effects of menopause:

> Menopause is a critical event that is associated with several menopausal complaints like vasomotor symptoms, sleep disturbances, urogenital symptoms, loss of bone density (osteoporosis) and increased risk of cardiovascular disease. The altered sex

[179] J. Mendes-Laureano et al., 'Comparison of fundamental voice frequency between menopausal women and women at menacme', *Maturitas* 55 (2006), 195.
[180] J. Mendes-Laureano, 'Letter to the Editor', *Maturitas* 56 (2007), 223-224.
[181] Yolanda D. Heman-Ackah et al., 'How do I maintain longevity of My Voice?', *Journal of Singing* 64 (2008), 470-471.
[182] Yezdan Firat et al., 'Effect of Intranasal Estrogen on Vocal Quality', *Journal of Voice* 23 (2008), 716.
[183] Catherine Froneberger Siarris, 'The Aging Female Voice: Medical Treatments and Pedagogical Techniques for Combatting the Effects of Aging with Emphasis on Menopause', (PhD dissertation, University of South Carolina, 2009), 30.

> hormone levels also have an effect on the larynx and the voice. As a result of decreased oestrogen levels the laryngeal mucosa changes. Oedema as well as muscular and mucosal dystrophy and atrophy were found in postmenopausal women. These laryngeal changes can result in an altered vocal quality and vocal performance. For the voice, the most important acoustic changes in postmenopausal women are a decrease in vocal frequency range, decreased fundamental frequency, and a higher frequency perturbation of the voice … Hormonal replacement is prescribed in some women … but it requires further research … The type and form of the application of hormone therapy seem to be important in the outcome of studies … Further research is necessary to determine the precise impact of hormone treatment on the larynx and vocal quality.[184]

According to Anoop Raj et al. (2010), menopausal vocal syndrome is characterised by lowered vocal intensity, vocal fatigue, decreased range, loss of high notes, loss of voice quality, vocal dysfunction and discomfort, throat dryness, frequent throat clearing, lower voice frequency level, and increased roughness and hoarseness.[185] Mendes-Laureano et al. (2009) undertook research to investigate whether variations in jitter and shimmer are detectible using acoustic measures among normally cycling NC and menopausal women. The methodology again detects no significant differences between the two groups.[186] D'haeseleer et al. (2009) reviews the literature relating to menopause and therapeutic options. Studies report positive organ-conserving effects of HRT on voice.[187] D'haeseleer et al. (2009) undertook further research to investigate the menopause transition; several differences were

[184] Evelien D'haeseleer et al., The Menopause and the Female larynx, clinical aspects and therapeutic options: A literature review', *Maturitas* 64 (2009), 32.
[185] Anoop Raj et al., 'A Study of Voice Changes in Various Phases of Menstrual Cycle and in Postmenopausal Women', *Journal of Voice* 24 (2010), 363.
[186] J. Mendes Laureano et al., 'Variations of Jitter and Shimmer Among Women in Menacme and Postmenopausal Women', *Journal of Voice* 23 (2008), 687.
[187] Evelien D'haeseleer et al., The Menopause and the Female larynx, clinical aspects and therapeutic options: A literature review', *Maturitas* 64 (2009), 27-32.

found between young and premenopausal women. Middle-aged women have more restricted vocal frequency range and lower intensity, but they could produce lower frequencies than younger women. This indicates that vocal changes occur prior to actual menopause.[188] Prakup (2011) undertook an acoustic measure study in older amateur singers and nonsingers. Results indicate that participants both male and female were perceived as significantly younger than their real ages.[189] D'haeseleer et al. (2011) studied the impact of HRT on vocal quality in postmenopausal women. HRT seems to be effective in counteracting the vocal changes caused by menopause.[190] Moore and Thibeault (2011) present findings regarding the biomechanical properties of vocal fold elastin with a view to developing strategies for elastic fiber repair and regeneration in aging and disease.[191] Gugatschka et al. (2012) review laryngeal tissue engineering as a result of stem cell manipulation. These innovations, however, remain somewhat at the mercy of uncertainty surrounding possible malignant transformations.[192]

Shanmugan and Epperson (2014) state that midlife decline in cognition, specifically in the area of executive functioning, is a frequent concern for which menopausal women seek clinical intervention. Their study considers the importance of ascertaining interactions of oestrogen with neurotransmitter systems, stress, genotype, and individual life events when determining the cognitive effects of menopause and oestrogen therapy (ET). The study reports that the time of initiation

[188] Evelien D'haeseleer et al., 'Vocal Characteristics of Middle-Aged Premenopausal Women', *Journal of Voice* 25 (2009), 364.
[189] Barbara Prakup, 'Acoustic Measures of the Voices of Older Singers and Nonsingers', *Journal of Voice* 26 (2011), 341-350.
[190] Evelien D'haeseleer et al., 'The Impact of Hormone Therapy on Vocal Quality in Postmenopausal Women', *Journal of Voice* 26 (2011), 671e1-671e7;
[191] Jaime Moore and Susan Thibeault, 'Insights Into the Role of Elastin in Vocal Fold Health and Disease', *Journal of Voice* 26 (2011), 269-275.
[192] Markus Gugatschka et al., 'Regenerative Medicine of the Larynx. Where are we Today? A Review', *Journal of Voice* 26 (2012), 670.e7-670.e13.

of ET and the duration of ET in menopausal women is likely to impact the efficacy of treatments. Individual life experience, such as those which effect the oestrogen response, are important considerations, as are any other events (such as pregnancy) or pharmacological treatments which have had influence on the individuals HPAA axis response and should be controlled for when evaluating individuals requiring treatment.[193]

Elliot (2017) presents a survey of reactions from professional singers experiencing menopause; the study gives voice to shared experiences across this difficult transition for women singers concerning both emotions and voice.[194]

Bio-identical hormones BHRT

The previous section identifies research which has evidenced a greater understanding of the general process of aging. This has assisted in the development of hormonal replacement treatments (HRT) for women, particularly professional voice users, which can delay the destructive effects of menopause on the voice. However, researchers have also evidenced problems occurring as a result of the use of hormones affecting the general health of postmenopausal women. HRT is not advised in cases of carcinoma in family history and for other health reasons; therefore, these therapies may be contraindicated for large portions of the population. Bio-identical hormones (BHRT), which are plant-derived hormonal replacements

[193] Sheila Shanmugan and Neill C. Epperson, 'Estrogen and the Prefrontal Cortex: Towards A New Understanding of Estrogen's Effects on Executive Functions in Menopause Transition', *Journal of Human Brain Mapping* 35 (2014), 850.
[194] Martha Elliot, 'Singing Through Menopause: Reactions and Responses–Survey Results', *Journal of Singing* 73 (2017), 269-278.

rather than those synthesised from equine sources (HRT) are, according to Mia Lundin (2009), associated with lower health risks.[195]

Thyroid dysfunction

According to Pfaff et al. (2016), thyroid disorders are very common. They effect approximately 15% of the population with, a female-to-male predominance of 4:1. The thyroid gland is responsible for the production of two major metabolic hormones, thyroxine (T4) and triiodothyronine (T3). These hormones play critical roles in regulating basal metabolic rate. Ailments can occur due to thyroid dysfunction, either Hyperthyroidism (too much thyroid hormone), the signs of which are excessive sweating, heat intolerance, heart palpitations, weight loss despite increased appetite, diarrhoea, anxiety, insomnia, tremors, skin thickening, palmar hyperhidrosis (sweaty hands), hyperreflexia, irritability and occasionally protrusion of the orbits of the eyes known as exophthalmos, or Hypothyroidism (a low hormone level condition) which can cause fatigue, weight gain, depression, constipation, impaired fertility, cold intolerance, hyporeflexia, bradycardia, periorbital puffiness, non-pitting oedema, muffling of the voice, thinning of the hair and can result in hoarseness, vocal fatigue, muffled quality, range loss, or a mass in throat.[196] Thyroid surgery can have a profound effect on the voice. Lee et al. (2016) followed up with 559 patients who underwent thyroidectomy. Permanent post-thyroidectomy voice

[195] Mia Lundin, 'The Bioidentical Hormone Solution' in *Female Brain Gone Insane: An Emergency Guide for Women Who Feel Like They Are Falling Apart* (Florida: Health Communications Inc., 2009), 45-66.
[196] Julia A. Pfaff et al., 'Thyroid Disorders and Their Treatments: What Singing Teachers Should Know', *Journal of Singing* 72 (2016), 577-586.

dysfunction PTVD (pathologies ranging from transient voice fatigue to permanent dysphonia) accounted for approximately 20% of patients undergoing the surgery.[197]

Differences affecting women in vocally demanding careers

Hunter et al. (2011) state that sex differences represent a significant risk factor in the acquisition of vocal problems for women. Females experience vocal issues more frequently than males. Physical differences include vocal fold thickness (female vocal folds are 20%-30% thinner than those of the male) and, there is reduced amount and density of collagen in females compared to males, and reduced levels of hyaluronic acid HA in the superficial layer of the lamina propria. Endocrine differences involving fluctuating reproductive hormones include changes in mucus viscosity, vein dilation, differences in pain sensitivity resulting from fluctuating oestrogen levels, differences in digestive systems (with increased acid reflux and reduced bodily hydration), and differences in breath management–with females tending not to use adequate air pressures. Other issues include muscle tension dysphonia, eating disorders, emotional stress, high rates of depression and behavioural differences such as, excessive talking.[198]

Personality traits, emotion and singing

Singing is an emotional activity; singers who succeed as soloists do so because they are highly skilled at interpreting the emotional content of music for the audience by means of the sound they reproduce with their voices. Morozov (1996) describes

[197] Doh Young Lee et al., 'Analysis of Temporal Change in Voice Quality After Thyroidectomy: Single-institution Prospective Study', *Journal of Voice* 31 (2016), 198.
[198] Eric J. Hunter et al., 'Gender differences affecting vocal health of women in vocally demanding careers', *Logopedics Phoniatrics Vocology* 36 (2011), 128-136.

singing as a 'conversation with the listener by means of the language of emotions'.[199] Foulds-Elliott et al. (2000) point out that performing states of mind differ from those engaged whilst rehearsing technically. Increased volumes of air are used when performing to convey emotional connectedness in vocal performances.[200] Although strongly advised, it is not always possible to hold back human emotion in order to preserve the voice when swept up by the energy of live performances.

Vocal injury

Abitbol (1988) investigates the cause and effects of fluctuating individual hormone levels in relation to vocal cord haemorrhage.[201] Lin et al. (1991) review the risk factors involved in acquiring vocal haemorrhages. Concomitant respiratory tract infection, hormone imbalance (including abnormal menstrual cycles), and the use of oestrogen supplements, gynaecological surgery and OCs was identified.[202]

As Sataloff (2006) notes:

> Although singers are less likely to be allowed cancel performances for menstrual reasons today, unlike their counterparts who were allowed rest and did receive payment under contractual agreement in the German and Italian houses of the early Nineteenth Century, 'Grace Days' for the modern self-employed performer are neither practical nor regularly sought globally within the profession. This could perhaps be due to issues arising from freelancing career and self-employment.[203]

[199] Vladimir P. Morozov, 'Emotional expressiveness of the singing voice: the role of macrostructural and microstructural modifications of spectra', *Logopedics Phoniatrics Vocology* 21 (1996), 49-58.
[200] S. D. Foulds-Elliott et al., 'Respiratory function in operatic singing: effects of emotional connection', *Logopedics Phoniatrics Vocology* 25 (2000), 151-168.
[201] Jean Abitbol, 'Vocal cord hemorrhages in voice professionals', *Journal of Voice* (1988), 261-266.
[202] Lin Pi-Tang et al., 'Risk Factors and Managements of Vocal Cord Hemorrhages: An Experience with 44 Cases', *Journal of Voice* 5 (1991), 74.
[203] Robert T. Sataloff, *Vocal Health and Pedagogy* Vol 2 (2006), 70.

As previously mentioned, Oberlander (2010) comments that PMS oedema is regarded by the industry as 'imagined' rather than a real issue deserving merit.[204] Contraceptive use, respiratory infection, and the use of products containing aspirin or other medical preparations, for example, may increase risk of vocal injury needing treatment according to Anticaglia Sataloff and Hawkshaw (2005).[205]Abitbol (1988) reviews 14 singers presenting with vocal cord haemorrhages, (12 women and 2 men); these singers were studied for up to one year. In those with bi-lateral haemorrhage (two patients), the voice was recovered enough after two months for use over short 15-minute periods: the voice was recovered fully between 3 and 6 months. Of those with unilateral haemorrhage (twelve patients), 3 were treated after one month and nine required surgery (seven of these needed further surgery after 6 months to treat after effects).[206] This implies that, for professional singers, vocal haemorrhage is a serious event that has the potential to be career ending. Uncertainty relating to recovery and extended loss of income may potentially drive singers out of the profession. Chernobelsky (1998) concludes that intrinsic laryngeal muscle tension which occurs during the menstrual cycle and also at other times can be the reason for the beginning of voice disorders for singers.[207] Murry and Rosen (2000) discuss phonotrauma associated with traumatic vocal behaviours, including crying which can cause injury.[208] Neely and Rosen (2000) discuss the risk of vocal fold haemorrhage with coumadin anticoagulation therapy; other drug-associated risks

[204] Erin Oberlander, 'Premenstrual Syndrome and its Effects on Laryngeal Functionality: An Approach of Singers and Pedagogues', *Journal of Singing* 67 (2010), 27-34.
[205] Joseph R. Anticaglia, Robert T. Sataloff and Mary Hawkshaw, 'What Singing Teachers Should Know About Complementary, Alternative, and Integrated Medicine', *Journal of Singing* 62 (2005), 45-52.
[206] Jean Abitbol, 'Vocal cord Hemorrhages in voice professionals', *Journal of Voice* 2 (1988), 261-266.
[207] Semyon Chernobelsky, 'Effect of the menstrual cycle on laryngeal muscle tension of singers and nonsingers', *Logopedics Phoniatrics Vocology* 23 (1998), 132.
[208] Thomas Murry and Clark A. Rosen, 'Phonotrauma Associated With Crying', *Journal of Voice* 14 (2000), 575.

reported include the use of aspirin and nonsteroidal anti-inflammatories.[209] Baker (2002) reviews voice disorders associated with psychological disequilibrium, where loss of normal volitional operation of the voice is due to problems which are psychological in origin. Common presentations of this type of voice loss are muscle tension following infection or emotional stress, and unresolved psychological conflict converted into somatic symptoms which symbolises the unconscious conflict. Females predominately experience these conditions, and it is suggested that as a population they exhibit high levels of anxiety in relation to life events, and bear the onus of responsibility in home/work relationships.[210] Miller (2003) states that psychotherapeutic work is nearly always a last resort for singers who usually exhaust every other possibility.[211] This report is in line with findings from Surow and Lovetri (1999) that singers frequently seek 'alternative' modes of treatments rather than traditional medical care.[212]

Walters Deeter (2005) investigated the dysfunctions in singing caused by excessive tension and improper body mechanics, involving the abdominal, neck and tongue musculature.[213] Abeida et al. (2011) investigated the psychological factors such as stress and personality which can influence the acquisition of vocal nodules, more frequently in women than men. They report that perceived stress and personality features such as hyperactivity and impulsivity are independent factors related to

[209] Jeffrey L. Neely and Clark Rosen, 'Vocal Fold Hemorrhage Associated With Coumadin Therapy in an Opera Singer', *Journal of Voice* 14 (2000), 272.
[210] Janet Baker, 'Psychogenic voice disorders–heroes or hysterics? A brief overview with questions and discussion', *Logopedics Phoniatrics Vocology* 27 (2002), 87.
[211] Juliet Miller, 'The crashed voice–a potential for change: a psychotherapeutic view', *Logopedics Phoniatrics Vocology* 28 (2003), 41-45.
[212] Jason B. Surow and Jeanette Lovetri, '"Alternative Medical Therapy" Use Among Singers: Prevalence and Implications for the Medical Care of the Singer', *Journal of Voice* 14 (1999), 398.
[213] Allissa Walters Deeter, 'Overlooked and Undermining: A Look into Some of the Causes, Effects, and Preventatives to the Dysfunctions Generated by Excessive Tension', *Journal of Singing* 62 (2005), 27-31.

developing vocal nodules. However, age, profession and voice misuse are also related and must be taken into consideration when evaluating the individual for treatments.[214] Dietrich and Verdolini Abbott (2012), report that introverts show greater muscle activity during perceived stress.[215] Holmqvist et al. (2013) observe that stress reaction provokes changes in the body involving cardiovascular alterations, autonomic reactions, and neuroendocrine and immunologic as well as psychoneuroimmunologic changes. Both the primary and secondary stress reaction may have consequence for vocal function. The study reports that both vocal symptoms and stress symptoms were more common among women. Stress, therefore, was a risk factor for a number of physiological, psychological, and behavioural symptoms, negatively affecting the female voice.[216] Giddens et al. (2013) investigated the possibility of identifying voice patterns which were indicative of stress. Results indicate that the most commonly reported voice response (to short term stress) is increase in fundamental frequency; however diminished vocal jitter is reported less frequently.[217] Larrouy-Maestri and Morsomme (2013) find contrasting effects of stress on vocal accuracy. Under less challenging conditions, stress could enhance performance. However, under challenging conditions, increased difficulty of repertoire combined with intensity of cognitive stress, negatively influenced vocal accuracy.[218]

[214] M. El Uali Abeida et al., 'Study of the Influence of Psychological Factors in the Etiology of Vocal Nodules in Women', *Journal of Voice* 27 (2011), 129.e19.
[215] Maria Dietrich and Katherine Verdolini Abbott, 'Vocal Function in Introverts and Extraverts During a Psychological Stress Reactivity Protocol', *Journal of Speech Language and Hearing Research* 55 (2012), 973-987.
[216] Sofia Holmqvist et al., 'The Association Between Possible Stress Markers and Vocal Symptoms', *Journal of Voice* 27 (2013), 787.e1.
[217] Cheryl l. Giddens et al., 'Vocal indices of Stress: A Review', *Journal of Voice* 27 (2013), 390e22.
[218] Pauline Larrouy-Maestri and Dominique Morsomme, 'The effects of Stress on Singing Voice Accuracy', *Journal of Voice* 28 (2013), 52.

Stress hormones

Most professional singers recognise the physical 'high' associated with performing that can make it difficult to sleep and the resultant post-performance slump of heavy fatigue as the body recovers from metabolising the stress hormone adrenaline. Mildly depressive reactions can occur. In opera where performances usually occur on alternate days, these reactions can often overlap, according to Spahn et al. (2010).[219]

Insomnia

Harvey and Saxon (2003) identify the importance of sleep for singers; they report:

> Sleep is critical in the regulation of hormonal/endocrine systems and has biochemical consequences including glucose tolerance, increases in cortisol, decreases in growth hormone and leptin, the hormone implicated in obesity responsible for signalling hunger and satiety. Lack of sleep is responsible for mood shifts, diminished concentration, reaction time, impaired short and long term memory, decreased logical reasoning, decreased response time and impaired cognition.[220]

Prolonged periods of interrupted sleep can interfere with the body's circadian secretion of hormones whose function it is to maintain bodily systems. Saxon, Harvey and Sataloff (2003) comment that given taxing audition/rehearsal schedules, travel, working second and third jobs, and energising pre-sleep activities, such as performance, singers and other performers are at increased risk of sleep

[219] Claudia Spahn et al., 'Music Performance Anxiety in Opera Singers', *Logopedics, Phoniatrics Vocology*, 35 (2010), 182.
[220] Pamela Harvey and Keith G. Saxon, 'Sleep and the Singer, Part 1', *Journal of Singing* 60 (2003), 64.

difficulties.[221] International travel can cause increased fatigue and risk of insomnia due to changes in time zones. Harvey and Saxon (2006) estimate that over 90% of performers suffer sleep problems.[222] Harvey and Saxon (2003) report that the vocal consequences of poor sleep included difficulties with breath support, reduced vocal endurance, increased huskiness, and greater time needed for warm-up. Singers described lack of concentration and increased irritability and frustration. 62% of singers involved in the research obtained a score indicating pathological sleepiness however, many of these singers described their sleep quality as adequate, indicating they did not register their high levels of fatigue.[223] McIntyre (2016) indicates that there is unequivocal empirical evidence supporting the association between sleep alteration and immune inflammatory system activation.[224] Carroll et al. (2016) describe the associations between age-related insomnia symptoms and vulnerability to mortality. This study concludes that insomnia symptoms are implicated in accelerated aging.[225]

Pain in performance

Kenny and Ackerman (2013) examined performance-related musculoskeletal pain and music performance anxiety (MPA) amongst professional orchestral musicians.

[221] Keith G. Saxon, Pamela Harvey and Robert T. Sataloff, 'A Sleep Survey', *Journal of Singing* 59 (2003), 409-412.
[222] Pamela L. Harvey and Keith G. Saxon, 'Sleep and the Vocal Performer', in Robert T. Sataloff (2006), 121.
[223] Pamela Harvey and Keith G. Saxon, 'Sleep and the Singer, Part 2', *Journal of Singing* 60 (2003), 165-171.
[224] Roger S. McIntyre, 'Sleep and Inflammation: Implications for Domain Approach and Treatment Opportunities', *Journal of Biological Psychiatry* 80 (2016), 9.
[225] Judith E. Carroll et al., 'Epigenetic aging and immune senescence in women with insomnia symptoms: Findings from the Women's Health Initiative Study', *Journal of Biological Psychiatry* (2016), 1-25, http://dx.doi.org/10.1016/j.biopsych.2016.07.008 [Accessed 21 April 2017].

This is also an issue for other performers, including singers. The study demonstrates complex relationships between trigger-point pain and psychosocial factors.[226]

Vocal arts medical specialists

Hybrid voice therapy has long been promoted for singers with voice problems Spencer (2004), as it is recognised that available voice therapy might not address the demands of professional singers who continue to be at high risk post treatment.[227] Gilman, Nix and Hapner (2010), draw attention to the need for an integrated approach to co-ordinate recovery from vocal injury between medical specialists, singing teachers and speech-language experts.[228] According to Sataloff (2014), although much progress has been made, challenges remain, as collaboration does not come naturally within all specialisms.[229] Understanding the special medical requirements of the elite vocalist and treating injuries sustained whilst singing are complex and, according to Heman-Ackah and Sataloff (2002),[230] there are many specialist occupations that care for voice problems. Interest in care of the professional voice has advanced medical techniques over the last thirty years and created an umbrella specialism called arts medicine, (see Heman-Ackah and Sataloff, 2007),[231] within the broader ear, nose and throat remit to care for, and treat voice issues. Information regarding professional voice care can be found in Sataloff

[226] Dianna T. Kenny, and Bronwen Ackerman, 'Performance–related musculoskeletal pain, depression and music performance anxiety in professional orchestral musicians: A population study', *Psychology of Music* (2013), 1-18.
[227] Martin L. Spencer, 'Hybrid Voice Therapy', *Journal of Singing* 61 (2004), 127.
[228] Marina Gilman, John Nix and Edie Hapner, 'The Speech Pathologist, the Singing Teacher, and the Singing voice Specialist: Where is the Line?', *Journal of Singing* 67 (2010), 171-178.
[229] Robert T. Sataloff, 'Healthcare Teamwork, Insights, and Challenges', *Journal of Singing* 70 (2014), 557-559.
[230] Yolanda D. Heman-Ackah and Robert T. Sataloff, 'Who takes care of Voice Problems? A Guide to Voice Care Providers', *Journal of Singing* 59 (2002), 139-146.
[231] Yolanda D. Heman-Ackah and Robert T. Sataloff, 'Otolaryngologic Clinics of North America', *The Professional Voice* 40 (2007), 909-1185.

(2006), [232] and Thurman and Welch (2007). [233] Also, Davies et al. (2007), surveyed the interactions between voice clinics and singing teachers in the UK.[234]

Research and developments in surgical techniques assist not only professional singers but also further the understanding and treatments of other ailments occurring in professional and non-professional voice users. These ailments include hearing loss Sataloff and Sataloff (1993), which is an occupational hazard and relevant to all professional musicians.[235] According to Sataloff, Sataloff and Sokolow (2006), hearing loss can have serious psychological consequences for the music professional.[236]

Sataloff (2006)[237] describes bodily injuries and their effects on the voice and other chronic health conditions, including surgery. For example, Debruyne and Oosterlinck (1995) describe voice effects after cricothyroid surgical procedures.[238] Baroody et al. (2013) report self-perceived singing voice changes from singing

[232] Robert T. Sataloff, 'Voice Care Professionals: A Guide to Voice Care Providers' in Robert T. Sataloff (ed.), *Vocal Health and Pedagogy Science and Assessment* (San Diego: Plural Publishing 2nd edn 2006), 121-126.
[233] Leon Thurman and Graham Welch, *Body Mind and Voice* (Iowa: The Voice Care Network, National Centre for Voice and Speech, 1997).
[234] J. Davies et al., 'Interactions between voice clinics and singing teachers: A report on the British Voice Association questionnaire to voice clinics in the U.K', *Logopedics Phoniatrics Vocology* 32 (2007), 83-86.
[235] Robert T. Sataloff and J. Sataloff, *Occupational Hearing Loss* (New York: Marcel Dekker, 2nd edn 1993).
[236] Robert T. Sataloff, Joseph Sataloff and Caren J. Sokolow, 'Hearing loss in Singers and other Musicians', in Robert T. Sataloff (ed.), *Vocal Health and Pedagogy* (2006), 33-48.
[237] Robert T. Sataloff, 'Bodily Injuries and Their Effects on the Voice', in Robert T. Sataloff (ed.), *Vocal Health and Pedagogy* (2006), 91-94.
[238] De Jong F. Debruyne and K. Oosterlinck, 'Changes in fundamental frequency and spectrum of the voice after surgical cricothyroid approximation', *Scandinavian Journal Logopedics Phoniatrics* 20 (1995), 103-106.

professionals after treatment for breast cancer.[239] Portnoy (2013) discusses laryngeal cancer effects on the voice.[240]

Cohn et al., in Sataloff (2006), describe 'allergy' as a specific immunologically-based response to substances that ordinarily do not adversely affect people, which affect 1 in 5 of the population. It is especially relevant for singers.[241] Sataloff, Cohn and Hawkshaw in Sataloff (2006), discuss respiratory dysfunction or 'support' dysfunction, which can involve deficiencies in anatomy or technique, that not only result in unacceptable vocal quality and projection, but in abusive compensatory vocal behaviours which can often result in laryngeal injury.[242] Anderson, Anderson and Sataloff in Sataloff (2006), state that endocrine dysfunction commonly affects the voice, and dysphonia may be the presenting symptom of serious systemic disease.[243] Research efforts continue to promote awareness of complementary as well as traditional medicines; however as previously mentioned, according to Surow and Lovetri (2000) alternative therapy is often the preferred course of treatment chosen by singers next to complementary therapies.[244] Complementary, alternative and integrated medicine is discussed by Anticaglia, Sataloff and Hawkshaw (2005). It is a billion dollar industry; however not all products or treatments have efficacy. [245]

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[239] Margaret M. Baroody et al., 'Self-Reported Changes in the Professional Singing Voice After Surgical Intervention Treatment for Breast Cancer: A Survey Pilot Study of Female Professional Singers', *Journal of Voice* 27 (2013), 225-229.
[240] Joel E. Portnoy et al., 'Laryngeal Cancer: An Overview for Singing Teachers', *Journal of Singing* 70 (2013), 49-56.
[241] John R. Cohn et al., 'Allergy', in Robert T. Sataloff (ed.), *Vocal Health and Pedagogy* (2006), 49-54.
[242] Robert T. Sataloff, John R. Cohn and Mary Hawkshaw, 'Respiratory Dysfunction', in Robert T. Sataloff (ed.), *Vocal Health and Pedagogy* (2006), 55-66.
[243] Timothy D. Anderson, Dawn Anderson and Robert T. Sataloff, 'Endocrine Dysfunction', in Robert T. Sataloff (ed.), *Vocal Health and Pedagogy* (2006), 81-90.
[244] Jason B. Surow and Jeanette Lovetri, '"Alternative Medical Therapy" Use Among Singers: Prevalence and Implications for the Medical Care of the Singer', *Journal of Voice* 14 (2000), 398-409.
[245] Joseph R. Anticaglia, Robert T. Sataloff, and Mary Hawkshaw, 'What singing teachers should know About Complementary, Alternative and Integrated Medicine,' *Journal of Singing* 62 (2005), 45.

Edman, Knodrad and Rakel (2011, 2012) present a review of complementary and alternative medicine for singers.[246]

Research undertaken in specialist voice centres (Titze and Verdolini-Abbott, 2012) continue to promote positive rehabilitation outcomes.[247] Creating awareness of good vocal hygiene practice among teachers of singing and vocal awareness among professional voice users is essential. However according to Achey, He and Akst (2015), the risk of dysphonia is not properly addressed through common vocal hygiene recommendations alone.[248] Oftentimes it is not until phonotrauma has occurred that the perception of how to care for the voice is addressed. Self-study and adherence to treatments are crucial to recovery according to Behrman et al. (2008).[249] Benninger and Oliveira (2013) report that innovations in imaging the larynx, studio quality voice recordings and cloud-based image storage to allow distance based evaluations–including the development of new tools to assess quality of life and new developments in the treatment of office-based procedures like injectables–combined with new voice therapy options have improved the quality of voice care for singers.[250] Guss et al. (2014) observe the typical causes of dysphonia in performers and current aspects concerning treatments.[251] Moore (2012) explores

[246] See Joel S. Edman, Lauren B. Knodrad and Birgit Rakel, 'The Use of Nutrition and Integrative Medicine or Complementary and Alternative Medicine (CAM) for Singers, Part 1', *Journal of Singing* 68 (2011), 165-173; Joel S. Edman, Lauren B. Knodrad and Birgit Rakel, 'The Use of Nutrition and Integrative Medicine or Complementary and Alternative Medicine (CAM) for Singers, Part 2', *Journal of Singing* 68 (2012), 291-297.
[247] Ingo R. Titze and Katherine Verdolini-Abbott, *Vocology: The Science and Practice of Voice Habilitation* (Salt Lake City, UT: National Centre for Voice and Speech, 2012).
[248] Meredith A. Achey, Mike Z. He, and Lee M. Akst, 'Vocal Hygiene Habits and Vocal Handicap Among Conservatory Students of Classical Singing', *Journal of Voice* 30 (2015), 192.
[249] Alison Behrman et al., 'Vocal Hygiene Education, Voice Production Therapy, and the Role of Patient Adherence: A Treatment Effectiveness Study in Women with Phonotrauma', *Journal of Speech, Language, and Hearing Research* 51 (2008), 350-366.
[250] Michael S. Benninger and Gisele Oliveira, 'What is New in the Evaluation and Treatment of Voice Disorders in Singers', *Journal of Singing* 70 (2013), 183-190.
[251] Joel Guss et al., 'Dysphonia in Performers: Toward a Clinical Definition of Laryngology of the Performing Voice', *Journal of Voice* 28 (2014), 349-355.

modified yoga techniques as an adjunct to voice therapy. Yoga effects are short term, rather than other physical retraining methods such as Alexander technique or Feldenkrais. However, benefits are identified when using yoga with clinical treatments to address muscle tension dysphonia (MTD).[252]

Vocal diagnostics

Improvements in vocal diagnostic technology (which allows spectrographic analysis), instrumentation such as fiberoptic and stroboscopic equipment, (which permits the examination of the vocal mechanism whilst singing), and other diagnostic equipment like MRI are now sufficiently sensitive to measure vocal disruption away from normal healthy parameters in useful and meaningful ways. Difficulties with acoustic measures (Mendes-Laureano, 2007) arose from previous research.[253] Barkmeier et al. (2003) describes several procedures including endoscopy with rigid fiberoptic and prism optic tubes inserted into the oral cavity. Flexible tubes can be inserted into the nasal passage, and stroboscopy (which can be used with the previously mentioned instrumentation) are available for vocal tract visualisation and imaging. [254] Larsson and Hertegård (2008) introduce a new laser triangulation technique to measure the width and length of vocal folds. This study demonstrates different patterns of vocal elasticity with increasing pitch, and observes significantly longer vocal folds in men and women. Measured values of vocal fold width were significantly larger for the bass/baritone group compared with all the

[252] Carmelle Moore, 'Reflections on Clinical applications of yoga in voice therapy with MTD', *Logopedics Phoniatrics Vocology* 37 (2012), 144-150.
[253] J. Mendes-Laureano, 'Letter to the Editor', *Maturitas* 56 (2007), 223-224.
[254] Julie Barkmeier et al., 'Vocal Tract Visualization and Imaging: Technical Report', *American Speech-Language-Hearing* Association (2003), 1-11.

other groups.[255] Echternach et al. (2010) present a real-time MRI study which enables researchers to visualise the vocal tract in women during singing.[256]

Banjara et al. (2012) indicate that laryngeal stroboscopy provides valuable information about vibration, with a visual image which can be used for immediate analysis and as a permanent record for comparison with a repeated examination at a later date.[257] Cho, Hong and Park (2012) use ultrasonography to assess the physiological true vocal fold changing length to reach the highest voice pitch ranges during singing.[258] Bakhaee et al. (2013) uses CT scan images and morphometric landmark dimensions to preserve biomechanically important measurements, increasing accuracy and facilitating comparisons between different studies.[259] Ventura Rua et al. (2013) describe morphologic differences in the way professional vocalist's manipulate changes to the space in their vocal tracts to aid resonance.[260] Castelblanco et al. (2014) used videostrobolaryngoscopy to study professional singers and discovered greater than expected laryngeal pathology in singers who identified themselves as healthy.[261]

[255] Hans Larsson and Stellan Hertegård, 'Vocal Fold Dimensions in Professional Opera Singers as Measured by Means of Laser Triangulation', *Journal of Voice* 22 (2008), 734-739.
[256] Matthias Echternach et al., 'Vocal Tract in Female Registers–A Dynamic Real-Time MRI Study', *Journal of Voice* 24 (2010), 133-139.
[257] Hansa Banjara et al., 'Demographic and Videostroboscopic Assessment of Vocal Pathologies', *Indian Journal Otolaryngologic Head Neck Surgery* 64 (2012), 150-157.
[258] Woojin Cho, Juhye Hong and Hachoon Park, 'Real-Time Ultrasonographic Assessment of True Vocal Fold Length in Professional Singers', *Journal of Voice* 26 (2012), 819.e1-819.e6.
[259] Hani Bakhaee et al., 'Three-Dimensional Reconstruction of Human Vocal Folds and Standard Laryngeal Cartilages Using Computed Tomography Scan Data', *Journal of Voice* 27 (2013), 769-777.
[260] Sandra M. Ventura Rua et al., 'Morphologic Differences in the Vocal Tract Resonance Cavities of Voice Professionals: An MRI-Based Study', *Journal of Voice* 27 (2013), 132-140.
[261] Liliana Castelblanco et al., 'Singing Voice Handicap and Videostrobolaryngoscopy in Healthy Professional Singers', *Journal of Voice* 28 (2014), 608.

Medications

Saltmarsh and Wicklund (1997) present a list of herbal medications for singers.[262] Sataloff and Hawkshaw (2006) caution against taking any medication without consulting a doctor; however, informed use of medicines is encouraged, especially for travelling performers. The more common medications and uses are outlined in this chapter.[263] A comprehensive review is presented in Sataloff, Hawkshaw and Anticaglia (2006) which describes many drug induced phenomena that affect the voice.[264] Murry, McRoy and Parhizkar (2007) differentiate between over the counter, prescription medications, vitamins and oral contraceptives.[265] Many, seemingly innocuous, over-the-counter medications (Abaza et al., 2007) can have surprising 'physical' and 'psychological' effects; it is advised that combination of medications needs specialist supervision.[266] Voice effects arising from use of oral contraceptive hormones are common, (see previous section on OCs). According to Youngnan (2013), many common medications can result in adverse vocal consequences.[267] The influence of drugs (over-the-counter, prescription, anxiety and recreational) on musical performance is discussed by West (2004).[268] Medical and medicinal

[262] Sue Saltmarsh and Karen Wicklund, 'Herbal Medications for Singers', *Journal of Singing* 54 (1997), 21-25.
[263] Robert T. Sataloff and Mary J. Hawkshaw, 'Medications for travelling Performers', in Robert T. Sataloff, (ed.), *Vocal Health and Pedagogy* (2006), 213-221.
[264] Robert T. Sataloff, Mary J. Hawkshaw and Joseph Anticaglia, 'Medications and the Voice', in Robert T. Sataloff (ed.), *Vocal Health and Pedagogy Science and Assessment* (San Diego: Plural Publishing 2nd edn 2006), 193-212.
[265] Thomas Murry, Danielle M. McRoy and Nooshin Parhizkar, 'Common Medications and Their Effects on the Voice', *Journal of Singing* 63 (2007), 293-297.
[266] Mona M. Abaza et al., 'Effect of Medications on the Voice', in Yolanda D. Heman-Ackah and Robert T. Sataloff (eds.), *The Professional Voice Otolaryngologic Clinics of North America* (Philadelphia: W. B. Saunders Company, 2007), 1081-1090.
[267] Jenny Cho, Youngnan, 'Medications and the Voice', in Anthony F. Jahn (ed.), *The singers Guide to Complete Health* (New York: Oxford University Press, 2013), 255-263.
[268] Robert West, in Aaron Williamon (ed.) *Musical Excellence: Strategies and techniques to enhance performance* (Oxford: Oxford University Press, 2004), 271-290.

instruction for the complete health of singers is outlined in Jahn (2013).[269] A more detailed list of medications is presented in Appendix D.

Stress related immunity illness

The field of medicine responsible for stress related immunity disorders is called Psychoneuroimmunoendocrinology (also known as the PNI super-system).[270] Over-time, chemical stress imbalance within the body can contribute to the development of health problems such as depressive episodes and compromised immunity Cohen et al., (2012).[271]

Inflammation illness

The lifetime risk of developing a mood disorder, according to Lapalme et al. (1977), is higher for those who may have heritable familial loading.[272] However, adverse life events can impact illness acquisition. Murphy and Brown (1980) discuss the relationship between life event trauma and the onset of organic physical illness in a general population of women.[273] The body's own immune system is implicated in western levels of depressive illness due to diet and habitual lifestyle stress overload generating inflammation and triggering dysregulated immunity response, (the mis-

[269] Anthony F. Jahn, (ed.) *The singers Guide to Complete Health* (Oxford: Oxford University Press, 2013).
[270] Psychoneuroimmunoendocrinology describes an approach to medicine which recognises that our biological and psychological states are intimately and irrevocably linked and, between them, serve the vital role of maintaining our health to ensure survival. Psycho- the study of the psyche and emotions; Neuro- the nervous system which constitutes the electrical wiring and messaging system; immuno- the immune or defence system and Endocrinology- the hormonal or chemical messaging system.
[271] Sheldon Cohen et al., 'Chronic stress, glucocorticoid receptor resistance, inflammation, and disease risk', *PNAS* 106 (2012), 5995-5999.
[272] Lapalme et al., (1997) in Manon H. J. Hillegers et al., 'Impact of stressful life events, familial loading and their interaction on the onset of mood disorders: Study in a high-risk cohort of adolescent offspring of parents with bipolar disorder', *British Journal of Psychiatry* (2004), 97.
[273] E. Murphy and G. W. Brown, 'Life events, psychiatric disturbance and physical illness', *The British Journal of Psychiatry* (1980), 326.

targeting and destroying of the body's own systems).[274] According to Rubin (1988), the discovery that autonomic nerves interlace lymph tissues has changed our understanding of the immune system. Therefore, much like the endocrine system our immune system has direct anatomical links to the brain via the hypothalamic-pituitary-adrenal axis (HPAA). As such the body and voice are vulnerable to allergic, dietary, chemical, stress and hormonal influences.[275] Chronic stress can affect brain size, structures and functions[276] Harris, Creed and Brugha (1992), implicate stressful life events and hereditary factors in increased risk for the onset of Hyperthyroidism or Graves' disease.[277]

Disease

Chronic elevated hormonal stress response, according to McEwan (2008), can potentially lead to purely physical disorders of the autonomic nervous system causing, headaches, irritable bowel syndrome, high blood pressure or disorders of the endocrine and immune systems, thereby creating vulnerabilities to depression, fatigue, coronary disease, including allergies and inflammation disorders such as rheumatoid arthritis.[278] Studies such as Cohen et al. (2012) confirm the link between hormone activation response to inflammation and disease precipitated by stress.[279] It

[274] Begoña Ruiz-Núñez et al., 'Lifestyle and nutritional imbalances associated with Western diseases: causes and consequences of chronic systemic low-grade inflammation in an evolutionary context', *Journal of Nutritional Biochemistry* 24 (2013), 1183.
[275] Wallace Rubin, 'Allergic, Dietary, Chemical, Stress, and Hormonal Influences in Voice Abnormalities', *Journal of Voice* 1 (1988), 378-385.
[276] See TED-ED lessons worth sharing, Education Video, How chronic stress can affect the brains size, structure, and how it functions: <https://www.facebook.com/TEDEducation/videos/1127655593914312/ > [Accessed 3 Feb 2016].
[277] Tirril Harris, Frances Creed and Traolach S. Brugha, 'Stressful Life Events and Graves' Disease', *British Journal of Psychiatry* 162 (1992), 535-541.
[278] Bruce S. McEwen, 'Central Effects of Stress hormones in health and disease: understanding the protective and damaging effects of stress and stress mediators', *European Journal of Pharmacology* 583 (2008), 174-185.
[279] Sheldon Cohen et al., 'Chronic stress, glucocorticoid receptor resistance, inflammation, and disease risk', *PNAS* 106 (2012), 5995-5999.

is suggested by Dantzer et al. (2008) that inflammation illness may induce a behavioural loop that influences the brain to continue to prolong sickness behaviours,[280] leading to the development of depression in vulnerable individuals.[281] This response is designed to promote allostasis (McEwen and Wingfield, 2010) and allow the body sufficient rest time in order that both body and brain might effect necessary repairs.[282]

The function of the brain in the regulation of the body continues to require further research. It is beginning to be understood that brain and body systems interact. Nabi, Hall and Vahtera (2010) found that somatic symptoms of anxiety were robustly associated with increased risk of coronary heart disease in women [283] White et al. (2012) studied the neurological disease of spasmodic dysphonia, which causes involuntary and sustained vocal muscle contractions. This disorder typically occurs in the fifth decade of life and has a female predominance. They argue that the coincidence of anxiety and depression with this underdiagnosed voice disorder cannot be ignored.[284]

[280] The peripheral immune system responds to infection by producing pro-inflammatory cytokines which act on the brain to cause individuals to feel ill and induces sickness behaviour so that the body receives the rest it needs to recover from the peripheral infection. However when this activation continues unabated, such as in cancer or autoimmune diseases the ensuing immune signalling to the brain can lead to exacerbation of sickness and the development of symptoms of depression in vulnerable individuals.

[281] Robert Dantzer et al., 'From inflammation to sickness and depression: when the immune system subjugates the brain', *Nature Reviews Neuroscience* (2008), 46.

[282] Bruce S. McEwen and John C. Wingfield, 'What's in a name? Integrating homeostasis, allostasis and stress', *Journal of Hormones and Behavior* 57 (2010), 1-16 <http://doi:10.1016/j.yhbeh.2009.09.011> [Accessed 8 Jan 2013].

[283] Hermann Nabi, Martica Hall and Jussi Vahtera, 'Psychological and Somatic Symptoms of Anxiety and Risk of Coronary Heart Disease: The Health and Social Support Prospective Cohort Study', *Biological Psychiatry* 67 (2010), 378-385.

[284] Laura J. White et al., 'Coprevalence of Anxiety and Depression With Spasmodic Dysphonia: A Case-Control Study', *Journal of Voice* 26 (2012), 667.e1-667.e6.

Research involving music performance anxiety (MPA)

Valentine (2002) states that anxiety may have numerous origins, but usually comprises a combination of principally three factors: the individual's trait anxiety, the task's level of difficulty, and the level of situational stress. 'People differ substantially in the responsiveness of their autonomic systems and their sensitivity to both internal types of arousal and critical judgement by others'.[285] Kenny (2011) describes anxiety as having a two-factor structure, state and trait. State anxiety is transitory, characterised by heightened tension and apprehension resembling fear; trait anxiety relates to relatively stable individual differences involving the propensity to feel chronically worried.[286] According to McEwan (2013), stress is a state of mind involving both brain and body as well as their interactions. Stress burden reflects genetic variations, embeddedness of early life, individual health behaviours diet, exercise and sleep, as well as experiences over a life-course. Hormones associated with chronic stress burden are protective in the short term and promote allostasis. However, long-term chronic stress can lead to changes in the body that can cause disease.[287] According to Shanmugan and Epperson (2014), oestrogen is essential to the executive functioning of the brain.[288] The mechanisms according to Driskill (2012), suggest that anxiety and other mood disorders might be described as an imbalance among neurotransmitters, since these chemicals regulate many biochemical and physiological reactions to fear-provoking thoughts. Therefore, according to Driskill, 'as perception is based upon individual assessment,

[285] Elizabeth Valentine, 'The fear of Performance', in John Rink *Musical Performance: A Guide to Understanding* (Cambridge: Cambridge University Press, 2002), 172.
[286] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (2011), 25.
[287] Bruce S. McEwen, 'Brain on Stress: How the social environment gets under the skin', *Proceedings of the National Academy of Sciences* 110 (2013), 1561.
[288] Shelia, Shanmugan and Neill C. Epperson, 'Estrogen and the Prefrontal Cortex: Towards A New Understanding of Estrogen's Effects on Executive Functions in the Menopause Transition', *Journal of Human Brain Mapping* 35 (2014), 847.

it can be described as an internal cause; it can be connected to other internal causes and it can also be connected to external origins'.[289]

Classifications of MPA

There is a large body of research investigating issues relating to music performance anxiety. In order to design effective treatments, a comprehensive classification of MPA is required. Brodsky, in the late 1990s, highlighted the difficulties regarding the management of performance-related psychological problems among musicians, and focused on career rather than underlying psychopathology.[290]

Salmon (1990) wrote that exclusive focus on symptomatic anxiety, in the performance context only, risked overlooking many factors that heighten vulnerability–including cognitive, pedagogical, psychodynamic, skills-based, genetic, and biological components.[291] MPA is defined by Salmon as:

> The experience of persisting, distressful apprehension about and/or actual impairment of, performance skills in a public context, to a degree unwarranted given the individual's musical aptitude, training, and level of preparation.[292]

Barlow (2000) relates each condition, MPA and Social Phobia, around negative evaluation:

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[289] Kristina Driskill, 'Symptoms, Causes, and Coping Strategies, for Performance Anxiety in Singers: A Synthesis of Research', (DMusperf Dissertation, West Virginia University, Morgantown, West Virginia, 2012), 25-26; Internal causes can include need for acceptance, self-criticism and negative self-talk, attentional focus, maladaptive perfectionism and external stimuli might include previous negative experiences, lack of support, bad lifestyle choices nutrition or alcohol consumption or learning environment.
[290] Warren Brodsky, 'Music Performance Anxiety Reconceptualized: A Critique of Current Research Practices and Findings', *Journal of Medical Problems of Performing Artists* 11 (1996), 88-98.
[291] Paul G. Salmon, 'A psychological perspective on musical performance anxiety: A review of the literature', *Journal of Medical Problems of Performing Artists* 5 (1990), 2-11.
[292] Ibid.3.

> Both conditions, music performance anxiety and social phobia, are centrally organised around the fear of negative evaluation in interpersonal interactions, either those under scrutiny or in specific performance circumstances.[293]

The more recent Kenny (2011) MPA classification considers the multi-dimensional aspects of occupational stress, focal anxiety, social anxiety and panic disorder, and recognises the comorbidity of MPA with other disorders–in particular, that of social anxiety disorder.[294] In terms of a working construct in performance Osborne and Kenny (2008) state that anxiety is generally understood as a combination of three separate but interacting systems:

> Physiological arousal (including disturbances in breathing rate, perspiration, inhibition of saliva), behavioural responses (including difficulty maintaining posture and failures of technique) and fearful cognitions (concerning the probability of a performance catastrophe and the likelihood and consequences of negative evaluation).[295]

The initial research which inspired this particular study concerned gender differences between boys and girls and anxiety issues relating to music performance in children and adolescents observed across pubertal hormonal changes, as investigated by Ryan (1988),[296] Ryan (2000),[297] Ryan (2004),[298] Ryan (2005),[299] Kenny and Osborne

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[293] David H. Barlow, 'Unravelling the Mysteries of Anxiety and Its Disorders From the Perspective of Emotion Theory', *American Psychologist* 55 (2000), 1247-1263.
[294] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (2011), 47-82.
[295] Margaret S. Osborne and Dianna T. Kenny 'The role of sensitizing experiences in music performance anxiety in adolescent musicians', *Psychology of Music* 36 (2008), 447.
[296] Charlene, Ryan, 'Exploring musical performance anxiety in children', *Journal of Medical Problems of Performing Artists* 13 (1988), 83-88.
[297] Charlene, Ryan, 'A study of the differential responses of male and female children to musical performance anxiety', (PhD Dissertation, McGill University, Canada, 2000).
[298] Charlene, Ryan, 'Gender differences in children's experience of musical performance anxiety', *Psychology of Music* 32 (2004), 89-103.
[299] Charlene, Ryan, 'Experience of musical performance anxiety in elementary school children', *International Journal of Stress Management* 12 (2005), 331-342.

(2006),[300] and Boucher and Ryan (2011).[301] This differentiated behavioural and hormonal stress response observed between boys and girls in these studies demonstrates increases in anxiety reporting at puberty, which prompted the researcher to further scrutinise hormonally driven sex changes at puberty and elevated stress response from females in subsequent student and adult studies. Goodyer et al. (1991) report that social factors like poor friendships are involved in anxiety load for children.[302] Goodyer et al. (2000) observe that both negative mood and feelings and alterations in adrenal steroid hormones precede the onset of first-time depressive episode in adolescents. However, they state that variations in levels of hormones may arise from more distal origins than recent life events and current ongoing difficulties.[303] Gender differences regarding symptoms in adolescent depression, according to Bennett et al. (2005), may indicate that there is a distinct etiology for depression amongst boys and girls.[304] Papageorgi (2007) finds significant maladaptive MPA in adolescent musicians.[305]

Kenny and Osborne (2006) state that 'Females are two to three times more likely to experience anxiety than males and this relationship appears to hold for MPA, where studies demonstrate that females have significantly higher MPA than males'.[306] They

[300] Dianna T. Kenny and Margaret S. Osborne, 'Music Performance Anxiety: New insights from young musicians', *Advances in Cognitive Psychology* 2 (2006), 103-112.
[301] Hélène Boucher and Charlene A. Ryan, 'Performance Stress and the Very Young Musician', *Research in Music Education* 58 (2011), 329-345.
[302] I. Goodyer et al., 'Social influences on the course of anxious and depressive disorders in school-age children', *The British Journal of Psychiatry* 158 (1991), 676-684.
[303] I. M. Goodyer et al., 'First-episode major depression in adolescents: Affective, cognitive and endocrine characteristics of risk status and predictors of onset', *British Journal of Psychiatry* 176 (2000), 142.
[304] David S. Bennett et al., 'Gender differences in adolescent depression: Do symptoms differ for boys and girls?', *Journal of Affective Disorders* 89 (2005), 41.
[305] Ioulia Papageorgi, 'The influence of the wider context of learning, gender, age, and individual differences on adolescent musicians' performance anxiety', *International Symposium on Performance Science AEC* (2007), 219-224 <www.performancescience.org > [Accessed 20 January 2014].
[306] Kenny, Dianna T. and Osborne, Margaret S., 'Music Performance Anxiety: New insights from young musicians', *Advances in Cognitive Psychology* 2 (2006), 103.

reported that the curvilinear trend in MPA levels in children and young adults is consistent with formal operational thought, a characteristic cognitive change associated with the progression from childhood into adolescence.[307] Osborne and Kenny (2008) state that aversive performance incidents can play a role in the development of some anxiety disorders.[308] Boucher and Ryan (2011) state: 'Adolescents have been found to experience anxiety in both solo and ensemble contexts, with gender differences emerging as a notable factor in the timing and extent to which anxiety affects them'.[309] Gender, and the onset of puberty, according to Ingalhalikar et al. (2013), including the release and level of sex hormones have been found to affect cognition.[310] Peper et al. (2014), in a study on boys, indicate that levels of pubertal hormones (in this case, testosterone) significantly alters white matter connectivity in the brain and influences aggression response.[311] Kessler et al. (2010) report that childhood adversities have strong associations with all classes of disorders across all life-course stages.[312] Essau et al. (2010) note that there are sex differences which determine the course of depressive disorders.[313] Essau, Lewinsohn, Seeley and Sasagawa (2010) report that adolescent depression may be a more significant risk factor for later major depressive disorder in women than in men.[314] Essau et al. (2014) report that adolescent anxiety, compared to childhood

[307] Ibid.106.
[308] Margaret S. Osborne and Dianna T. Kenny, 'The role of sensitizing experiences in music performing anxiety in adolescent musicians', *Psychology of Music* 36 (2008), 447.
[309] Hélène Boucher and Charlene Ryan 'Performance Stress and the Very Young Musician', *Journal of Research in Music Education* 58 (2011), 329.
[310] Madhura Ingalhalikar et al., 'Sex differences in the structural connectome of the human brain', *PNAS* (2013), 1 http://www.pnas.org/cgi/doi.10.1073/pnas.1316909110 [Accessed 4 Dec 2013].
[311] Jiska S. Peper et al., 'Short Fused? Associations Between White Matter Connections, Sex Steroids, and Aggression Across Adolescence', *Journal of Human Brain Mapping* 36 (2015), 1044.
[312] Ronald C. Kessler et al., 'Childhood adversities and adult psychopathology in the WHO World Mental Health Surveys', *British Journal of Psychiatry* 197 (2010), 378.
[313] Cecilia A Essau et al., 'Gender differences in the developmental course of depression', *Journal of Affective Disorders* 127 (2010), 185-190.
[314] Cecilia A. Essau, Peter M. Lewinsohn, John R. Seeley and Satoko Sasagawa, 'Gender differences in the developmental course of depression', *Journal of Affective Disorders* 127 (2010), 185.

anxiety is associated with more adverse psychosocial outcomes at age 30.[315] Väänänen et al. (2011) suggest that the relationship between social phobia and depression differs between boys and girls mid-adolescence and remarks that co-morbid disorders are more difficult to treat.[316] Hillegers et al. (2004) find that, independent of familial loading, adverse life events increase the liability to mood disorders.[317] Lewinsohn et al. (2003) find that, for adolescents who suffered from depressive episodes, females were much more likely to have recurrences.[318] Indeed, adolescent screening for susceptibility to MPA using the music performance anxiety inventory for adolescents (MPAI-A) developed by Osborne and Kenny (2005),[319] Osborne, Kenny and Holsomback (2005),[320] and evidenced by Osborne and Kenny (2008),[321] according to Thomas and Nettelbeck (2013) may be significant for the early identification of future potential MPA vulnerability.[322] Using another scale, the performance anxiety scale for music students (PASMS) Çirakoğlu and Şentürk (2013) also report that anxiety scores for females were significantly higher than those for males.[323] Kenny (2011) cautions educators on the development of

[315] Cecilia A. Essau et al., 'Anxiety disorders in adolescents and psychosocial outcomes at age 30', *Journal of Affective Disorders* 163 (2014), 125-132.
[316] Juha-Matti Väänänen et al., 'Relationship between social phobia and depression differs between boys and girls mid-adolescence', *Journal of Affective Disorders* 133 (2011), 97-104.
[317] Manon H. J. Hillegers et al., 'Impact of stressful life events, familial loading and their interaction on the onset of mood disorders: Study in a high-risk cohort of adolescent offspring of parents with bipolar disorder', *The British Journal of Psychiatry* 185 (2004), 97.
[318] Peter M. Lewinsohn et al., 'The Symptomatic Expression of Major Depressive Disorder in Adolescents and Young Adults', *Journal of Abnormal Psychology* 112 (2003), 251.
[319] Margaret S. Osborne and Dianna T. Kenny, 'Development and validation of a music performance anxiety inventory for gifted adolescent musicians', *Journal of Anxiety Disorders* 19 (2005), 725-751.
[320] Margaret S. Osborne, Dianna T. Kenny and Richard Holsomback, 'Assessment of Music Performance Anxiety in Late Childhood: A Validation Study of the Music Performance Anxiety Inventory for Adolescents (MPAI-A)', *International Journal of Stress Management* 12 (2005), 312-330.
[321] Margaret S. Osborne and Dianna T. Kenny, 'The role of sensitizing experiences in music performance anxiety in adolescent musicians', *Society for Education, Music and Psychology Research* 36 (2008), 447-462.
[322] Jason P. Thomas and Ted Nettelbeck, 'Performance anxiety in adolescent musicians', *Psychology of Music* 42 (2013), 624-634.
[323] Okan Cem Çirakoğlu, and Gülce Coşkun Şentürk, 'Development of a Performance Anxiety Scale for Music Students', *Medical Problems of Performing Artists* 28 (2013), 199.

'embeddedness' in adolescent musicians, especially those who have had unsatisfactory attachment relationships or who experienced emotional distress. Heightened self-consciousness and self-criticism at this time often means that adverse musical performances are recalled in some detail, leaving the young person with residual trauma akin to post-traumatic-stress-disorder (PTSD).[324]

Kokotsaki and Davidson (2003) reveal differences between men and women, observing student females to be more anxious compared to norms both as a personality trait and as a state condition in anticipation of a jury situation.[325] Wehr-Flowers (2006) indicates that young females are significantly less confident, more anxious, and have less self-efficacy towards learning Jazz improvisation.[326] Kreutz, Ginsborg and Willamon (2009) indicate that performance students (who are in the formative stages of musical development) do not manage stress effectively in their daily lives.[327] Bernhard (2010) states that students of voice report high levels of burnout. Singers also report higher levels of depersonalisation. There are correlations between burnout, sleep, exercise and relaxation.[328] Iusca and Dafinoiu (2012) investigated undergraduates in exam situations and found that levels of MPA differ according to sex (females report higher levels of anxiety) and musical instrument (vocalists and string players report suffering the highest anxiety levels).[329]

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[324] Kenny (2011), 268.
[325] Dimitra Kokotsaki and Jane W. Davidson, 'Investigating Musical Performance Anxiety among Music College Singing Students: a quantitative analysis', *Music Education Research* 5 (2003), 45-59.
[326] Erin Wehr-Flowers, 'Differences between Male and Female Students' Confidence, Anxiety, and Attitude toward Learning Jazz Improvisation', *National Association for Music Education* 54 (2006), 345.
[327] Gunter Kreutz, Jane Ginsborg and Aaron Williamon, 'Health-promoting behaviors in conservatoire students', *Psychology of Music* 37 (2009), 56.
[328] Christian Bernhard, 'A survey of burnout among college music majors: a replication', *Music Performance Research* 3 (2010), 31-41.
[329] Dorina Iusca and Ion Dafinoiu, 'Performance anxiety and musical level of undergraduate students in exam situations: the role of gender and musical instrument', *Procedia–Social and Behavioral Sciences* 33 (2012), 448-452.

Social Phobia

Brown, Craig and Harris (1985) observe that depression can be labelled 'disease' or 'distress', depending on the situational context–for example, hospital versus community settings–even when the clinical symptoms for both situations are comparable.[330] Kasper (1998) describes social phobia as characterized by a fear of social situations which are either avoided or endured with intense anxiety or distress.[331] Le Blanc et al. (1997) confirms that the presence of an audience was associated with greater anxiety.[332] Hook and Valentiner (2002) investigated the generalised and specific subtypes of social phobia. It is postulated that general social phobia and specific social phobia are separate disorders rather than variants of the same disorder which requires different conceptual frameworks.[333] Osborne and Franklin (2002) state that MPA is investigated either as a discrete phenomenon or as a variant of social phobia.[334] Turner et al. (2003) sought to develop an inventory to assess the cognitions associated with social phobia.[335] Kenny, Fortune and Ackermann (2011) aim to identify the predictors of MPA. Their study highlights the multifactorial nature of MPA and the need for future studies to investigate these factors in a single model to accurately maximise MPA predictions.[336] Roelofs et al. (2009) find that hyperresponsiveness of the HPAA (increased release of cortisol) are

[330] G. W. Brown, T. K. Craig and T.O Harris, 'Depression: Distress or Disease? Some Epidemiological Considerations', *British Journal of Psychiatry* 147 (1985), 612-622.
[331] Siegfried Kasper, 'Social phobia: the nature of the disorder', *Journal of Affective Disorders* 50 (1998), S3-S9.
[332] Albert LeBlanc et al., 'Effect of Audience on Music Performance Anxiety', *Journal of Music Education* 45 (1997), 494.
[333] J. N. Hook and D. P. Valentiner, 'Are specific and generalized social phobias qualitatively distinct?', *Clinical Psychology: Science and Practice* 9 (2002), 379-395.
[334] Margaret S. Osborne and J. Franklin, 'Cognitive processes in music performance anxiety', *Australian Journal of Psychology* 54 (2002), 86-93.
[335] S. M. Turner et al., 'The social thoughts and beliefs scale: A new inventory for assessing cognitions in social phobia', *Psychological Assessment* 15 (2003), 384-391.
[336] Dianna T. Kenny, James M. Fortune and Bronwen Ackermann, 'Predictors of music performance anxiety during skilled performance in tertiary flute players', *Psychology of Music* 41 (2011), 306-328 http://pom.sagepub.com/content/41/3/306 [Accessed 8 Jan 2014].

associated with increased social avoidance behaviour in patients with social phobia.[337]

Multidimensionality of MPA

Episodes of acute anxiety can occur at any age and remain indiscriminate of professional status, proficiency, gender or instrument (Barlow, 2002).[338] Hamann (1982) suggests that anxiety produces increments in performance for those with high task mastery, and recommends formal education to achieve increases in musical proficiency.[339] Steptoe (1982) argues that psychological arousal is necessary to improve performance, but beyond optimum levels of arousal caused declining outcomes.[340] However, MPA acquisition is multifactorial. Sârbescu and Dorgo (2014) identify three related MPA dimensions: somatic and cognitive features, performance context, and evaluation.[341] Nicholson, Cody and Beck (2015) observe that the fear of negative evaluation is a core component of MPA. Focal anxiety and specific performance concerns appear to be more strongly related to MPA than more generalised social interaction concerns.[342] It is reported by Ryan and Andrews (2009), for example, that issues with conductors emerged as one of the primary factors influencing choral singers' experience of anxiety.[343] Buma, Bakker and

[337] Karin Roelofs et al., 'Hypothalamus-Pituitary-Adrenal Axis Hyperresponsiveness Is Associated with Increased Social Avoidance Behavior in Social Phobia', *Journal of Biological Psychiatry* 65 (2009), 336.
[338] David H. Barlow, *Anxiety and its disorders: The nature and treatment of anxiety and panic* (New York: Guilford Press, 2nd edn 2002).
[339] Donald L. Hamann, 'An Assessment of Anxiety in Instrumental and Vocal Performances', *Journal of Research in Music Education* 30 (1982), 77-90.
[340] Andrew Steptoe, 'Performance Anxiety: Recent developments in its analysis and management', *The Musical Times* 123 (1982), 537-538.
[341] Paul Sârbescu and Mădălina Dorgo, 'Frightened by the stage or by the public? Exploring the multidimensionality of music performance anxiety', *Psychology of Music* 42 (2014), 568-579.
[342] D. Riley Nicholson, Megan W. Cody and J. Gayle Beck, 'Anxiety in musicians: On and off stage', *Psychology of Music* 43 (2015), 438-449.
[343] Charlene Ryan and Nicholle Andrews, 'An Investigation into the Choral Singer's Experience of Music Performance Anxiety', *Journal of Research in Music Education* 57 (2009), 108-126.

Oudejans (2015) investigated the foci of attention of elite musicians during moments of high pressure using concept mapping and verbal reports. It was found that elite performers focus on music-related information, physical aspects, and thoughts that gave confidence.[344]

Trauma

Sataloff, Rosen and Levy (1999) note the situational context of some temporary trauma which distracts the performer and impairs performance.[345] However, the added burden of experiencing serious musical impairment whilst under distraction from other traumas may be more difficult to treat. Shapiro in Arneson (2010), states:

> Once an individual experiences a trauma, the event becomes locked into the nervous system into its own state-specific neuro-network and is isolated from other neuro-networks which contain therapeutic information. Instead of being processed into our narrative memory, in which we would simply recall the event, a trauma is processed into our motoric memory, thus retaining all of the negative emotions, feelings, sights, sounds, and overall recall sensations associated with the original trauma.[346]

Stress and sex differences

Medical and psychological research has found significant chemical responses to stress within the body. Dolan et al. (1985) found life events were associated with the onset of depression in clinical and community studies but also that cortisol levels

[344] Lori A. Buma, Frank C. Bakker and Raôul R.D. Oudejans, 'Exploring the thoughts and focus of attention of elite musicians under pressure', *Psychology of Music* 43 (2015), 459-472.
[345] Robert T. Sataloff, Deborah Caputo Rosen and Steven Levy, 'Medical Treatment of Performance Anxiety: A Comprehensive Approach', *Journal of Medical Problems of Performing Artists* 14 (1999), 122-126.
[346] Francine Shapiro in Christopher Arneson, 'Performance Anxiety: A Twenty-First Century Perspective', *Journal of Singing* 66 (2010), 540.

were higher in patients with life event and depressive difficulties.[347] Goldberg (2001) indicate that social factors (such as marital breakup and separation from partners) do appear to influence the prevalence of depression, but this effect is not independent of personality effects such as introversion or genetically determined vulnerability.[348] Harris et al. (2000) observe that individual differences in morning salivary cortisol levels may represent an independent risk factor for major depressive disorder (MDD) in adult women.[349] In contrast, Strickland et al. (2002), found in women (who were vulnerable to depression but not currently depressed) that cortisol concentrations were not increased in the depressed or vulnerable. Morning salivary and serum cortisol were reduced in depression. Evening cortisol was increased after recent life events. However, life events and depression were associated with increased prolactin responses. They maintain that the HPAA is sensitive to social stress, but does not mediate vulnerability to depression. They conclude exaggerated 5-HT_2 receptor responsiveness to stress may play a role in the evolution of depression.[350] This 5-HT brain response is explained in Deakin and Graeff (1991); 5-HT systems are concerned with the active responses to aversive events.[351] According to Kajantie and Phillips (2006), sex is one of the most important determinants of human health. Sex differences in the prevalence of disease may be in part explained by sex differences regarding the physiological response to stress. They report that, although some differences are dependent on the stressor used, the responses of both HPAA and

[347] R. J. Dolan et al., 'Life Events, Depression and Hypothalamic-Pituitary-Adrenal Axis Function', *British Journal of Psychiatry* 145 (1985), 429-433.
[348] David Goldberg, 'Vulnerability factors for common mental illnesses', *The British Journal of Psychiatry* 178 (suppl. 40), (2001), s69-s71.
[349] T. O. Harris et al., 'Morning cortisol as a risk factor for subsequent major depressive disorder in adult women', *The British Journal of Psychiatry* 117 (2000), 505-510.
[350] Paul L. Strickland et al., 'Bio-social origins of depression in the community: Interactions between social adversity, cortisol and serotonin neurotransmission', *The British Journal of Psychiatry* 180 (2002), 168-173.
[351] J. F William Deakin and Frederico G. Graeff, '5-HT and mechanisms of defence', *Journal of Psychopharmacology* (1991), 305-315.

Autonomic systems show marked and consistent differences according to phase of menstrual cycle, pregnancy and menopause having marked effects in females.[352]

MPA in singers

Chiefly of interest are studies relating to MPA in singers. The vocal instrument is sex hormone dependent, and Kenny (2011) indicates that females are disturbed by all three related dimensions of sensitivity–physical, emotive and cognitive concerns–unlike men, who scored higher in social and cognitive stress tests.[353] MPA and the physical symptoms associated with the fight or flight adrenaline response may also have the unfortunate ability to create an audible identifier, not ideal for the professional vocal performer.[354] Van Lierde et al. (2009) observe that psychological stress can influence voice quality.[355] Giddens et al. (2013) conclude that the type of stress, gender, individual differences in baseline tone and parasympathetic influences may be elements which underpin audible voice changes in relation to stress. The consistent trend is towards increases in fundamental frequency.[356] Holmqvist et al. (2013) note significant association between stress symptoms and the occurrences of vocal symptoms, and conclude that physical changes caused by the stress reaction (psyche, personality, emotions, coping, adaption, individual differences) negatively

[352] Eero Kajantie and David I. W. Phillips, 'The effects of sex and hormonal status on the physiological response to acute psychosocial stress', *Psychoneuroendocrinology* 31 (2006), 151.
[353] Dianna T. Kenny, (2011), 24-25.
[354] Sofia Holmqvist et al., 'The Association Between Possible Stress Markers and Vocal Symptoms', *Journal of Voice* 27 (2013), 787.e1-787.e10.
[355] K. Van Lierde et al., 'Effect of Psychological Stress on Female Vocal Quality a multiparameter Approach', *Folia Phoniatrica et Logopaedica* 61 (2009), 105.
[356] Cheryl L. Giddens et al., 'Vocal Indices of Stress: A Review', *Journal of Voice* 27 (2013), 390.e21-390.e29.

affect the voice.[357] Larrouy-Maestri and Morsomme (2014) observe that stress can negatively influence singing voice accuracy.[358]

Professional singers are subject both to their musical and familial histories and their inherited genetic make-up. Understanding what constitutes serious MPA is multifaceted. The heritable female genetic components in stress acquisition, and environmental factors influencing anxiety sensitivity–for example, early learning and sex-role socialisation–make determining the root of anxiety issues extremely complex. Due to the essentially hybrid nature of anxiety (comprising a wide range of underlying causes associated with human behaviour, both individual and in group settings), it is challenging to attempt to encompass all contributory factors.

Differences between professional, amateur, and student musicians

Previous research recommends that inquiries relating to MPA in the music profession ought to be focused exclusively on the career professionals and not on students or amateurs, since it is highly possible that the influence of high task mastery may significantly impact the accurate reporting of information relating to MPA (Brodsky, 1996).[359] Papageorgi, Creech and Welch (2011) confirm solo performance as creating the highest disturbance, with females demonstrating higher levels of anxiety than males. However, performance experience counterbalances the effects of MPA, and higher levels of expertise are related to improved performance.[360]

[357] Sofia Holmqvist et al., 'The Association Between Possible Stress Markers and Vocal Symptoms', *Journal of Voice* 27 (2013), 787.e1-787.e10.
[358] Pauline Larrouy-Maestri and Dominique Morsomme, 'The Effects of Stress on Singing Voice Accuracy', *Journal of Voice* 28 (2014), 52-58.
[359] Warren Brodsky, 'Music Performance Anxiety Reconceptualised: A Critique of Current Research Practices and Findings', *Journal of Medical Problems of Performing Artists* 11 (1996), 91.
[360] Ioulia Papageorgi, Andrea Creech and Graham Welch, 'Perceived performance anxiety in advanced musicians specializing in different musical genres', *Psychology of Music* 41 (2011), 18-41.

Other career-centered issues

Dobson (2010) describes career-centered issues including professional sociability, alcohol use, insecurity and maladaptive traits of perfectionism, as being known to regularly affect professional musicians.[361] Hays (2010) identifies problems which have parallels with sport and other performing specialisms. These are issues associated with skills related to performance enhancement, psychological skills training, developmental issues, injury and retirement concerns, and other issues–for example, eating disorders.[362]

Perfectionism

According to Kenny (2011), professional musicians record high levels of maladaptive perfectionism, a prevalent risk factor identified in the acquisition of MPA disorders. Maladapted perfectionists impose constant and intense evaluations on themselves; they tend to equate a perfect performance with self-worth and impaired performances with worthlessness. Those musicians who tend to be more preoccupied with attaining perfection in their performances may be more vulnerable to impaired performance, have difficulty concentrating and experience higher performance dissatisfaction. As a result, perfectionists fail regularly, and consequently are more susceptible to chronic anxiety. Individuals with such personality traits tend to have strong feelings of inadequacy and poor self-concept.[363] Stoeber and Corr (2016) indicate that not all dimensions of perfectionism undermine

[361] Melissa C. Dobson, 'Insecurity, professional sociability, and alcohol: Young freelance musicians' perspectives on work and life in the music profession', *Psychology of Music* 39 (2010), 240-260.
[362] Kate F. Hays, 'The Enhancement of Performance Excellence Among Performing Artists', *Journal of Applied Sports Psychology* 14 (2010), 299-312.
[363] Perfectionism, is a personality trait characterised by an individual's striving for flawlessness and setting excessively high performance standards, accompanied by overly critical self-evaluations and concerns regarding others evaluations; Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (2011), 73-76.

flourishing, and that it is important to differentiate perfectionist strivings and concerns when regarding the perfectionism-flourishing relationship. According to Stoeber and Kersting (2007), perfectionistic strivings predict higher performance in tests.[364] Self-orientated adaptive perfectionism traits can promote health and well-being. What is under discussion in relation to interference in music performance are maladaptive traits which may be linked with personality or may be socially prescribed. Kellow (2002) comments that maladaptive perfectionism surrounding audience expectation creates a vulnerability that is a problem for performers.[365] Kenny (2011) comments that the external imposition of goals and standards heightens feelings of uncontrollability for musicians, not only in relation to significant others but by the availability of perfect recordings which may be used for self-comparison.[366] Kunstman and Smith (2014) observe that feelings relating to 'power' and self- determination have protective effects with regard to perfectionistic tendencies.[367] Stoeber (2018) defines maladaptive perfectionism as; 'a personality disposition characterized by a striving for flawlessness and setting exceedingly high standards of performance accompanied by overly critical self-evaluations and beliefs that others expect perfection'.[368] According to Noble, Ashby and Gnilka (2014), perfectionism is implicated as a significant contributor to negative outcomes, including depression, in student populations. Results suggest avoidant coping mediated the relationship between both adaptive and maladaptive perfectionism and

[364] Joachim Stoeber and Martin Kersting, 'Perfectionism and Aptitude Test Performance: Testees Who Strive for Perfection Achieve Better Test Results', *Journal of Personality and Individual Differences* 42 (2007), 1093.
[365] Brian, Kellow, 'High Anxiety' *Opera* 36 (2002), 542.
[366] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (New York: Oxford University Press, 2011), 73-75.
[367] Jonathan W. Kunstman and April R. Smith, 'Overpowering Restriction: Power reduces restriction among self-critical perfectionists', *Journal of Social and Clinical Psychology* 33 (2014), 630-652.
[368] Joachim Stoeber, 'Perfectionism: of personality and Individual Differences', In V. Zeigler-Hill and T.K. Shackelford, (eds.) *Encyclopaedia* (New York: Springer, 2018).

depression. Adaptive perfectionists ruminate less, use less denial, are less distracted from tasks, and exhibit less 'giving-up' behaviours because of reasonable and realistic self-expectations'; greater avoidant coping served to explain elevated depression in maladaptive perfectionists.[369]

Coping

The results described above compare to similar studies. Ben-Zur (2009) found that problem-focused coping was positively correlated to positive effect, whereas avoidant coping had the opposite pattern of association.[370] Howerton and Van Gundy (2009) investigated three coping styles types–problem focused, emotion focused and avoidance focused–and found that women more often use emotion focused-strategies and avoidance-focused techniques. This study suggests that the expression of feelings reduced depressed mood for women.[371]

Delahaij et al. (2011) report that coping style and coping self-efficacy are important predictors of performance under acute stress and this effect is mediated by coping behaviour.[372] Riley and Park (2014) introduce meaning-focused coping as possibly being more helpful than problem-focused coping. It is explained that the meanings individuals assign to stressful events (their appraisals) are closely linked to their adjustments to those events. This type of coping operates by reinterpreting or

[369] Christina L. Noble, Jeffrey S. Ashby and Philip B. Gnilka, 'Multidimensional Perfectionism, Coping and Depression: Differential Prediction of Depression Symptoms by Perfectionism Type', *Journal of College Counseling* 17 (2014), 80-94.
[370] Hasida Ben-Zur, 'Coping Styles and Affect', *International Journal of Stress Management* 16 (2009), 87-101.
[371] Amanda Howerton and Karen Van Gundy, 'Sex differences in Coping Styles and Implications for Depressed Mood', *International Journal of Stress Management* 16 (2009), 333-350.
[372] Roos Delahaij et al., 'Predicting Performance Under Acute Stress: The role of Individual Characteristics', *International Journal of Stress Management* 18 (2011), 49.

positively reframing events, and is linked to positive adjustments in many different situations.[373]

Resilience

Individual differences are implicated in resilience according to Rutter (1985) whereby protective as well as vulnerability factors act as buffering towards stress.[374] McEwen, Grey and Nasca (2015), define resilience as:

> Achieving a positive outcome in the face of adversity. This can involve 'bending and not breaking', that is, recovering from a bad experience. Or it can involve an 'active resistance' to adversity through coping mechanisms that operate at the time of trauma.[375]

Eschleman, Bowling and Alarcon (2010) investigated 'Hardiness' which is a multidimensional personality trait that is hypothesised to protect individuals from the effects of stress. They suggest that hardiness is positively related to other traits and non-traits that are designed to protect from stress; for example it is positively related to social support and active coping and performance.[376]

[373] Kristen E. Riley and Crystal L. Park, 'Problem-Focused vs. Meaning-Focused coping as mediators of the Appraisal-Adjustment Relationship In Chronic Stressors', *Journal of Social and Clinical Psychology* 33 (2014), 587-611.
[374] Michael Rutter, 'Resilience in the face of adversity. Protective factors and resistance to psychiatric disorder', *The British Journal of Psychiatry* (1985), 599-601.
[375] Bruce McEwen, Jason D. Grey and Carla Nasca, 'Recognising resilience: Learning from the effects of stress on the brain', *Neurobiology of Stress* 1 (2015), 1-11.
[376] Kevin J. Eschleman, Nathan A. Bowling and Gene M. Alarcon, 'A Meta-Analytic Examination of Hardiness', *International Journal of Stress Management* (2010), 277-307.

Flow

Many habitual performers, at times, also experience the opposite of anxiety, called peak performance, or 'Flow', whilst performing Csikszentmihalyi (1990).[377] 'Flow' is defined as 'a merging of action and awareness where consciousness, mind and body become ordered and harmoniously directed, without feelings of chaos, indecision or anxiety'.[378] However, finding a state of flow repeatedly in normal performance is perhaps elusive to many. According to Csikszentmihalyi (1997), flow is experienced when at least one, if not all, of the following conditions are met: the challenge matches the skill level; the individual is totally absorbed in the task; goals are clear and the accomplishment provides immediate feed-back; the individual has a sense of executive control and is unselfconscious; and, finally, time appears transformed whilst engaged in the task.[379] According to Kirchner (2011), fostering flow conditions could be helpful in reducing MPA. Five key predictors are present in flow proneness: confidence and self-trust, desire to experience and express feelings through music, having experience goals, ability to focus, and play/sing without self-criticism. [380] Sinnamon, Moran and O'Connell (2012) describe differences between elite musicians and students in flow. Elite performers scored less on loss of self-consciousness than students, which seems to suggest that, at a certain point in expertise, they need to be partially self-aware and only experience flow in intensely challenging situations. Novice performers have all of their psychological resources

[377] Veerle L. Simoens, Sampsa Puttonen and Mari Tervaniemi, 'Are music performance anxiety and performance boost perceived as extremes of the same continuum?', *Psychology of Music* 43 (2015), 171-187.
[378] Mihaly Csikszentmihalyi, *Flow: The Psychology of Optimal Experience* (New York: Harper and Row, 1990).
[379] Mihaly Csikszentmihalyi, *Finding Flow: The Psychology of engagement with everyday life* (New York: BasicBooks, 1997).
[380] Joann Marie Kirchner, 'Incorporating flow into practice and performance', *Work* 40 (2011), 289-296.

concentrated on the task at hand.[381] Simoens, Puttonen and Tervaniemi (2015) state that MPA is not the opposite of performance boost or flow, and that perceived pressure and support might be more accessible anchor points to treat MPA and maintain stimulation of performance boost.[382]

Singing can promote well-being

Grape et al. (2003) find that professional singers experience less well-being than amateur singers in singing lessons.[383] According to Chanda and Levitin (2013), music is used to regulate mood and arousal in everyday life. However underlying personality dimensions are factors that mediate stress response to music, as is context of listening or participation. Music connects to improve immune response facilitated by oxytocin and vasopressin via neural networks, and social context is crucial.[384] Fancourt, Aufegger and Willamon (2015) find that singing effects cortisol as well as cortisone. Under low stress conditions singing can be stress reducing, but stress response increases significantly under high stress conditions.[385] Weinstein et al. (2016) observed the potential of music participation in large groups to facilitate social bonding. They detected positive endorphin-induced increases in pain thresholds in both small and large group choir situations.[386] Goldenberg (2017) states

[381] Sarah Sinnamon, Aiden Moran and Michael O'Connell, 'Flow Among Musicians: Measuring Peak Experiences of Student Performers', *Journal of Research in Music Education* 60 (2012), 6-25.
[382] Veerle L. Simoens, Sampsa Puttonen and Mari Tervaniemi, 'Are music performance anxiety and performance boost perceived as extremes of the same continuum', *Psychology of Music* 43 (2015), 171-187.
[383] Christina Grape et al., 'Does Singing Promote Well-Being?: An Empirical Study of Professional and Amateur Singers during a Singing Lesson', *Journal of Integrative and Behavioral Science* (2003), 72.
[384] Mona Lisa Chanda and Daniel J. Levitin, 'The Neurochemistry of Music', *Journal of Trends in Cognitive Sciences* 17 (2013), 188.
[385] Daisy Fancourt, Lisa Aufegger and Aaron Willamon, 'Low-stress and high-stress singing have contrasting effects on glucocorticoid response', (2015), *Journal of Frontiers in Psychology* (2015), 1242.
[386] Daniel Weinstein et al., 'Group music performance causes elevated pain thresholds and social bonding in small and large groups of singers', *Journal of Evolution and Human Behavior* (2016), 152.

that singing lessons can promote better health quality with patients of impaired respiratory health, and group lessons provide social support and facilitate group bonding.[387]

Difficulties developing treatments for anxiety

Despite the influence of gender, females are individuals with different genes. Kenny (2011)[388] life experiences and personalities; as a result, finding 'one fix for all' solutions to issues as complex as anxiety simply is not feasible. Females are affected by all three dimensions of anxiety sensitivity however, they tend to be disturbed more from physiological subjective discomfort (the emotion or affect anxiety symptoms), rather than from cognitive (worry, dread, and rumination) or overt behavioural symptoms (shaking, trembling, posture, muscle tension).[389] With so much of the research indicating elevated stress response in women, understanding how female sexual hormonal status impacts stress perception and acquisition becomes increasingly important. Kajantie and Phillips (2006) state:

> In a psychophysiological laboratory, the autonomic nervous system response can be provoked by many different stressors including physical, mental and psychosocial tasks, while the hypothalamic-pituitary-adrenal axis (HPAA) response seems to be more specific to a psychosocial challenge incorporating ego involvement … the responses of both systems show marked and consistent differences according to sex,

[387] Rachel B. Goldenberg, (2017), 'Singing Lessons for Respiratory Health: A Literature Review', *Journal of Voice* (2017), 1< http://dx.doi.org/10.1016/j.jvoice.2017.03.021> [Accessed 24 May 2017]
[388] Recent research with twins has found that anxiety sensitivity is heritable in women but not in men and that severe anxiety sensitivity is more strongly associated with genetic factors, Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (2011), 24-25.
[389] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (2011), 107.

> with the phase of the menstrual cycle, menopausal status and pregnancy having marked effects.[390]

Deciphering the magnitude and complexity of MPA, when viewed as combinations of genes, hormonal status, personality, social class, education, musical history, family, lifestyle, work, audience (live audience, internet, print, or social media) traumatic life events, and how these come together to contribute to the allostatic load (individual's overall stress perception), is a time consuming process for both the individual and those involved with treating these issues. Gaps in the research preclude the development of definitive treatments at this time. For example, Yang Xu et al. (2012) comment that: 'Recognising differences in clinical symptoms and treatment-seeking in men and women with social anxiety disorder (SAD) may be important for optimising screening strategies and enhancing treatment efficacy for SAD'.[391]

Social factors in recovery

Social support is essential to assist in recovery from anxiety and depression, according to McEwen (2007). Support is having regular social contacts with supportive friends and family or health professionals, who provide useful information, and it has been shown to reduce allostatic load score.[392] Brown, Lemyre and Bifulco (1992) implicate positive social factors or events involving improvement and recovery in women with depressive disorders. Such events were characterised by three dimensions: 'anchoring' an increased sense of security; a 'fresh start' the

[390] Eero Kajantie and David I. W. Phillips, 'The effects of sex and hormonal status on the physiological response to acute psychosocial stress', *Psychoneuroendocrinology* 31 (2006), 151.
[391] Yang Xu et al., 'Gender differences in social anxiety disorder: Results from the national epidemiologic sample on alcohol and related conditions', *Journal of Anxiety Disorders* 26 (2012), 12.
[392] Bruce S. McEwen, 'Physiology and Neurobiology of Stress and Adaption: Central Role of the Brain', *Physiological Review* 87 (2007), 894.

lessening of the difficulty or deprivation and increase in hope; and 'relief', the lessening of the difficulty not involving a fresh start.[393]

Performance remedies

Remedies exist to help performers with anxiety issues.[394] Seligman et al. (2005) discuss positive psychology, an umbrella term for the study of positive emotions. This branch of psychology believes that understanding suffering and happiness, and their interaction, will help develop validated interventions to relieve suffering and increase happiness, seen as two separate endeavours.[395] Motivational psychology research and other remedies, such as those applied in sports, have proved of some benefit to sufferers. Hatzigeorgiadis et al. (2008) state that positive self-talk can enhance self-confidence and reduce cognitive anxiety.[396] Hassanzadeh, Ebrahimi and Mahdinejad (2012) tested self-efficacy, metacognitive beliefs and the relationship with some predictive variables in test anxiety. They report that self-efficacy is a structure which influences test anxiety.[397] Williamon (2004) discusses measures to enhance the performance strategies of habitual performers; of note are useful diagrams denoting the engagement of bodily systems under stress.[398] Emmons and

[393] G. W. Brown, L. Lemyre and A. Bifulco, 'Social factors and Recovery from Anxiety and Depressive Disorders: A Test of Specificity', *British Journal of Psychiatry* 161 (1992), 44-54.
[394] Dianna T. Kenny, 'A Systematic Review of Treatments for Music Performance Anxiety', *Anxiety Stress and Coping: An International Journal* 18 (2005), 183-20; Dianna T. Kenny, 'Treatment Approaches for Music Performance Anxiety: What Works? ', (unpublished, 2005), 1-21 <http://www.researchgate.net/...Music_performance_anxiety...treatment/.../5046.pdf> [Accessed 3 March 2013].
[395] Martin E.P. Seligman et al., 'Positive Psychology Progress: Empirical Validation of Interventions', *American Psychologist* 60 (2005), 410-421.
[396] Antonis Hatzigeorgiadis et al., 'Mechanisms underlying the self-talk-performance relationship: The effects of motivational self-talk on self-confidence and anxiety', *Psychology of Sport and Exercise* 10 (2008), 186-192.
[397] Ramzan Hassanzadeh, Sedigheh Ebrahimi and Galin Mahdinejad, 'Studying Test Anxiety and Its Relationship with Self-Efficacy, Metacognitive Beliefs and Some Effective Predictable Variables', *European Journal of Social Sciences* 30 (2012), 511-522.
[398] Aaron Williamon, 'A Guide to enhancing Musical Performance' in Aaron Williamon (ed.), *Musical Excellence: Strategies and techniques to enhance performance* (New York: Oxford University Press, 2004), 3-18.

Thomas (2008) offer ten practical suggestions for managing performance anxiety.[399] Winter Hunnicutt and S. Winter (2011) discuss adapting psychotherapy techniques of desensitization to the voice studio.[400] Ignacio (2016) notes that mental rehearsal strategies have also been successful to improve performance and reduce stress in other occupations.[401] Hoffman and Hanrahan (2011) investigated the benefits of short-term mental skills training on MPA reduction and performance enhancement. They report a significant decrease in self-reported anxiety one month post intervention.[402]

Wan and Huon (2005) initiated an experiment to compare the predictions of two theories, distraction theory and explicit monitoring. Distraction theory explains performance degradation as a result of attentional shifts to task-irrelevant information. Explicit monitoring postulates that degradation occurs as a result of increased attention to step-by-step control of skill processes. The results were consistent with explicit monitoring theory and further evidence concludes that video-monitoring training was found to ameliorate the performing deficits.[403]

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[399] Shirlee Emmons and Alma Thomas, 'Understanding Performance Anxiety', *Journal of Singing* (2008), 461-465.
[400] Heather Winter Hunnicutt and A. Scott Winter, 'Musical Performance Anxiety: Adapting Psychotherapy Techniques of Desensitization to the Voice Studio, Part 1,' *Journal of Singing* 67 (2011), 445-450; Heather Winter Hunnicutt and A. Scott Winter, 'Musical Performance Anxiety: Adapting Psychotherapy Techniques of Cognitive Restructuring to the Voice Studio, Part 2', *Journal of Singing* 67 (2011), 445-450; Heather Winter Hunnicutt and A. Scott Winter, 'Musical Performance Anxiety: Adapting Multiple Cognitive Behavior Therapy Techniques to the Voice Studio, Part 3', *Journal of Singing* 68 (2011), 67-73.
[401] Jeanette Ignacio et al., 'Development, implementation, and evaluation of a mental rehearsal strategy to improve clinical performance and reduce stress: A mixed methods study', *Journal of Nurse Education Today* 37 (2016), 27-32.
[402] Sophie L. Hoffman and Stephanie J. Hanrahan, 'Mental Skills for Musicians: Managing Music Performance Anxiety and Enhancing Performance', *Sport, Exercise, and Performance Psychology* (2011), 1-12.
[403] Catherine Y. Wan and Gail F. Huon, 'Performance degradation under pressure in music: An examination of attentional processes', *Psychology of Music* 33 (2005), 155-172.

Current treatment methods to alleviate anxiety symptoms are according to Kenny (2004), pharmacological, physiological, cognitive, meditative, or musical.[404] Pharmacological remedies are only briefly mentioned here; a more detailed description is given in Appendix D.

Kenny (2005) compiled a review of all available treatment studies, but found considerable difficulties regarding modality, sample size and methodologies which precluded firm conclusions regarding any MPA treatments.[405] Thurber et al. (2010) provide an updated review of treatments. Whilst it is indicated that Beta Blockers (see Lehrer, 1987)[406] can reduce some of the physiological symptoms of MPA, they do little to reduce the psychological components and they have the potential to be over-used. Some efficacy has been demonstrated with behavioural and cognitive-behavioural therapies; however, no conclusions can be reached regarding the effectiveness of cognitive therapy alone. Studies on hypnosis, music therapy, and the Alexander technique show promise, but further research with larger samples is required. Electromyography and temperature training biofeedback have been effective when combined with other psychological interventions. According to Thurber et al. (2010), electroencephalographic biofeedback, or neurofeedback, has been effective in improving performance quality, but further study is needed to demonstrate efficacy in reducing MPA. Results of the study suggest that heart rate variability coherence, biofeedback training and emotional management techniques

[404] Dianna T. Kenny, 'Music Performance Anxiety: Is it the music, the performance or the anxiety?', *Music Forum* (2004), 12 <*www.researchgate.net/.../Dianna_Kenny/...Music.../0046351bfaef13a20a000000.pdf*> [Accessed 6 Jan 2013]
[405] Dianna T. Kenny, 'A Systematic Review of Treatments for Music Performance Anxiety', *Journal of Anxiety, Stress and Coping* 18 (2005), 183-208.
[406] Paul M. Lehrer, 'A Review of the Approaches to the Management of Tension and Stage Fright in Music Performance', *Journal of Research in Music Education* 35 (1987), 146.

decrease MPA.[407] Leddick (2011) introduced a model integrating psychoanalytic psychotherapy with neurofeedback. Untangling the knots that develop from early traumatic relationships is facilitated by the simultaneous presence of neurofeedback and psychotherapy, because the present brain retelling and response is monitored and re-normalised while the psychotherapeutic interventions are occurring.[408] McGrath (2012, PhD Dissertation) comprehensively reviews current therapies for MPA: Cognitive Behavioural Therapies, (rational emotive, behavioral therapy, meditation, electromyographic biofeedback, progressive muscular relaxation and alexander technique); Expressive Art Therapies (guided imagery and music therapy) Exposure Therapies (systematic desensitization); and Pharmacological Treatments (beta blockers, benzodiazepines).[409]

Certainly, exposure programmes such as the *Virtual Concert Hall* performance simulator developed at the Royal College of Music in London are welcome advances for training the aspiring student musician.[410] However, it is unclear whether these new training strategies on their own would be successful in preventing MPA longer-term, or whether they could assist in the treatment of MPA in professional musicians. Nonetheless, they do create awareness and provide a basis whereby these common issues are open to discussion. MPA and strategies to treat it can be tested for efficacy within the educational environment.

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[407] Myron R. Thurber et al., 'Effects of Heart Rate Variability Coherence Biofeedback Training and Emotional Management Techniques to Decrease Music Performance Anxiety', *Biofeedback* 38 (2010), 28-39.
[408] Katherine H. Leddick, 'letting go of Performance Anxiety and Optimizing Musical Performance in a case of Traumatic loss'', *Association for Applied Psychophysiology and Biofeedback* 39 (2011), 35.
[409] Casey Eileen McGrath, 'Music Performance Anxiety Therapies: A review of the Literature', (PhD Dissertation, University of Illinois, Urbana Illinois, 2012).
[410] The Performance Simulator operates in two modes: (i) concert and (ii) audition simulation. It allows musicians to develop and refine valuable professional skills in various settings such as regular coaching sessions to enhance stage presence skills, counselling applications for musicians suffering from performance anxiety, and state-of-the-art physiological monitoring before, during and after a performance.

What interferes with the enjoyment of personal performances (Cox, 2015) is perhaps key to understanding MPA and is vital to assisting performers during rehabilitation counselling or within the relative sanctuary of the music studio.[411] Buma, Bakker and Oudejans (2015) studied forty-four professional musicians and the process of Narrative Thinking[412] was discovered to be successful in relaxing the majority of professionals.[413] These performance-based strategies are being developed; however, the level of awareness of these and other remedies within the broader professional music environment is unknown. As Braun-Janzen and Zeine (2009) found singers are generally not overly interested in or aware about, vocal function and dysfunction unless it particularly affects them.[414] Kwak et al. (2013) observe that advanced singers do not have significantly greater knowledge of vocal form and function than novice singers; however, they do worry about vocal pathology.[415] Dejonckere (2011) describes a 2007 initiative to promote awareness.[416] It is unknown whether singers know where to solicit expert performance help, where to access the latest performance strategies, or indeed how to contact other specialists if problems arise

[411] David Cox, 'It'll be alright on the night: how musicians cope with performance stress', *The Guardian* 8 September 2015 <http://www.theguardian.com/music/2015/sep/08/how-classical-musicians-cope-with-performance-stress> [Accessed 27 September 2015].
[412] Narrative Thinking is a process of practice where the performer disentangles what the composer has written, reducing it to the bare bones of the harmonies and study of embellishments completely internalising various aspects of the music, seeing different phrases almost as various passages in a story.
[413] Lori A. Buma, Frank C. Bakker and Raôul R. D. Oudejans, 'Exploring the thoughts and focus of attention of elite musicians under pressure', *Psychology of Music* 43 (2015), 459-472.
[414] Colleen Braun-Janzen and Lina Zeine, 'Singers' Interest and Knowledge Levels of Vocal Function and Dysfunction: Survey Findings', *Journal of Voice* 23 (2009), 470-483.
[415] Paul E. Kwak, 'Knowledge, Experience, and Anxieties of Young Classical Singers in Training', *Journal of Voice* 28 (2014), 191-195.
[416] Philippe H. Dejonckere, 'The COST–Action 2103 "Advanced Voice Function Assessment"', *Logopedics Phoniatrics Vocology* 36 (2011), 51; 'The COST –Action 2103 "Advanced Voice Function Assessment" was launched in the beginning of 2007, with a double challenge: Create a European network of voice experts; building a bridge between the community of basic scientists involved in signal processing and the community of medical professionals responsible for the care and cure of patients with voice disorders'.

due to psychological issues other than via traditional routes involving general practitioners GPs.

Nelson and Blades-Zeller (2001) describes the Feldenkrais method of body management, used to co-ordinate and develop posture and alignment and remove unnecessary bodily tension.[417] Nelson and Blades-Zeller (2005) emphasise the importance of pelvic centring (relating the pelvis to the head) for full freedom in the body when singing.[418] De Alcantara, (1997) introduces Alexander Technique, another method which addresses postural issues. Alexander Technique has been most successful for singers especially regarding positions of the head in relation to the rest of the body.[419] Hudson (2002) states that the use of Alexander Technique can focus attention to become more inclusive of the field of attention; this is said to assist greatly with breath management.[420]

Gregg and Clark (2007) discuss the theoretical and practical applications of mental imagery. Singers report greater uses of images in successful goal achievement compared to instrumental musicians. Imagery affects performance through cognitive and motivational functions. Cognitive includes strategy–and specific skill rehearsal and motivational consists of being successful in controlling emotions and overcoming adversity.[421] Juncos and Markman (2015) investigate acceptance and commitment therapy (ACT) for the treatment of music performance anxiety. ACT

[417] Samuel Nelson and Elizabeth Blades-Zeller, *Singing with your Whole Self: The Feldenkrais Method and Voice* (Lanham, MD: Scarecrow Press, 2001).
[418] Samuel Nelson and Elizabeth Blades-Zeller, 'Singing with Your Whole Self: The Feldenkrais Method and Voice', *Journal of Singing* 62 (2005), 145-157.
[419] Pedro De Alcantara, *Indirect Procedures: A Musician's Guide to Alexander Technique* (Oxford: Clarendon Press, 1997).
[420]Barbara Hudson, 'The Effects of The Alexander Technique on the Respiratory System of the Singer/Actor Part II: Implications for Training Respiration in Singer/Actors Based on Concepts of the Alexander Technique', *Journal of Singing* 59 (2002), 105-110.
[421] Melanie J. Gregg and Terry Clark, 'Theoretical and Practical applications of mental imagery', *International Symposium on Performance Science* (2007), 295-300.

aims to enhance psychological flexibility in the presence of unwanted symptoms through six core processes. Clinically significant improvements were observed.[422] Hoffman and Hanrahan (2011) initiated short-term mental skills training intervention to assist with MPA in musicians. Although there was modest improvement (it appeared the treatment was better than no treatment), issues with research design meant that it was not possible to say if the intervention was any more beneficial than other forms of therapy, such as contact with a therapist.[423] Kenny, Arthey and Abbass (2016) observe that severe MPA can be unresponsive to usual treatments such as cognitive behavioral therapy CBT; their study investigated attachment ruptures and tested the efficacy of short-term dynamic psychotherapy (ISTDP). Initial results are positive; however, they advise that further research is required.[424]

Lin et al. (2008), investigates the effects of Chan (Zen) meditation on MPA and music performance quality. Findings suggest that enhanced concentration and mindfulness might enable performers to improve musical performance.[425]

Farnsworth-Grodd (2012), PhD dissertation examined the role that mindfulness plays in guiding adaptive coping methods in musicians to manage MPA. Mindfulness acts with awareness (expressed in dispositional and situational forms) and is associated with lower MPA. 'Coping responses of higher hope and lower avoidance partially mediated dispositional act, with awareness effects on the

[422] David G. Juncos and Emily J. Markman, 'Acceptance and Commitment Therapy for the treatment of music performance anxiety: A single subject design with a university student', *Psychology of Music* 44 (2015), 1-18.
[423] S. L. Hoffman and Stephanie J. Hanrahan, 'Mental Skills for Musicians: Managing Music Performance Anxiety and Enhancing Performance', *American Psychological Association* (2011), 1-11.
[424] Dianna T. Kenny, Stephen Arthey and Allan Abbass, 'Identifying attachment ruptures underlying severe music performance anxiety in a professional musician undertaking an assessment and trial therapy of Intensive Short-Term Dynamic Psychotherapy (ISTDP)',
[425] Peter Lin et al., 'Silent illumination: a study on Chan (Zen) meditation, anxiety, and musical performance quality', *Society for Education, Music and Psychology Research* 36 (2008), 139.

situational act with awareness.'[426] The goal-oriented strategy of hope also contributed to increased practice efforts. During performance, the coping strategy of positive focus, self-kindness and self-acceptance partially mediated the relationship between levels of situational act with awareness and MPA.[427] Boutin and Tosi (1983) investigated the efficacy of RSDH Hypnotherapy in the modification of irrational ideas.[428] Wan and Schlaug in Deutsch (2013) discuss the benefits of music performance towards enhancing brain plasticity. Previous studies have investigated the structural and functional effects of music on the brain. Therefore music-based treatments are considered to have the potential to benefit and enhance treatments of neurological disorder. However, there is need for further research in this area.[429] A more comprehensive explanation and summary of therapies to assist in combating MPA is presented in Appendix D.

Brain function research- tracing the effects of stress

The discovery of steroid hormone receptors in brain regions that mediate every aspect of brain function has broadened the definition of 'neuroendocrinology' to include reciprocal communication between the brain and the body via hormonal and neural pathways. Studies of functional responses to tests of emotional recognition, in which men and women score the same, reveal different patterns of activation across brain regions between the sexes. Thus, men and women use different strategies of

[426] Virginia Ann Farnsworth-Grodd, 'Mindfulness and Self-Regulation of Music Performance Anxiety' (PhD dissertation, University of Auckland, 2012), ii.
[427] Ibid.
[428] Gerard E. Boutin and Donald J. Tosi, 'Modification of Irrational Ideas and Test Anxiety through Rational Stage Directed Hypnotherapy [RSDH]', *Journal of Clinical Psychology* 39 (1983), 382-391.
[429] Catherine Y. Wan and Gottfried Schlaug in Diana Deutsch, *The Psychology of Music* (San Diego: Elsevier, 3rd edn 2013), 565-581.

problem solving because of subtle differences in brain architecture (McEwen, Gray and Nasca, 2015).[430]

According to McEwen (2006), the mind involves the whole body, in two-way communication between the brain and the cardiovascular, immune and other systems via neural and endocrine mechanisms. Stress is a condition of the mind-body interaction. Many events of daily life elevate physiological systems. Sleep deprivation, overeating, and other health-damaging behaviours–not only dramatic life events–can produce the feeling of being stressed out. Overtime, this causes wear and tear on the body, known as allostatic load. Hormones associated with stress and allostatic load protect the body in the short term and promote adaption by a process known as allostasis, but in the longer term allostatic load leads to changes in the body and the brain which can result in disease. Brain regions respond to stress by undergoing structural remodelling which alters behavioural and physiological responses.[431]

McEwen (2007) describes how economic environment and social status influence success in mediating stressful experiences. [432] McEwen and Gianaros (2010) investigated stress-related processes embedded in the social environment that are embodied within the brain, which dysregulate allostasis and promote maladaptive wear and tear on the body. Life stress can presage ill health in vulnerable individuals. Vulnerability is determined by genetic, bio-behavioural, and environmental factors

[430] McEwen, Gray and Nasca, 'Redefining neuroendocrinology: stress, sex and cognitive and emotional regulation', *Journal of Endocrinology* 226 (2015), T67-T83.
[431] Bruce S. Mc Ewen, 'Protective and damaging effects of stress mediators: central role of the brain', *Journal of Dialogues in Clinical Neuroscience* 8 (2006), 367-381.
[432] Bruce S. Mc Ewen, 'Physiology and Neurobiology of Stress and Adaption: Central Role of the Brain', *Physiology Review* 87 (2007), 873-904.

that interact over a lifespan, particularly through neurobiological pathways.[433] McEwen (2013) discusses the epigenetic effects of maternal care, prenatal stress, prolonged maternal separation, postnatal maternal abuse, and maternal anxiety on subsequent behaviour and development. Whilst it is possible for the stress-induced plasticity of the brain to be reversed in the young adult brain by top down interventions like physical activity and positive social interactions, research has highlighted the importance of nurturing in early life experiences for healthy brain and body over a life-course.[434] It remains, that aside from vulnerabilities which can be inherited, stressful experiences in early life have long-lasting effects on brain development and the capacity to respond to stress later in life (McEwen et al., 2012).[435] McEwen and Gianaros (2010) describe the brain as:

> The key organ of stress reactivity, coping, and recovery processes. Within the brain, a distributed neural circuitry determines what is threatening and thus stressful to the individual. Instrumental brain systems of this circuitry include the hippocampus, amygdala, and areas of the prefrontal cortex. Together, these systems regulate physiological and behavioural stress processes, which can be adaptive in the short-term and maladaptive in the long-term. Importantly, such stress processes arise from bidirectional patterns of communication between the brain and the autonomic, cardiovascular, and immune systems via neural and endocrine mechanisms underpinning cognition, experience, and behaviour. In one respect, these bidirectional stress mechanisms are protective in that they promote short-term adaptation (allostasis). In another respect, however, these stress mechanisms can

[433] Bruce S. McEwen and Peter J. Gianaros, 'Central role of the brain in stress and adaption: Links to socioeconomic status, health, and disease', *Annual New York Academy of Sciences* 1186 (2010), 190-222.
[434] Bruce S. McEwen, 'Brain on stress: How the social environment gets under the skin', *Proceedings of National Academy Sciences USA* 110 (2013), 1561-1575.
[435] Bruce S. McEwen et al., 'Stress and Anxiety: Structural plasticity and epigenetic regulation as a consequence of stress', *Journal of Neuropharmacology* (2012), 11<http://doi:10.1016/j.neuropharm.2011.07.014> [Accessed 21 May 2015]

> lead to a long-term dysregulation of allostasis in that they promote maladaptive wear-and-tear on the body and brain under chronically stressful conditions (allostatic load), compromising stress resiliency and health.[436]

The entire nervous system is identified as a target of reproductive hormones McEwen (2009).[437] Steroid hormone receptors are found in brain regions that mediate every aspect of brain function, this involves reciprocal communication between the brain and the body via hormonal and neural pathways McEwen (2015).[438] The brains response to stress is sexually dimorphic, with differences in how men and women process information. According to Ingalhalikar et al. (2013), male brains are designed to facilitate connectivity between perception and co-ordinated action, and female brains facilitate communication between analytical and intuitive processing.[439] The brain controls compensatory mechanisms and neurodegeneration. However, gender differences mean that gene expression is set differently in men and women; these differences affect how the brains of each sex age according to Berchtold et al. (2008).[440] Over the life of the individual, the brain responds to experiences with structural and functional plasticity; hormones, neurotransmitters and other mediators are involved via a complex collaborative network. Mediators of the plastic changes in the brain include glucocorticoids, excitatory and inhibitory neurotransmitters, neurotropic factors and inter-cellular

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[436] Bruce S. Mc Ewen and Peter J. Gianaros, 'Central role of the brain in stress and adaption: Links to socioeconomic status, health, and disease', *Annual N Y Academy of Sciences* (2010), 190 NIH Public Access National Institute of Health PMC publication PMCID: PMC2864527 <www.ncbi.nlm.nih.gov/pmc/articles/PMC2864527/> [Accessed 8 January 2014].
[437] Bruce S. McEwen, 'Introduction: The End of Sex As We Once Knew It', *Journal of Physiology and Behaviour* 97 (2009), 143.
[438] Bruce S. McEwen, 'Redefining neuroendocrinology: stress, sex and cognitive and emotional regulation', *Journal of Endocrinology* 226 (2015), T67.
[439] Madhura, Ingalhalikar et al., 'Sex differences in the structural connectome of the human brain', *PNAS* (2013), 1.
[440] Nicole C. Berchtold et al., 'Gene expression changes in the course of normal brain aging are sexually dimorphic', *PNAS* 105 (2008), 15605.

signalling molecules, including endocannabinoids. These operate in a non-linear network, where the biphasic actions of each mediator system include reciprocal interactions that have self-limiting (homeostatic) features. McEwan (2012) states that brain circuits are plastic and remodelled by stress to change the balance between anxiety, mood control, memory and decision making. Such changes can be adaptive in particular contexts, but their persistence and lack of reversibility can be maladaptive over a life-course. Early life experiences and socio-environment are important factors in this adaption process.[441] When disrupted, these systems can lead to pathophysiology.

The adolescent brain

According to Raznahan et al. (2010), humans have systematic sex differences in brain-related behaviour, cognition and mental health risk. Many of these differences emerge during adolescence, a developmental period of intense neuro-structural and endocrine change. Findings suggest that sex and sex steroids shape brain development in a spatiotemporally specific manner, within neural systems known to underpin sexually dimorphic behaviours.[442]

Sex differences in brain connectivity and response

Ingalhalikar et al. (2013) have identified that the human brain cognises threatening stimuli according to sex. Sexual changes that audibly impact vocal identity at puberty also influence the way male and female brains become wired to receive and

[441] Bruce S. McEwen, 'Brain on stress: How the social environment gets under the skin', *Proceedings of National Academy Sciences USA* 109 (2012), 17180-17185.
[442] Armin Raznahan et al., 'Longitudinally mapping the influence of sex and androgen signalling on the dynamics of human cortical maturation in adolescence', *PNAS* 107 (2010), 16988-16993.

process all kinds of information, including the stress response to perceived threats.[443] Cosgrove et al. (2007) state:

> There are important differences which distinguish the male and female brains in healthy individuals. Overall brain volume is different between men and women, yet, when controlling for total volume women have a higher percentage of grey matter and men a higher percentage of white matter. Regional volume differences are less consistent. Global cerebral blood flow is higher in women than men. Sex-specific differences in dopaminergic, serotonergic and GABAergic markers indicate that male and female brains are neurochemically distinct.[444]

Understanding these distinct differences between men and women may lead to determining the mechanisms involved in neuropsychiatric disorders and thus guide the development of sex-specific treatments.

Structural brain differences between the sexes

Alonso-Nanclares et al. (2008) state that, despite well-known inter-individual variability in the brain, their study observed lower synaptic density in women in all cortical layers of the temporal neocortex. They conclude that it is likely that these differences represent a micro-anatomical substrate for sex differences in the fine-tuning of several functions. However, caution is recommended in extrapolating this data as it is reported that the anterior commissure, which connects several regions of the frontal and temporal lobes, is larger in women than in men, suggesting that women would have more commissural associative connections.[445] Structural changes

[443] Madhura Ingalhalikar et al., 'Sex differences in the structural connectome of the human brain', *PNAS Early Edition* (2013), 1-6.
[444] Kelly P. Cosgrove et al., 'Evolving Knowledge of Sex Differences in Brain Structure, Function and Chemistry', *Biological Psychiatry* 62 (2007), 847-855.
[445] L. Alonso-Nanclares et al., 'Gender differences in human cortical synaptic density', *PNAS 105* (2008), 14615-14619.

are constantly occurring in the architecture of the brain. According to McEwen (2012) brain architecture is more plastic and adaptable, and hormones from the peripheral endocrine organs play a role along with neurotransmitters and a host of endogenous molecules, including neurotrophic factors. Therefore, top-down interventions such as exercise and social support represent the brain's ability to change itself with the help of the correct support and assistance. Thus, according to McEwen (2012), the efficacy of pharmaceutical agents must be understood in terms of integrative ongoing neuronal activity and behavioural therapies.[446]

Young et al. (2013) investigated sex differences in autobiographical memory (AM), which is the episodic memory for personally experienced events. Sex differences in AM recall have been reported in several behavioural studies, but the functional anatomical correlates underlying such differences have been unclear. Behaviourally, females recalled more negative and fewer positive AMs compared with males. Whilst males and females did not differ substantially in rates of arousal, vividness, memory age or control task, neurophysiologically females showed increased hemodynamic activity in certain regions compared to males. Upon direct comparison, males and females differed in their BOLD responses in the hippocampus and the dorsolateral pre-frontal cortex. It is proposed that the differential hemodynamic changes may reflect sex-specific cognitive strategies during recall of AMs, irrespective of the phenomenological properties of those memories.[447]

[446] Bruce S. McEwen, 'The Ever-Changing Brain: Cellular and Molecular Mechanisms for the Effects of Stressful Experiences', *Journal of Developmental Neurobiology* 72 (2012), 878-890.
[447] Kymberly D. Young et al., 'Functional Neuroimaging of Sex Differences in Autobiographical Memory Recall', *Journal of Human Brain Mapping* 34 (2013), 3320-3332.

Oestrogen, Progesterone and Oral Contraceptive brain effects

According McEwen et al. (2012), circulating hormones have been a very effective way to probe brain structure and function. The study of hormonal effects on the brain has demonstrated the plasticity of the developing and adult brain, not only in relation to important events in the hypothalamus that regulate reproductive functions and homeostasis but in higher cognitive processes as well as emotional regulation and decision making. Knowledge regarding the actions of steroid hormones has expanded, especially for oestrogen, which now is known to be involved across the entire central nervous system (CNS). This means that, potentially, oestrogen could affect cognition, mood, blood pressure regulation, and alter inflammatory processes and innate and acquired immune function, both in the brain and the body.[448]

Graham and Milad (2013) investigated fear extinction in rodents (N=140) and women (N=76). Fear extinction is a laboratory model of fear inhibition and is the basis of exposure therapy for anxiety disorders. Emerging evidence from naturally cycling women indicates that oestrogens are necessary to the consolidation of fear extinction. Oral contraceptives (OCs) inhibit oestrogen production, yet their effects on fear extinction is unknown. A cross-species translational approached was used. Results indicate that women using OCs exhibited significantly poorer extinction recall when compared with naturally cycling women. Estradiol substantially impacts cell signalling, excitability, and morphology; for example, estradiol enhances dendritic spine density and synaptogenesis in the hippocampus. As such, the extinction deficit observed in the study may reflect a longer-term consequence of OC

[448] Bruce S. McEwen et al., 'Estrogen effects on the brain: actions beyond the hypothalamus via novel mechanisms', *Journal of Behavioral Neuroscience* 126 (2012), 4-16 <http://doi:10.1037/a0026708> [Accessed 6 Jan 2016].

on spine density following persistent reductions of oestrogen. Therefore, the speculation is that observed deficits in extinction caused by OCs may be mediated by a downward regulation of both the longer-term genomic and shorter-term non-genomic effects of estradiol. Graham and Milad comment:

> Few studies have examined potential effects of oestrogen on anxiety disorders, and the neurobiological reason for women's greater vulnerability to anxiety remains unknown. It could be further speculated that women may be less likely to naturally extinguish fearful memories or further, be less responsive to exposure therapy when estradiol levels are low.[449]

Recommendations are that future studies should examine the possibility that systemic estradiol might prevent extinction impairments or enhance exposure-based therapies for anxiety in women. The data highlights the importance of taking into consideration OC use, and hormonal status in general, in women in clinical settings. The data suggests the need for further investigations into the impact of OCs on emotion regulation and therapeutic interventions for anxiety.[450]

Pletzer, Kronbichler and Kerschbaum (2015) indicate that the effects of OCs on human brain structure and behaviour have only recently become the focus of research. They report differential effects of androgenic and anti-androgenic progestins on human brain structure. As seen from other research, OC users have differed from naturally cycling women in an emotional memory paradigm (Nielsen et al., 2011). Alterations of brain activation patterns due to OC use have been observed in verbal (Rumberg et al., 2010) and numerical tasks (Pletzer et al., 2014).

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[449] Bronwyn M. Graham and Mohammed R. Milad, 'Blockade of Estrogen by Hormonal Contraceptives Impairs Fear Extinction in Female Rats and Women', *Journal of Biological Psychiatry* 73 (2013), 377.
[450] Ibid. 371-378.

Pletzer et al. (2015), determine that duration of OC use is important. OCs appear to alter brain structure, with different pill types affecting different areas. The effects on some areas being quickly reversible whilst, in others, not. These effects of OC use for women's cognitive performance, emotion and behaviour, according to Pletzer et al. (2015), require further research.[451]

Nagaya and Maren (2015) comment on findings by (Glover et al., 2015). As discussed by Glover et al., ovarian hormones play an important role in modulating fear extinction, a form of learning involved in the suppression of learned fear responses. Women in the luteal phase (high circulating oestrogen) of the menstrual cycle have stronger extinction recall compared with women in the early follicular phase or on contraceptives (low circulating oestrogen). In addition to oestrogen, progesterone and its neuroactive metabolite, allopregnanolone, have been shown to modulate anxiety and fear. Although progesterone has not been linked to fear extinction, it has been implicated in various psychiatric disorders, including major depressive disorder MDD and premenstrual dysphoric disorder PDD. Glover et al., suggest that it is not absolute levels of oestrogen but rather fluctuations in oestrogen levels that give rise to sex-specific susceptibility.[452]

Testosterone brain effects

Hahn et al. (2016) state that, due to ethical issues, administration of testosterone is mostly limited to single doses. It is known that testosterone is integrally involved in the development of language processing. This study assessed the influence of

[451] Belinda Pletzer, Martin Kronbichler and Hubert Kerschbaum, 'Differential effects of androgenic and anti-androgenic progestins on fusiform and frontal grey matter volume and face recognition performance', *Journal of Brain Research* 1596 (2015), 108-115.
[452] E. M. Glover et al., in Naomi Nagaya and Stephen Maren, 'Sex, Steroids, and Fear', *Society of Biological Psychiatry* 78 (2015), 152-153.

continuous high-dose hormone application in adult female to male transsexuals. Findings suggest testosterone dependent neuro-plastic adaptations in adulthood within language-specific brain regions and connections. Importantly, deteriorations in grey matter volume seem to be compensated by enhancement of corresponding structural and functional connectivity.[453]

Inflammation and sickness behaviour

Dantzer et al. (2008) state that inflammation is an important biological event that may increase the risk of disease and depression. Sickness is the normal response to infection, just as fear is normal in response to a stressor. The behaviour of sick people changes dramatically. In sickness, pro-inflammatory cytokines are produced at the site of infection; these coordinate local and inflammatory response to infection but also cause the behavioural symptoms of sickness. It is suggested that this sickness behaviour is responsible for re-organising perceptions and actions to enable ill individuals to cope better.[454]

According to Dhabhar et al. (2012), the surveillance and effector functions of the immune system are critically dependent on the appropriate distribution of immune cells in the body. Acute stress induces a rapid redistribution of immune cells among different body compartments orchestrated by stress hormones. A major distinguishing characteristic of stress is therefore duration. Acute stress is short-term, chronic stress persists for hours, weeks or months. Short-term stress response is designed to be adaptive and advantageous. There may be many ways that this short-term effect might be medically manipulated. However, it is important to appreciate

[453] Andreas Hahn et al., 'Testosterone Affects Language Areas of the Adult Human Brain', *Human Brain Mapping* 37 (2016), 1738-1748.
[454] Robert Dantzer et al., 'From inflammation to sickness and depression: when the immune system subjugates the brain', *Nature Reviews Neuroscience* 9 (2008), 46-56.

that the cessation of the stressor does not result in the immediate cessation of the physiological stress response; therefore, the immune cell redistribution cascade is likely to proceed even after relatively brief stressors. Chronic stress induces significant reduction of resting state numbers of circulating lymphocytes and induces a loss of immune cell responsivity to acute stress redistribution. Interestingly, a dysregulation of the circadian corticosterone rhythm is observed around the time that the deleterious effects of chronic stress begin to manifest.[455]

Cohen et al. (2012) state that chronic psychological stress is associated with a greater risk of depression, cardiovascular disease, diabetes, autoimmune disease, and upper respiratory infections, as well as poorer wound healing. Although these associations are often attributed to stress-induced dysregulation of the HPAA, the simple notion that chronic stress acts through direct effects of elevated circulating cortisol is becoming less likely. What may matter more is how target tissues respond to cortisol, rather than levels of the hormone per se. GCR refers to the decrease in sensitivity of the immune cells to glucocorticoid hormones that normally terminate the inflammatory response. Failure of the HPAA to regulate the production of pro-inflammatory cytokines contributes to the risk of clinical illness. Because inflammation plays a role in the progression of multiple diseases, this may explain why prolonged stress and inflammation response would play a role in other inflammatory diseases.[456]

According to Kinner, Wolf and Merz (2016), dysfunctional reward processing is known to play a central role in the development of psychiatric disorders.

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[455] Firdaus S. Dhabhar et al., 'STRESS-INDUCED REDISTRIBUTION OF IMMUNE CELLS-FROM BARRACKS TO BOULEVARDS TO BATTLEFIELDS: A TALE OF THREE HORMONES-CURT RICHTER AWARD WINNER', *Psychoneuroendocrinology* 37 (2012), 1345-1368.
[456] Sheldon Cohen et al., 'Chronic stress, glucocorticoid receptor resistance, inflammation, and disease risk', *PNAS* 109 (2012), 5995-5999.

Glucocorticoids that are secreted in response to stress have been known to attenuate reward sensitivity, and, by so doing, may promote the onset of psychopathology. Findings suggest that the administration of cortisol diminishes the neural correlates of verbal and monetary reward anticipation. In men, activation in the amygdala, the precuneus, the anterior cingulate, and hippocampal regions is reduced under cortisol, whereas, in cortisol-treated women, a signal increase was observed in these regions. Behavioural performance also indicated that reward learning in men is impaired under cortisol concentrations, while it is augmented in women. Findings indicate that the effects of the stress hormone cortisol influence the neural reward system which is sensitive to sex differences, and which may translate into different vulnerabilities for psychiatric disorders. It is immensely important to note that all the women in this study were taking OCs. It has been previously demonstrated that cortisol effects on brain activation in normally cycling (NC) women are similar to men. Thus, OC usage, or rather sex hormone status and not sex per se, appear to interfere with stress hormone actions. They conclude that the different reward patterns in men and women might reflect a distinct responsivity of the brain to the complex interplay of circulating endogenous and exogenous hormones released by both axes. Since a considerable percentage of women are using OCs, future studies are warranted that will compare the impact of cortisol on reward processing in OC and NC Women.[457]

According to Morena et al. (2016), the endocannabinoid (eCB) system is also an integral regulator of the stress response. The eCB is a group of endogenous cannabinoid receptors located in the mammalian brain and throughout the central and peripheral nervous systems, consisting of neuromodulatory lipids and their

[457] Valerie L. Kinner, Oliver T. Wolf and Christian J. Merz, 'Cortisol alters reward processing in the human brain', *Journal of Hormones and Behavior* 84 (2016), 75-83.

receptors. The eCB system in humans regulates many of the same domains and appears to be a critical component of stress regulation. Impairments in this system may be involved in the vulnerability to stress-related psychiatric disorders. This suggests that the eCB system is an important regulatory system in the brain which largely functions to buffer against many effects of stress, and that dynamic changes in this system contribute to different aspects of the stress response.[458]

Disease and neuroendocrine system

According to Frick et al. (2009), stress alters the neuroendocrine system, immunity and cancer development. Although the classic hormones involved in stress are glucocorticoids, thyroid hormones are also implicated in stress. In their study on mice, differentiated endocrine alterations are observed in response to acute and chronic stress. While corticosterone and noradrenaline levels are increased by acute stress, they are restored by prolonged exposure to the stressor. Instead, thyroid hormone levels are only reduced in chronically stressed animals in comparison to control subjects. Correlating chronic, but not acute stress impaired T-cell reactivity. Thyroxin replacement restores the euthyroid status and reverses the observed reduction of T-cell lymphoproliferative responses. Thyroid replacement also reverses the alterations of lymphoma growth.[459]

Brain and Gut

There is growing evidence of a link between the gut microbiome in shaping behaviour relevant to many psychiatric and neurological disorders. Findings suggest

[458] Maria Morena et al., 'Neurobiological Interactions between Stress and the Endocannabinoid System', *Journal of Neuropsychopharmacology* 41 (2016), 80-102.
[459] Luciana Romina Frick et al., 'Involvement of Thyroid Hormones in the Alterations of T-Cell Immunity and Tumor Progression Induced by Chronic Stress', *Journal of Biological Psychiatry* 65 (2009), 935-942.

that the microbiome is necessary for appropriate regulation of the miRNA expression in brain regions implicated in anxiety like behaviours. Preclinical evidence suggests that certain probiotics and prebiotics have anxiolytic-like activity, which highlights the potential of microbiota-mediated therapeutic approaches for treating anxiety-related disorders (Clark et al., 2017).[460] Interestingly, hypothyroid disorders are connected to inflammation dysregulation, gut and food sensitivities.

Oxytocin and Vasopressin

According to Young (2012), polymorphisms in the oxytocin and vasopressin receptor genes have been linked to attachment, generosity, and pair bonding behaviours in humans. The name Oxytocin, meaning quick birth, is derived from the Greek. The name Vasopressin, meaning vessel pressure is derived from the Latin. Originally, Oxytocin was studied because of its peripheral release to regulate labour, nursing and water homeostasis amongst pregnant and nursing mothers. Stevenson and Caldwell (2012) observe the actions of vasopressin, which is produced primarily within the paraventricular nucleus and supra-optic nucleus of the hypothalamus. In conjunction with oxytocin, vasopressin is an important modulator of the endocrine stress response. Vasopressin is implicated in the neural regulation of social behaviours, including social forms of aggressive behaviour, social memory, and social motivation.[461] There is substantial cross-talk between both peptides oxytocin and vasopressin. Oxytocin can activate the vasopressin receptor and vice versa (Young, 2012).[462] The evidence suggests that psychosocial risk factors contribute to

[460] Bernard Clark et al., 'Microbial regulation of microRNA expression in the amygdala and prefrontal cortex', *Journal of Microbiome* (2017), 1-19 <https//doi.org10.1186/s40168-017-0321-3> [Accessed 26 Aug 2017].
[461] Erica L. Stevenson and Heather k. Caldwell, 'The Vasopressin 1b receptor and neural regulation of social behavior', *Journal of Hormones and Behavior* 61 (2012), 277-282.
[462] Larry J. Young, 'Editorial comment: Oxytocin, vasopressin and social behavior', *Journal of Hormones and Behavior* 61 (2012), 227-229.

a wide spectrum of somatic, psychosomatic and psychiatric disorders, with major public health significance. Heinrichs et al. (2003) report that the neuropeptide oxytocin seems to enhance the buffering effects of social support. Their study comprised of 37 healthy men. Combinations of social support and oxytocin exhibited the lowest cortisol concentrations, as well as increased calmness and decreased anxiety during stress.[463] According to Veenema (2011), the early life environment has profound effects on brain development and on subsequent expression of social behaviour. Early social environment may alter social behaviour via changes in the oxytocin/vasopressin systems. Findings suggest that oxytocin and vasopressin may mediate early social environment-induced alterations in social behaviour.[464]

Lischke et al. (2012) state that, in humans, Oxytocin (OT) decreases amygdala reactivity to threatening faces in males, but enhances amygdala reactivity in females, suggesting sex-specific differences in OT-dependent threat-processing. Findings suggest that there is increased amygdala activity to scenes depicting social and non-social threat in females. OT may thus enhance the detection of threatening stimuli in the environment, potentially by interaction with other gonadal steroids such as progesterone and oestrogen.[465]

Scheele et al. (2014) report that OT selectively promotes self-interest moral judgements in men. By contrast, in women, oxytocin (OT) increased the reaction time difference between accepted and rejected moral dilemmas and led women to supress their self-interest and respond more altruistically for the benefit of others.

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[463] Markus Heinrichs et al., 'Social Support, Oxytocin and Stress', *Journal of Biological Psychiatry* 54 (2003), 1389-1398.
[464] Alexa H. Veenema, 'Toward understanding how early-life social experiences alter oxytocin-and vasopressin-regulated social behaviors',
[465] Alexander Lischke et al., 'Oxytocin increases amygdala reactivity to threatening scenes in females', *Psychoneuroendocrinology* 37 (2012), 1431-1438.

Taken together, findings suggest OT-related sexual dimorphism in human moral behaviour may have evolved adaptively to optimise both protection and nurturing of offspring by promoting selfish behaviour in men and altruistic behaviour in women.[466]

Eckstein et al. (2014) state that social stress in all social species can be a catalyst for detriment in mental and physical health. It has been shown that OT can have benefits in conjunction with social support. However, OT can also have the opposite effect. Results from the study support the view that OT can induce a self-referential processing bias (an increased perception and awareness of one's own negative feelings), which facilitates the sensation of social stress in the absence of altered endocrine responses. Thus, as cortisol levels were unchanged, they consider that OT effects on psychosocial stress are context dependent. OT treatment may require concomitant social support to precipitate a reduction in cortisol levels.[467]

Hu et al. (2015) state that there are cultural differences in social facilitation of learning. In Caucasian males, learning is facilitated by receipt of social support, compared with non-social feedback with OT treatment facilitating this effect. However, Chinese subjects performed worse with the same reinforcement associated learning (emotional faces) and non-social feedback task. The OT effect was strongest in both groups using female rather than male faces. Functional magnetic imaging showed that, during response but not feedback phase, OT selectively increased activity in specific brain regions during social conditioning. Therefore, OT may be increasing the salience and reward value of anticipated social feedback. OT may also

[466] Dirk Scheele et al., 'Opposing Effects of Oxytocin on Moral Judgement in Males and Females', *Human Brain Mapping* 35 (2014), 6067-6076.
[467] Monika Eckstein et al., 'Oxytocin Facilitates the Sensation of Social Stress', *Human Brain Mapping* 35 (2014), 4741-4750.

have facilitated learning by reducing anxiety in the social feedback condition. These results provide support for psychological studies which suggest that social reinforcement is a potent facilitator for human learning.[468]

Leng and Ludwig (2015) express caution when interpreting the results of research which reports a variety of behavioural effects using intranasal OT. They question the actual amounts delivered in this method that would penetrate the blood brain-barrier to reach the CSF and recommend dose response studies and the need to include controls for peripheral effects, by administering OT peripherally and by blocking peripheral actions with antagonists. They report that claims of peripheral measurements of OT reflecting central release are questionable at best. More research is advised.[469]

Rationale for undertaking this study

Solo performance is understood to elicit the highest disturbance due to anxiety. However, expert performers are known to develop coping measures to mitigate debilitating anxiety symptoms. Freelancing is different to being permanently employed. Often, freelancing involves partaking in multiple employments (not just performance) which can lead to vocal and physical fatigue. Female elite singers are subject to continuous disruption of the voice and emotions by life-cycle hormones. Hormones are involved in sexually dimorphic processing and evaluation of stressors by the brain. Over a life-course, events such as reproduction place an added burden

[468] Jiehui Hu et al., 'Oxytocin Selectively Facilitates Learning with Social Feedback and Increases Activity and Functional Connectivity in Emotional Memory and Reward Processing Regions', *Human Brain Mapping* 36 (2015), 2132-2146.
[469] G. Leng and M. Ludwig, 'Intranasal oxytocin: myths and delusions', *Journal of Biological Psychiatry* 79 (2015), 243-250.

on females which may increase personal and occupational constraints. Female performers self-report the highest levels of anxiety. Soliciting responses from 'Ordinary coping-as-best-as-possible singers' will likely give true observances regarding this population of performers. Observing differing situations of ovarian hormone (normal reproductive cycles, contraceptive cycles, pregnancy, dysfunction and menopausal conditions) in anticipation of a stress condition such as solo performance–where the instrument and emotions are being directly influenced by individual hormone levels–has not previously been researched. This study intends to fill that gap.

Aims

The aims of this study are to distinguish the uppermost occupational and life-style concerns of female solo singers in light of personal experiences under professional and personal constraints, to evaluate the situational effects of hormones on voice functioning and perceptions of music performance anxiety. Singers experience alterations in voice responsiveness and emotional ability to mediate stress as a result of hormone fluctuations. Therefore it was considered important to measure short term hormonal effects in relation to state/trait anxiety, music performance anxiety and singing voice impairment on a day of (solo performance) stress. The study aims to assess and identify any correlations between the measures using (Cohen et al., 2007, S-VHI), (Heinemann 2009, SHE), (Kenny 2009, K-MPAI), and (Spielberger et al., 1970), STAI A-Trait and STAI A-State). A supplemental informal survey (designed by the researcher) seeks to discern levels of injury, illness and disease and methods being employed by this group of singers to reduce symptoms of stress.

Research Questions

The research enquires into the broad professional and personal experiences of expert singers and seeks to discover aspects of the career or lifestyle which influence stress load over a life-course. These questions explore education, voice use, personality, personal fertility, social interactions with friends and family, social interactions with colleagues, lifestyle, life trauma, illness and disease, and other occupational and life-related stress; they also probe into awareness of medical or alternative therapies and the use of such measures by these women to alleviate stress symptoms. The research investigates the possibility that variations in levels of ovarian hormones may be involved in the higher levels of self-reporting of stress by females which is observed in performance and in other psychological research literature.

Rationale for Method

A mixed-method survey in the English language delivered via email attachment, together with previously validated amended research instruments, comprising text box selection with graded replies including open-ended questions for personal recounting of experiences, was considered the best option to generate valuable responses, given that the research sample is globally dispersed and the research is not funded. This survey requires qualitative and quantitative evaluation by the researcher. Snowball sampling is employed through personal contacts and via social media to recruit participants.

Rationale for employing the chosen research instruments

The informal survey was designed by the researcher to investigate (as comprehensively as possible) the personal experiences of solo singers. It used text box, graded selection and invited open comment answering from respondents. A

total of 100 singers were initially recruited to take part in the research. Logistically, it was not going to be possible to conduct personal interviews or for the researcher to personally attend all performances to collect data. This study was undertaken as part fulfilment of the requirements of a doctorate in music performance. The dissertation representing one element, as such, the project was subject to considerable time constraints. The participants were diversely located, and performing, across the globe. It was decided that using email to deliver self-reporting questionnaires was the best method to allow direct contact with as many soloists as possible in a cost-effective manner. It was not intended that any recipient would incur any monetary cost as a result of agreeing to take part in the research and there was no financial incentive offered to participants. Informal survey design was geared towards determining the broadest concerns of singers and gaining as much quality of insight into their personal experiences. The research instruments were chosen as they were deemed to measure the necessary elements the researcher wished to compare and because they had been extensively employed elsewhere and were regarded as reliable. The researcher did appreciate that it would not be possible to personally oversee the completion of surveys. However, it was considered on balance, that the instruments were suitable to measure the desired effects. Follow-up was undertaken to check that correct procedure was implemented. However, the researcher had to trust that respondents completed questionnaires when they were asked to do so.

Research Instruments

The instruments: STAI State/Trait (Spielberger, 1970) was chosen because it is widely used and is considered a reliable measure of anxiety in the general population; it measures both short-term state and longer-term more stable anxiety

proneness. The researcher had to rely on the respondents to follow procedures as instructed.

K-MPAI, (Kenny, 2009) is widely used and considered very reliable; K-MPAI is thought to be more sensitive concerning the domains of anxiety suffered by musicians, and it is possibly less time critical than the STAI State measure.

The S-VHI (Cohen et al., 2007) was developed to specifically measure singing problems and was known as a reliable measure. On deciding on the research instruments the S-VHI was considered more appropriate than the Rosen et al. (2004), VHI-10 to investigate the vocal concerns professional singers.[470] Elite singers were more likely to be aware of voice problems and suffer less dysfunction. Also, attention on voice responsiveness is likely focused prior to performance.

The SHE, (Heinemann, 2009) was the only short-term hormonal effect measure that was deemed sufficiently developed and which had been previously validated. The SHE was considered sensitive enough to differentiate between situational short-term hormonal states. The mixed methods survey (including the series of research instruments) is presented in Appendix B, along with letters detailing the consent of respondents.

Hypothesis

The research explores the possibility that variations in levels of ovarian hormones, distinguished by hormonal situation, may be involved in perceptions of vocal impairment and implicated in the differentiated reporting of anxiety by females which is observed in performance and other psychological research literature.

[470] C. A. Rosen et al., 'Development and validation of the voice handicap index-10', *laryngoscope* 114 (2004), 1549.

What follows is a description of the method employed in this study.

CHAPTER 3: Method

Respondents

100 participants were initially recruited; 42 fully-completed surveys were returned. The mean age of respondents was 41 years. All participants are female and all are classically- trained singers. Those younger than 20 were deemed to be students and were excluded. All women were required to be performing solo in public and have upcoming performances. All singers were required to be fluent in the English language. Almost all, (40 of the 42) had performed in main-scale operatic productions at some point during their careers, although one performer stated that she was now mainly a crossover artist and concentrated on formats within the popular classical genre only. The majority, but not all, continued to be involved in combinations of soloist operatic, concert and oratorio performance. One singer worked exclusively as a lieder singer–and one performed exclusively contemporary compositions; both of these women combined singing performance with academic lecturing.

Other employments

Of the total group of 42 women, 16 women were exclusively working as full-time vocal soloists, engaging in no other employments. The remaining 26 women, or 62%, reported undertaking other employments; 85% of these (22 women) taught singing. Other additional work included music related employments like event organising, conducting, music lecturing and professional chorus. Of the remaining 4 women who had other employments, the work was non-music related in industries such as law, marketing, design and solo-entrepreneurship.

State of Health

None of the 42 women report any ill-health or any respiratory or voice complaints when completing performance day tests.

Recruitment

The research sample does not fulfil the normal criteria for a completely random sample. Snowball sampling was employed to recruit over 100 soloist singers from the researcher's immediate and extended acquaintances (friends of friends). In all cases, personal email addresses were voluntarily supplied by the respondents. This involved direct contact and contact via social media. 42 fully-completed surveys were returned: 2 women were based in Northern Ireland, 12 in Ireland, 15 in the United Kingdom, 3 in Germany, 2 in France, 1 in Poland, 4 in the USA, and 3 women were based in Australia. The questionnaires required a good grasp of the English language; therefore, only those who were fluent in English could be asked to complete the study.

Rate of drop out

Problems arising from self-reporting of negative, undesirable traits or characteristics have been discussed as being problematic for researchers involved in this type of investigative study.[1] Certainly, evidence of defensive behaviour was found during this study. 10 respondents who completed first surveys were subsequently omitted from the final research due to incomplete second surveys. 3 respondents successfully completed the shorter (fifteen minute) series of questionnaires on the performance

[1] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (New York: Oxford University Press, 2011), 94.

day and did not return the longer (forty minute) general survey and trait test. This left a remaining 45 participants who failed to return either questionnaire. These partially-filled surveys indicate that perhaps those experiencing greater difficulties with anxiety or other career debilitating illnesses may have, upon reflection, not wished to be included in the research. Second tests returned support this conclusion. However this cannot be known for certain. The research was undertaken completely voluntarily and the participants were advised upon initial contact that responses could not be included unless both survey elements were returned; this position was made clear in the supporting documentation which accompanied the surveys (see Appendix B). Due to the number of questions involved, the informal survey took a considerable amount of time to complete (approximately 35-40 mins) and this may have deterred some respondents. The questions inquired about personal issues; 3 singers voiced regret and did not wish to continue with the research upon reading the material. There were issues with compatibility between Mac and PC operating systems and the attachments did not open correctly in some instances. This may have deterred some women from continuing. Often, there was a large amount of time elapsing between initial contact and performances. Some women forgot to complete the surveys despite being issued with reminders. It happened that the research coincided with the loss of the Germanwings flight. This created some ethical issues as a number of singers where considerably upset. The researcher offered support to those who were affected and it was agreed that they were withdrawn from further taking part in the research. A total of 3 singers withdrew due to illness involving cancelled performances. The normal response rate for questionnaires of this nature is 30%. Considering this, receiving 42 fully and correctly completed responses from

100 surveys sent is above what might generally be regarded as an acceptable rate of response.

Voice Type

Respondents were represented by voice type as follows: 34 were sopranos, 7 were mezzo-sopranos, and one singer was a contralto.

Marital Status

A total of 23 respondents were married, 8 were either separated or divorced, and the remaining 11 were single.

Hormonal situation of respondents

Of the 42 respondents, 22 women were experiencing normal monthly cycles, 10 were taking oral contraceptives, 2 were pregnant, 6 were menopausal, and 2 had hormone dysfunction from teenage years. Both pregnant women were in the later stages of pregnancy. Of the total number of respondents, five were in the first three days of their monthly cycles. Three of the women were day one; one of these was not taking contraceptives, one was taking contraceptives, and the third woman was not using contraceptives but described herself as possibly experiencing peri-menopause with intermittent periods. Because of the difficulties involved in categorising this woman, and due to the fact that she was not interfering with the natural hormone and yet still experiencing fluctuations in hormone across the calendar month this woman was included among those with normal cycles and was recorded in the first group of twenty-two. Two of the women were day three, one normal cycle and one using contraceptives. Unfortunately, none of the sample contained responses from women on day two which, due to abdominal discomfort

and swelling of the vocal chords, is considered by female singers to be the most disruptive day in relation to the functioning of the voice.

Materials

The research includes an informal mixed-methods questionnaire which comprises one hundred and fifty items designed by the researcher, including a combination of open-ended and multiple-choice type questions. The contents of this questionnaire cover general demographics, vocal classification, education, occupational issues, negative critique and career pressures, personality and stage persona, habitual voice use, and hormonal influence across menstruation, fertility, pregnancy and menopause, stress and music related anxiety, general health in relation to illness and injury, and the use of stress-reducing methods. The survey contained open-ended questions. The value of open-ended questions is that they allow the respondents to answer in their own words, thus allowing insight into what is at the forefront of the respondent's mind. Open-ended questions also garner information that might not have been collected previously but which could shed further light on critical issues. This informal survey explored the broadest concerns of singers. The questions mainly derived from personal experience of the researcher. The majority of questions were short, multiple-choice questions; some of these asked the participant to rank responses in order of importance. The high value of including this type of questionnaire was that it recorded the personal experiences of the singers in their own words while assembling the broad concerns each encountered during their occupational and personal lifestyle. It was considered that the questions probed by the externally validated research instruments were the principal focus of the research. However, the experiences gleaned from the open ended questions in the informal survey did support the use of this method to collect valuable information pertinent to

the main concerns of female singers, some of which has not been previously reported. Quotations were chosen from as broad a range of respondents as possible which reflected the primary concerns. Some comments were very detailed others brief. Where possible, those which were detailed and contributed to the research were included in full. The final part of the first section was the inclusion of the STAI (Spielberger et al., 1970) A-Trait test to measure trait anxiety.[2] The STAI A-Trait measures (via self-report) the stable aspects of anxiety proneness, including general states of calmness, confidence, and security. The informal general questionnaire is available with the STAI A-Trait test in Appendix B. The second part of the survey contained a series of short research instruments the Spielberger et al., 1970), STAI A-State, Kenny (2009) K-MPAI, Heinemann (2009), SHE and the Cohen et al., (2007), S-VHI which are explained in detail below and are available directly following the informal survey and STAI A-Trait test in Appendix B.

(Spielberger et al., 1970) State and Trait Anxiety Inventory Scale (STAI)

Since the 1960s it has been understood that anxiety exists as a two-factor structure, with state and trait components. According to Dianna Kenny (2011):

> State anxiety is understood to be a transitory emotional state characterized by heightened tension and apprehension, while trait anxiety refers to relatively stable individual differences in anxiety prone-ness; that is, in differences between people in their tendency to respond to situations perceived as threatening with elevations in anxiety-state intensity. State anxiety more closely resembles fear, while trait anxiety

[2] Charles D. Spielberger et al., *STAI Manual for the STATE-TRAIT ANXIETY INVENTORY ("Self-Evaluation Questionnaire")* (California: Consulting Psychologists Press, Inc., 1970) 1-23.

> refers to the propensity of the individual to feel chronically worried or apprehensive.[3]

Spielberger et al. developed this reliable measure consisting of twenty questions for each dimension of anxiety, originally intended for use in 'normal' (non-psychiatrically disturbed) adults. Reliability was calculated for this measure (Cronbach's alpha = .85). The A-State inventory is a tool which measures feelings of stress experienced by individuals at a particular moment in time. The A-Trait scale may be used by researchers to measure individuals who vary in their disposition and respond to psychological stress with different levels of A-State intensity, either those induced by stressful situations or as an index of drive level. The statements were rated on a four-point Likert scale. It was considered essential to measure levels of anxiety proneness. Since these measures were widely used and independently verified to measure levels of a person's anxiety, it was considered appropriate to include both STAI A-Trait and STAI A-State as a starting point in measuring the general proneness and situational anxiety of participants in the current study. The A-Trait test was included at the end of the general questionnaire survey and participants were advised that this section of the survey could be completed at any time.

The second part of the Spielberger State/Trait test, the A-State test and the other instruments were to be completed by singers on the actual performance day. Four further questions relating to the situational aspects of the performance in which each individual was involved were included in addition to the A-State test. This involved specifying the type and size of venue, the type of singing, and the size of the role. An open text box was included for any further qualifying comments (see Appendix B).

[3] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (New York: Oxford University Press, 2011), 25.

It was decided to include a more recently devised research instrument, the Kenny Music Performance Anxiety Inventory (K-MPAI)[4], in addition to the state/trait tests. This test has been found to be a reliable and valid assessment of music performance anxiety and is perhaps a more sensitive measure to assess an individual's anxiety, specifically that which occurs in the context of musical performance. It was also considered that the (Kenny, 2009) K-MPAI measure might be less time critical than the (Spielberger et al., 1970), STAI A-State.

Kenny-Music Performance Anxiety Inventory K-MPAI (2009)

This is an expanded forty-item questionnaire developed from previous inventory concerning adolescents (Kenny et al., K-MPAI (2004), 15 item scale). Twelve underlying factors are understood using the following categories: early relationship context, psychological vulnerability, and proximal performance concerns. According to Kenny (2011), this expanded measure provides evidence for the complex structure of music performance anxiety. She notes specifically the importance of control in the expression and development of negative emotions. Feelings of uncontrollability have been established to have strong associations with the development of psychological vulnerability for anxiety and depression.[5] According to Kenny, state cognitive and somatic anxiety prior to, or during, performance fails to take account of the etiological complexity of MPA. Thus the K-MPAI was developed to include an assessment of underlying psychological vulnerabilities identified by Barlow's emotion-based theory concerning the etiology of anxiety disorders as well as pre-

[4] Dianna T. Kenny, 'The factor structure of the revised Kenny Music Performance Anxiety Inventory', *International Symposium on Performance Science* (2009), 37-41<www.researchgate.net/publication/223995005_The_factor_structure_of....> [Accessed 11 Feb 2013].

[5] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (2011), 99.

performance experiences.[6] Principal axis factoring (with varimax rotation) of the K-MPAI revealed twelve underlying factors; these included depression/hopelessness, worry/dread (negative cognitions), proximal somatic anxiety, parental empathy, memory, pre- and post-performance rumination, generational transmission of anxiety, self/other scrutiny, controllability, opportunity cost, trust, and pervasive anxiety. The statements were rated on a seven-point Likert scale and reliability for this instrument was measured (Cronbach's alpha = .94). It was considered that the K-MPAI might provide a more robust test of the relevant psychometric properties of music performance anxiety. To measure MPA this is the most widely used measure. This test was therefore included as the second element within the performance day questionnaire, in addition to the A-State test. For eight questions on the K- MPAI inventory, reverse coding was applied; this was done so that a high-value response has the same meaning for all questions. It was not intended to report on domains or sub-scales as part of the current study.

Short-term Hormonal Effects (SHE)

Lothar A. J. Heinemann initially developed this psychometric scale to measure the short-term effects of sex-steroid hormone use (Oral Contraceptive or HRT).[7] This scale consists of fifteen items in five domains and was developed and validated in response to the desire to evaluate the short-term benefits or risks of hormone use. It was considered that there was a gap in validated clinical research methods to measure the short-term effects of sex-steroid hormones which could demonstrate

[6] Dianna T. Kenny, 'The factor structure of the revised Kenny Music Performance Anxiety Inventory', *International Symposium on Performance Science* (2009), 38.

[7] Lothar A. J. Heinemann, 'How to measure "Short-term Hormonal Effects"?', *Obstetrics and Gynaecological International* 29 (2009), 459485 <www.ncbi.nim.nih.gov/pmc/articles/PMC2778827> [Accessed 6 Jan 2014].

differences between relevant drugs. This scale was deemed to meet the psychometric requirements relevant for the health-related-quality-of-life scales.[8] Domain one, 'sexual problems' (SEX), represented 15 % of the total variance; domain two, 'menstrual problems' (MENS), 14.8 %; domain three, 'Hormonal effects' (HORM), 14 %; domain four, 'Psychological problems' (PSYCH), 13.2 %; and domain five, 'Abdominal complaints' (ABDOM), 9 % of the total variance respectively. However, this test, whilst measuring good consistency reliability for most of the domains, was not consistent in regards to domain five (ABDOM). The reasons for this require further investigation. The SHE scale demonstrated internal consistency (Cronbach's alpha = .74).This inventory has not previously been used to evaluate short-term hormonal effects in the context of comparative studies such as the one being undertaken here, and very little data is available regarding its effectiveness in measuring treatment-related observational or clinical studies. However, it was felt that this inventory had been advanced sufficiently for the purposes of measuring short-term hormonal psychometric data. The Heinemann (SHE) scale had the benefit of large studies in Italy and Germany to test its usefulness and, as no other more suitable test was in development, it was decided that the SHE scale provided the best vehicle currently available to measure short-term hormonal effects. This scale was rated by using a five-point Likert scale which could indicate the absence of menstruation. However, this test was adjusted by the addition of further situational data requests. A supplemental three-question text box was inserted, and respondents

[8] The scale was developed by the "ZEG - Centre for Epidemiology and Health Research Berlin". The ZEG was founded as independent research institute in 1990 <www.zeg-berlin.de>, outsourced from the Academy of Sciences Berlin. The research of the institute is focused on analysis and consulting for all epidemiological issues, specifically drug safety-related topics, on designing and executing of epidemiological or pharmaco-epidemiological studies for (potentially) problematic issues–from the perspective of regulators or industry including advice and assistance in drug crisis management, and also experienced in development of international disease and/or exposure-specific registries.

were requested to indicate (a) whether they were menopausal, (b) what day of the month they were in their normal monthly cycle, or (c) what day of the month they were in their cycle if taking contraceptive medication. Follow-up revealed that two respondents were pregnant whilst completing the study and a further two women experienced hormonal dysfunction. It is not intended to report domain and sub-scale results as part of the current study.

Singing Voice Handicap Index (S-VHI)

The singing voice handicap index is a health status instrument which was developed by Seth M. Cohen et al. to identify disorder specifics for use in patients with singing problems.[9] It comprises thirty-six questions rated on a five-point Likert scale. Singers were found by Rosen Murry and Behrman et al. (2007), to exhibit lower voice handicap scores than non-singers.[10] The original vocal handicap index developed by C.A Rosen et al. (2004), focused on the speaking voice.[11] It was therefore considered necessary to devise an instrument which measured impairment of the singing voice. The S-VHI was found to discriminate between singers with vocal dysfunction and singers without voice problems; this finding further supported its validity. The S-VHI demonstrated internal consistency (Cronbach's alpha = .97). It was of interest to discover if professional soloists who are highly proficient expert voice users would exhibit any issues across this measure. As part of screening in the general questionnaire, the respondents were asked to report any incidences of vocal injuries. In order to adequately assess voice problems in normal performing singers,

[9] Seth M. Cohen et al., 'Creation and Validation of the Singing Voice Handicap Index', *Annals of Otology, Rhinology and Laryngology* (2007), 402-406.
[10] See Rosen, Murry and Behrman et al., in Seth M. Cohen et al., 'Creation and Validation of the Singing Voice Handicap Index', *Annals of Otology, Rhinology and Laryngology* (2007), 405.
[11] C. A. Rosen et al., 'Development and validation of the voice handicap index-10', *Laryngoscope* 114 (2004), 1549-1556.

this instrument was considered sensitive enough to discriminate between health and other issues and, therefore, it was considered appropriate for use in the current study. This protocol does not have domains or sub-scales.

Procedure – Pilot Study

A pilot study of five women was undertaken in an attempt to identify problems with the informal survey design and to resolve any formatting issues. Some questions were amended as a result. However, in retrospect it might have been greatly shortened. It was too large to consider externally validating on this occasion. The research instruments were chosen on the basis that they had all been previously tested by external sources and a number had been widely used for research purposes and were universally understood to be reliable.

Procedure

Ethics approval was sought and granted from the Royal Irish academy of Music board of studies. It was necessary to consider that some women might be suffering from anxiety issues and be upset by the questions posed. If so, appropriate procedures were outlined (see, Appendix A). The researcher checked back regularly with the respondents and routinely inquired as to when they had filled out the tests. Two women were asked to repeat the performance day tests as it was made clear to the researcher that the correct procedure had not been followed. These women re-submitted the performance day tests on subsequent performances. It is an acknowledged weakness of the research design, particularly for instruments such as (Spielberger et al., 1970) STAI A- State which are especially time critical. The researcher made every effort to ensure that tests were completed on the day of the performance. It was made abundantly clear to every respondent that this was an

absolute requirement of the research. Returns could not be accepted which were filled out in advance of, or retrospective to, the actual performance day. However the researcher had to trust that respondents completed the questionnaires when they were asked to do so.

The first and second elements of this research were each sent simultaneously via e-mail. The respondents were required to complete both questionnaires themselves. However, the investigator was able to follow up and resolve any queries regarding responses with the women via e-mail. Due to the number of questions involved, the informal survey and STAI A- trait test took a considerable amount of time to complete (approximately 35-40 mins). The second element of the research was required to be carried out on a day of performance and comprised a series of four short research instruments, including the second part of the Spielberger et al. STAI (the A-State test); also included were the K-MPAI, SHE, and S-VHI tests, as explained (this took approximately 15 mins).

Due to the disparate nature of employments and locations of the soloists, from performances in Sydney, Australia to the USA and other locations in mainland Europe, the U.K. and Ireland over many months, the performance day questionnaires could only be administered once.

The researcher consulted (face to face meeting) with a health and safety officer in a large operatic company in the United Kingdom in September 2015 confirming what supports are available to singers within these organisations and with a medical endocrine specialist (face to face meeting) in April 2016 regarding queries the

researcher had relating to the results, which arose from the analysis of the data collected.[12]

For professional singers, the functioning of the voice is of primary concern. Hormonal situation, such as fluctuating levels of hormone in women who are normally cycling, taking contraceptive medications or in menopause, affect the responsiveness of the vocal instrument. Hormonal influence in relation to other factors like anxiety has not heretofore been compared. Also, it was considered perceptions of voice impairment may increase perceptions relating to MPA. This second series of elements sought to observe the correlations of all three measures, SHE, S-VHI, and K-MPAI in a population of routinely performing elite vocalists. The second series of short questionnaires directly follows the first in Appendix B.

Some difficulties

Problems were encountered with Adobe compatibility between Mac and PC platforms, causing read errors and issues with selecting the survey's designed tick boxes. This had not been encountered with the smaller test group. A total of 5 respondents were sent the surveys in hard copy and they obligingly returned them by post. With a large number of the recruited singers there were many months between performances. In took upwards of 8 months to return all the questionnaires. Free-lance singing is an occupation where, at times, there are many weeks during which the singer might not have any public engagements whatsoever. For example, on average four to five weeks might be spent rehearsing an opera. Due to the requirement to complete two separate surveys–a general survey and trait test, and a

[12] My sincere thanks to Elizabeth Bishop, Health and Safety Officer at Welsh National Opera, Cardiff, United Kingdom and Professor Gerald Tomkin, Diabetes/Endocrinology MD FRCP (lond) FRCPI FRCP (ed.) FACP for their assistance and advice.

performance-day study comprising the four shorter tests–the time between completing the initial survey and the performance day meant that many singers repeatedly forgot to complete the second study, despite being sent reminders. The research questions were sensitive in nature, dealing with personal fertility and emotive concerns, musical anxiety and perceived instrument impairment. The research questions were considered by some as too personal and intrusive. A total of 3 women sent regrets due to the nature of the research questions. A number of respondents initially omitted answering questions relating to age. The research tests were self-administered by the singers. Errors occurred, with many surveys returned incomplete. Two respondents omitted parts of questionnaires and failed to revert concerning queries which resulted in their responses being excluded from the study.

Data Analysis

The returned surveys were compiled using an Excel file and initial data tests were conducted using Excel. Charts and graphs to display data from the informal survey were generated using Excel. The data from each of the specific research instruments used during the second study was compiled into the appropriate format in Excel and transferred into IBM SPSS-22 statistical program in order to allow correlational statistical analysis to be conducted. Initial correlations were investigated to determine if any relationships could be seen between the data. Charts were generated to observe the interplay of the variables S-VHI, SHE, K-MPAI and TRAIT anxiety.

Descriptive Statistics (using IBM SPSS-22) were generated for the total sample; this data presented the mean and standard deviations for the full sample (N=42) between all five tests (Figure 38 Appendix C).[13]

[13] Figure 38. Mean & Standard Deviation: Full Cohort (N= 42), 288.

A table of correlations was presented for the full cohort, SHE, S-VHI, K-MPAI, TA and SA (Figure 39 Appendix C).[14] It was decided that the correlations observed between SHE hormone S-VHI and K-MPAI required further analysis.

Descriptive Statistics were generated for STAI ST/ TA for the whole sample (N=42) (Figure 1).[15] It was considered that the STAI State results were unusable as they showed poor correlation with results from STAI - TA. A line diagram (Figure 2),[16] which plotted the relationship between the two elements, supports this decision. STAI/ Trait results were individually plotted on a line diagram, (Figure 3).[17] This demonstrates the relative homogeneity and level of Trait Anxiety reported by respondents across the total group. K-MPAI results were individually plotted on a line diagram, (Figure 4).[18] SHE results were individually plotted on a line diagram, (Figure 5).[19] S-VHI results were individually plotted on a line diagram, (Figure 6).[20] These individually demonstrate each factor over the total group of participants.

To further investigate these relationships, the researcher divided the sample into 3 groups based on the extra information requested by the researcher on the hormonal instrument measure SHE. The situations represented were, Normal Menstrual Cycle, Menopausal, taking hormonal contraceptives or other. In the case of normal cycling women and contraceptive women, the day of the cycle was requested (see Appendix B - SHE). The participants were divided into three subsets: those women who self-reported having normal monthly cycles (Subset A, N=22) were ranked 1 to 22

[14] Figure 39. Correlation: Trait/State Anxiety, SHE, S-VHI, and K-MPAI (N=42), 288.
[15] Figure 1 Descriptive Statistics STAI State and Trait (N=42), 172.
[16] Figure 2 Line diagram State/ Trait Anxiety Total Group (N=42), 173.
[17] Figure 3 Line diagram Trait Anxiety Total Group (N=42), 174.
[18] Figure 4 Line diagram K-MPAI Anxiety Total Group (N=42), 175.
[19] Figure 5 Line diagram SHE Short term Hormonal Effects Total Group (N=42), 176.
[20] Figure 6 Line diagram S-VHI Total Group (N=42), 177.

according to the day of their menstrual cycles, roughly over 3 points: menstruating, ovulating and pre-menstrual.

Subset B included two pregnant women, one woman in menopause who was taking HRT, a further five menopausal women, and two participants who self-reported hormonal dysfunction from teenage years. Pregnancy incorporates the absence of menstruation and, given the relatively small nature of the overall sample, it was deemed appropriate to include the pregnant women with the group in menopause and others with no cyclical bleeding (that is, the two women who experienced hormonal dysfunction). However, it is advised that this might not be considered appropriate were the research seeking to examine definitive processes regarding cause and effect involving sex hormones.[21] Subset B, N=10 was organised commencing with the two pregnant women, followed by the six menopausal women, and the two hormonal dysfunction women were the last two results of this group.

Finally, those taking contraceptive medications were assigned to the final group (Subset C, N=10 according to their contraceptive cycle days).

To explore further the relationships between the results for the various subsets it was necessary to examine the descriptive statistics and any correlations and to plot these relationships using a range of charts including scatterplot, line diagrams and boxplots.

A Correlation Matrix is presented for the Total Group N=42 and each of the measures S-VHI, SHE, K-MPAI, and STAI T-A under the Subgroups A, B, and C

[21] To clinically examine processes with regard to the actions of hormone requires very large population samples. Pregnancy, Menopause and Hormonal dysfunction are distinctive states. Professor Gerald Tomkin, Diabetes/Endocrinology MD FRCP (lond) FRCPI FRCP (ed.) FACP.

(Figure 7)[22] this displays the statistically significant correlations of all the measures together. The researcher directs the reader to Appendix for correlations relating to each individual subset as described below.

Descriptive statistics were generated for the Normal Cycle participants displaying the mean and standard deviations, range, maximum and minimum scores (see Figure 8 Table Normal Cycle),[23] and displaying the mean and standard deviations (see Figure 40 Subset A (N=22), Appendix C)[24] and correlations between the five tests: SHE, S-VHI, K-MPAI, TA and SA (Figure 41 Appendix C).[25] A line diagram was generated to display the relationships between SHE, S-VHI and K-MPAI (Figure 9).[26] The participants (N=22) were ordered in sequence from lowest to highest (1-31) days determined by the self-reported responses of where they were in their ovulatory cycles. The range of days recorded on the day of performance was then indicated below the diagram for each participant in roughly three stages: menstruation and early part of the cycle, mid-cycle and ovulation, and late cycle and pre-menstruation days.

Descriptive statistics were generated for the P/M/D participants in subset B (N=10) displaying the mean and standard deviations, range, maximum and minimum scores (Figure 10 Table),[27] and mean and standard deviations (Figure 42),[28] and correlations between the five tests: Trait, State, SHE, S-VHI, and K-MPAI (Figure 43).[29] A line

[22] Figure 7. Correlation Matrix N=42, S-VHI, SHE, K-MPAI and TA; A, B, and C, 178.
[23] Figure 8. Table Mean & Standard Deviations: Normal Cycle–Subset A (N = 22), 179.
[24] Figure 40. Mean and Standard Deviation Subset A (N=22), 289.
[25] Figure 41. Correlations A: Tr/St Anxiety, SHE, S-VHI, and K-MPAI (N=22), 289.
[26] Figure 9. Line Diagram A: SHE, S-VHI, and K-MPAI–Normal Cycle (N=22), 180.
[27] Figure 10. Descriptive Statistics Table Subset B–P/M/Dys (N=10), 181.
[28] Figure 42. Mean and Standard Deviation Subset B–P/M/Dys (N=10), 290.
[29] Figure 43. Correlations B: Tr/St Anxiety, SHE, S-VHI, and K-MPAI (N=10), 290.

diagram was generated to display the relationships between SHE, S-VHI, and K-MPAI for this subset B (Figure 11).[30]

Descriptive statistics were generated for the contraceptive participants in Subset C (N=10), displaying the mean and standard deviations, range, maximum and minimum scores (Figure 12)[31]and mean and standard deviation (Figure 44),[32]correlations between the five tests: Trait, State, SHE, S-VHI, and K-MPAI (Figure 45).[33] A line diagram was generated to display the relationships between SHE, S-VHI, and K-MPAI, for Subset C (Figure13).[34]

A scatterplot was generated to display the spread of data from the total sample (N=42) depicting the relationships between K-MPAI and S-VHI for each hormonal subset, Normal Cycle A, (N=22), P/M/D, B (N=10), and Contraceptive, C (N=10). (Figure 14).[35] These were displayed according to shape and colour. A scatterplot was then generated to show the relationships between K-PMAI and S-VHI for each subset individually. The scatterplot in Figure 15[36] depicts the relationship between K-MPAI and S-VHI for those in Normal Cycles, Subset A (N=22); the scatterplot in Figure 16,[37] illustrates the K-MPAI and S-VHI for subset B, those experiencing P/M/Dys (N=10), and the scatterplot in Figure 17,[38] illustrates the K-MPAI and S-VHI for Subset C, those taking oral contraceptives. Two additional scatterplots were generated for this last group, Subset C – Contraceptive. Figure 18,[39] illustrates the

[30] Figure 11. Line Diagram B: SHE, S-VHI and K-MPAI, P/M/D (N=10), 182.
[31] Figure 12. Descriptive Statistics Table Subset C–Contraceptive (N=10), 183.
[32] Figure 44. Mean /Standard Deviation Subset C–Contraceptive (N=10), 291.
[33] Figure 45. Correlations C: Trait/State Anxiety, SHE, S-VHI and K-MPAI (N=10), 291.
[34] Figure 13. Line Diagram C: Contraceptive, SHE, S-VHI and K-MPAI (N=10), 184.
[35] Figure 14. Scatterplot: K-PMAI v S-VHI Colour-Coded, Total Group (N=42), 185.
[36] Figure 15. Scatterplot: K-MPAI v S-VHI, Subset A –Normal Cycles (N= 22), 186.
[37] Figure 16. Scatterplot: K-MPAI v S-VHI Subset B –P/M/D (N= 10), 186.
[38] Figure 17. Scatterplot: K-MPAI v S-VHI Subset C –Contraceptives (N= 10), 188.
[39] Figure 18. Scatterplot: SHE v S-VHI Subset C –Contraceptive (N= 10), 188.

positive correlation of 0.643 at the ($p < 0.05$) between SHE and S-VHI for those on contraceptives, and Figure 19,[40] illustrates the positive correlation of 0.846 at the ($p < 0.01$) between SHE and K-MPAI for this group, Subset C.

Descriptive statistics for each of the 3 subsets A, B, and C can be found; Figure 46,[41] Figure 47[42] and Figure 48[43] respectively in Appendix C.

The final illustrations, three Boxplots, compare the relationships between Normal Cycle (N=22), P/M/D Cycle (N=10) and Contraceptive Cycle (N=10). These were generated in Excel to compare results separately for each of the three tests under examination – the K-PMAI test for Music Performance Anxiety, the S-VHI test for Singing Voice Impairment and the SHE test for Hormone disruption. The K-MPAI relationships between Normal Cycle (N=22), P/M/D Cycle (N=10) and Contraceptive Cycle C, (N=10) are presented in Figure 20.[44] The S-VHI relationships between the same three groups are presented in Figure 21[45], and the SHE relationships between these groups are presented in Figure 22.[46]

Finally, as the results seemed to suggest strong relationships between the measures, analysis of variance (ANOVA) was carried out using IBM SPSS-22. The ANOVA very strongly suggests that it is extremely unlikely that the results for S-VHI and K-MPAI under the conditions of SHE (Normal Cycle, P/M/Dys, and Contraceptive) would occur in a population that did not have a relationship. *Within* the groups variance for both S-VHI and K-MPAI were greater than *between* the groups

[40] Figure 19. Scatterplot: SHE v K-MPAI Subset C –Contraceptive (N= 10), 189.
[41] Figure 46. Descriptive Statistics: Subset A- Normal Cycle (N=22), 292.
[42] Figure 47. Descriptive Statistics: Subset B- P/M/Dys (N=10), 292.
[43] Figure 48. Descriptive Statistics: Subset C- Contraceptives (N=10), 293.
[44] Figure 20. Boxplot: K-MPAI scores for all three subsets, 190.
[45] Figure 21. Boxplot: S-VHI scores for all three subsets, 191.
[46] Figure 22. Boxplot: SHE scores for all three subsets, 192.

variance. Results for SHE suggest the opposite; variance *between* the groups was greater than *within* the groups, supporting the hypothesis that hormone situation has influence on Voice Impairment and Music Performance Anxiety. For results of the ANOVA N=42 see Figure 49, Appendix C.[47] Due to the different situation in hormones affecting pregnant women, (the argument is that these respondents should not be grouped amongst those who are menopausal or suffering dysfunction). Therefore a further analysis of variance was run excluding the two pregnant women, as expected, results confirm the relationship remains the same, greater *within* group variance for both S-VHI and K-MPAI rather than *between*. The variance for SHE continued to be greater for *between* group variance rather than *within* group. See ANOVA (N=40) Figure 50, Appendix C.[48]

Limitations

The size of the sample is limited with regard to the inferences which might be drawn from the correlations. The research design precluded the inclusion of results for State anxiety as it was deemed the results were affected by procedural issues concerning time sensitivity and self-reporting.

Rationale for the correlational analysis

The data analysis from the informal survey and the results from the performance day tests are presented in Chapter 4. Overall scores were correlated using the total scores for each participant across the measures. No domains or sub-scales are presented. The literature reviewed in chapter two indicates that sex hormone factors influence voice production. It is reasonable to assume if the voice is not responding optimally

[47] Descriptive Statistics ANOVA Figure 49, S-VHI, K-MPAI and SHE (N=42), 294.
[48] Descriptive Statistics ANOVA Figure 50, S-VHI, K-MPAI and SHE (N=40), 295.

this might influence perceptions regarding MPA. Brain research indicates that sex hormones are involved in the processing of stressful stimuli. It is reasonable to assume if oestrogen is fluctuating, depleted, or depressed that this may affect the reporting of stress. Observing correlations between these factors in 'real world situations' amongst a sample of ordinary working women, over 3 discrete situations of hormone (normally cycling, no menstruation, and taking oral contraceptives) furthers research regarding behavioral sex hormone influence beyond that which has previously been observed in animal only or cross-species combinational studies. The research also benefits MPA and performance research and demonstrates that different situations under the influence of hormones, are observable as behaving discreetly, adding to the current literature concerning voice impairment and anxiety which may be advantageous when directing appropriate treatments for anxiety issues, and conducting further research.

The data analysis from the informal survey and the results from the performance day tests are presented in Chapter 4.

CHAPTER 4: Quantitative and Qualitative Results

Quantitative Results – Research Instruments, score interpretation.

Upon analysis of the data, scores recorded for State Anxiety did not reflect sufficient correlation between the measures State/Trait and K-MPAI. (See Figure 38 and Figure 39 in Appendix C: mean and standard deviation and correlation Total Group N=42) respectively. Pearson 0.124 between STAI A-T and STAI A-S was not significant. There was a negative relationship -0.103 between STAI A-S and K-MPAI. This likely occurred due to the methodical methods employed (self-reporting of questionnaires). Respondents filled out the measures independently. The researcher is unable to say unequivocally when the state test may have been implemented by respondents and, as this test is particularly time sensitive, this element STAI A-S was deemed unusable. See Figure 1 for comparison of the results between State and Trait.

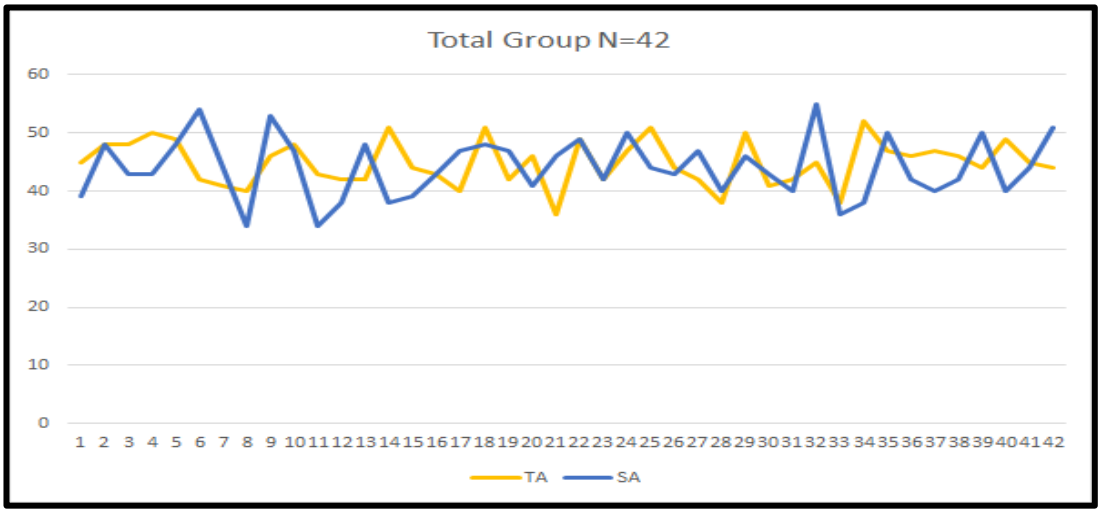
Figure 1. Descriptive Statistics STAI (Trait) and STAI (State) N=42

	Trait	*State*
Mean	44.90	44.14
Standard Deviation	3.93	5.19
Range	16	21
Minimum	36	34
Maximum	52	55
Sum	1886	1854
Count	42	42

The mean scores for both measures are 44.90 and 44.14 respectively. As the Trait inventory measures the more stable anxiety proneness, and is not as time sensitive as

the State inventory (which is designed to measure levels of arousal), it was considered appropriate to consider the Trait portion of scores from the inventory only to compare with the results from the other measures: S-VHI, SHE and K-MPAI. Figure 2 presents a visual of Trait and State results for the total group N=42.

Figure 2. Line diagram Comparison of Trait and State Anxiety Total Group N=42



The **Trait Anxiety** inventory has 20 elements and measures longstanding traits; it is thus less sensitive to change over a short period of time. A high score indicates greater levels of trait anxiety. The scores for the trait test are calculated using a 4-point Likert-type scale, 1= Almost Never to 4=Almost Always. The range of scores is 20-80. Donzuso et al. (2014)[1] recommend a cut-off point > 40 for assessing anxiety. Median scores indicate moderate levels of anxiety proneness. However, other studies (Knight et al.,1983) recommend a cut-off of 54-55 for older

[1] Giulia Donzuso et al., 'The neuroanatomical correlates of anxiety in a healthy population: differences between the State-Trait Anxiety Inventory and the Hamilton Anxiety Rating Scale', *Brain and Behavior* 4 (2014), 506.

adults.[2] Women are known to score higher than men. Scores for STAI A-T recorded in this study are presented in Figure 3.

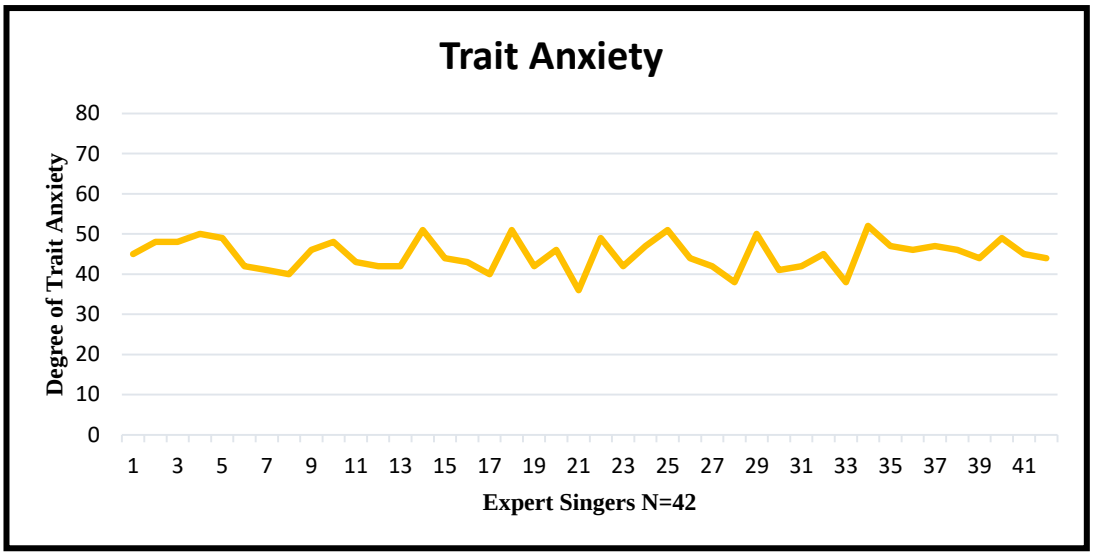


Figure 3. Trait Anxiety Total Group N=42

*Note Subscales are not reported as part of the current study.

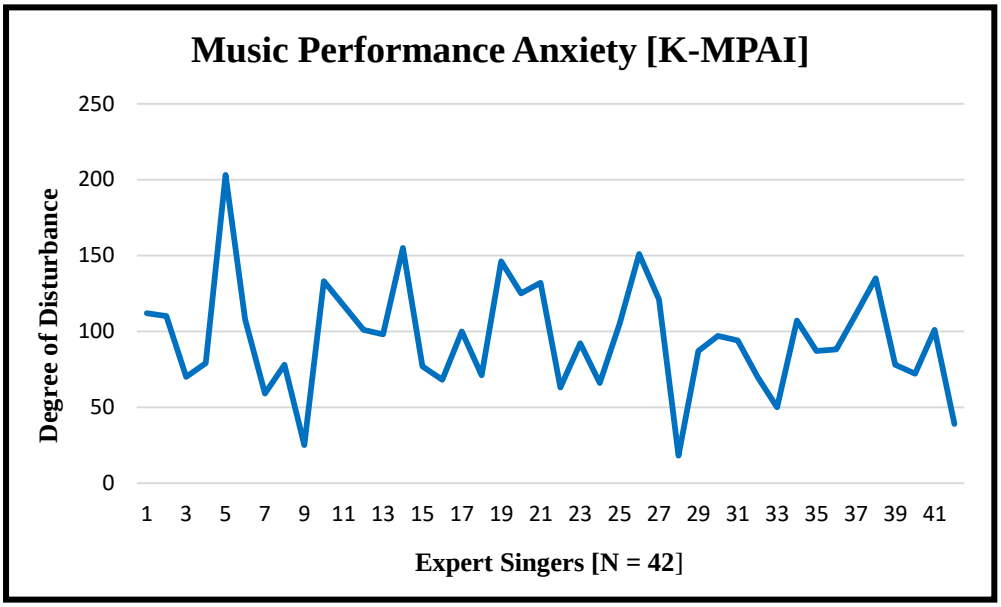
Results from this test indicate that this sample of professional singers were reasonably but not overly, trait anxious (see Spielberger et al., 1970).[3] Also note, Trait Anxiety scores for the whole sample are reported at reasonably similar levels.

K-MPAI Music Performance Anxiety. Music performance anxiety was measured using the Kenny Music Performance Anxiety Inventory (K-MPAI, 2009). The K-MPAI consists of a 40 item self-reporting questionnaire which measures cognitive, behavioural, and somatic indications of music performance anxiety using a 7-point Likert-type scale, 0= Strongly Disagree to 6=Strongly Agree. It is not intended to report domains and subscales for the purposes of the current study. To facilitate easy

[2] R. G. Knight et al., 'Some norms and reliability data for the State-Trait Anxiety Inventory and the Zung Self-Rating Depression scale', *British Journal of Clinical Psychology* 22 (1983), 245-249.
[3] Spielberger et al. (1970), STAI Manual, Table 1 Normalised State and Trait T-Scores, 6.

comparison between all measures in the study, inventory reverse coding was applied to the K-MPAI, this was done so that a high-value response has the same meaning for all questions. In this instance, total scores can range from 0 to 240, where a low score indicates the absence of music performance anxiety, and 240 indicates the highest possible intensity of disturbance. See Figure 4

Figure 4. K-MPAI Music Performance Anxiety Total Group N=42

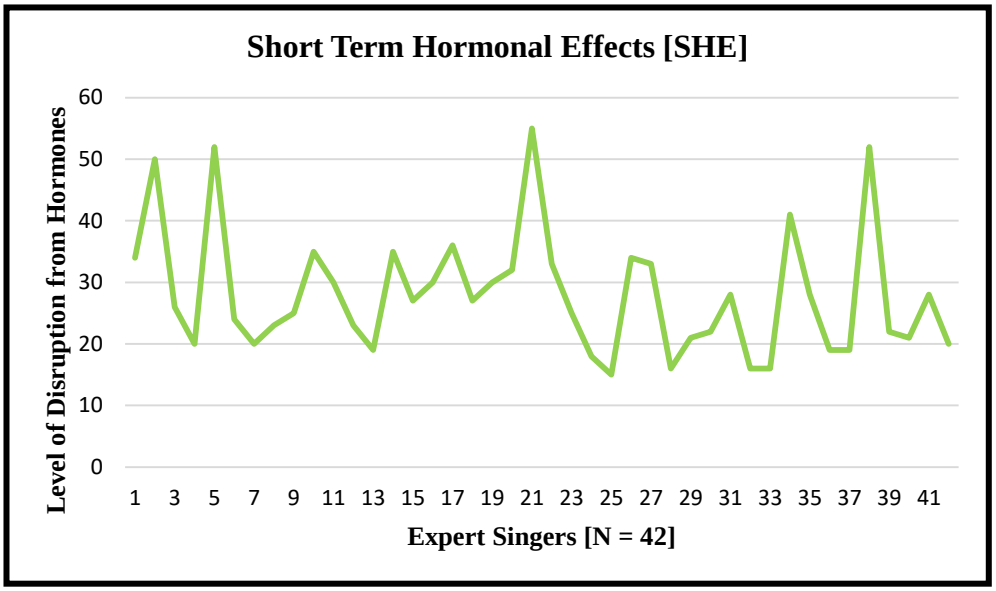


*Note: Domain scores or subscales for K-MPAI are not reported as part of this study.

SHE (Short term hormonal effects) comprises a 15 item scale of symptoms, where the score increases point by point with increasing severity/intensity of subjectively perceived complaints in each of 15 specific items. The items are scored on a 6-point Likert-type scale. If items are not present at all, 'No' (score =1) was coded; if 'Yes' was marked, one of four intensity grades have to be chosen (scores 2-5). If a question does not apply to the personal situation ('Had strong menstrual bleeding', for example, in a situation where the woman is either pregnant or menopausal) then

the code ‘0’ (not applicable) can be used. The lowest score is 12 and the highest possible disruption from hormones is 75. See figure 5.

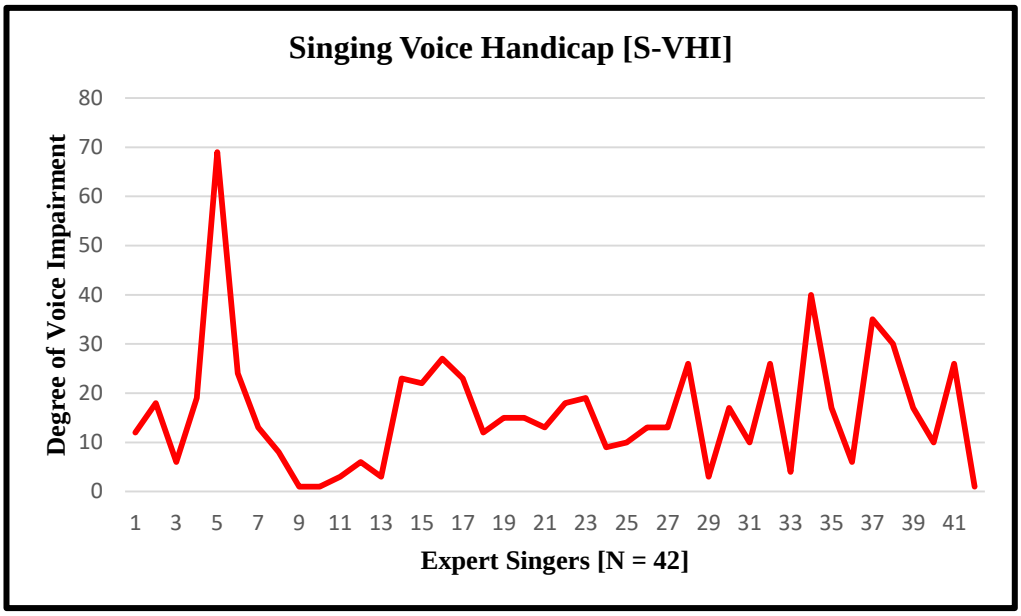
Figure 5. SHE Short Term Hormonal Effects Total Group N=42



*Note: Domain scores or subscales for SHE are not reported as part of this study.

S-VHI (Singing -Voice Handicap Index) The S-VHI is a 36-item self-administered questionnaire designed assess difficulties related to the voice health status typical of the singing professional. The questions are answered using a 5-point Likert-type scale: 0=never to 4=Always. The raw total scores range from 0 to 144 with a higher number representing more self-perceived vocal handicap. The raw scores are multiplied by 100 and then divided by 144 to produce the final S-VHI score which is therefore scaled from 0 to 100. Results for the S-VHI are presented in Figure 6.

Figure 6. S-VHI Singing Voice Handicap Total Group N=42



* Note: This protocol does not present domains or subscales.

There are sufficient correlations to suggest some relationships in the data between K-MPAI, SHE and the S-VHI scores. To investigate these relationships further, the data was transferred to the IBM SPSS-22 statistical programme for correlational analysis.

What follows is a description of the findings derived from the statistical analysis of the research instruments using IBM SPSS- 22. The full set of data for each instrument was imported into IBM SPSS-22 from Excel. Data-sets for the full cohort and each of the 3 sub-groups, with ANOVA (analysis of variance) are presented in Appendix C.

Figure 7 displays the correlation matrix for the total group. As can be seen, results indicate significant correlations between S-VHI, SHE, K-MPAI and TA in the full group and observed in subsets A, B, and C.

Figure 7. Correlation Matrix Correlations: S-VHI, SHE, K-MPAI, TA, Full Cohort [N=42], Subset A [N=22], Subset B [N=10], Subset C [N=10]

		S-VHI				SHE				K-MPAI			
		Full N=42	NC N=22	PMD N=10	OC N=10	Full N=42	NC N=22	PMD N=10	OC N=10	Full N=42	NC N=22	PMD N=10	OC N=10
S-VHI	Pearson Correlation	1											
	Sig. (2-tailed)												
SHE	Pearson Correlation	.431**	.485*	-.260	.643*	1							
	Sig. (2-tailed)	.004	.022	.469	.045								
K-MPAI	Pearson Correlation	.432**	.535*	-.462	.846**	.650**	.615**	.743*	.732*	1			
	Sig. (2-tailed)	.004	.010	.179	.002	.000	.002	.014	.016				
TA	Pearson Correlation	.186	.212	-.652*	.593	.080	.025	-.304	.450	.168	.057	.255	.524
	Sig. (2-tailed)	.239	.344	.041	.071	.617	.911	.393	.192	.289	.802	.477	.120

* Correlation is significant at the (p, < 0.05)

** Correlation is significant at the (p, < 0.01)

The correlations between SHE Hormone, K-MPAI and S-VHI scores which are observable here in the total group and between the subsets prompted further analysis of these results in terms of the discrete hormonal situations between the participants. Correlations for the full cohort N=42 are presented separately in Figure 39 Appendix C.

Pearson correlation between the factors S-VHI and SHE are 0.431 (p, < 0.01), between K-MPAI and SHE 0.650 (p, < 0.01) and between K-MPAI and S-VHI 0.432 (p, < 0.01). Suggesting very strongly that there is a relationship between the factors.

In order to facilitate presentation of analysis of these three factors, the participants were observed in three subsets: Subset A, those who were experiencing normal cycles; Subset B, those either pregnant, menopausal or suffering hormonal dysfunction; and Subset C, those who were regulating their fertility by taking oral hormonal contraceptives.

Figure 8. Table Descriptive Statistics: Subset A – Normal Cycle (N=22)

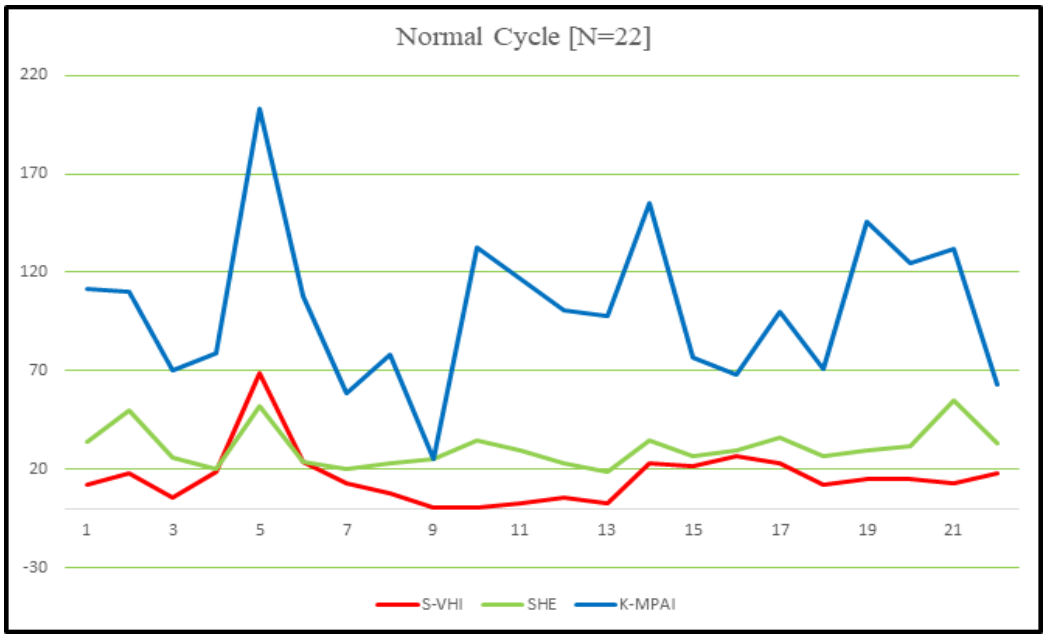
Subset A: Normal Cycle Group [N = 22]				
	S-VHI	***SHE***	***K-MPAI***	***TA***
Mean	40.95	31.18	101.36	44.82
Standard Deviation	14.22	10.02	39.00	4.08
Range	68	36	178	15
Minimum	26	19	25	36
Maximum	94	55	203	51

Looking at the range of scores shown above in Figure 8, subset A, the K-MPAI and S-VHI scores show larger deviations from the mean and there is a large disparity between the minimum and maximum scores for these. The range of scores for K-MPAI is the highest for all three subsets.

The Pearson correlation between the factors S-VHI and SHE continued to be significant 0.485 ($p, < 0.05$); between K-MPAI and SHE it was 0.615 ($p, < 0.01$); and between K-MPAI and S-VHI it was 0.535 ($p, < 0.05$) See Figure 41 Appendix C.

The test totals for this subset were plotted on a line diagram to visually illustrate the results over the month. The women are ordered 1-22 in relation to their monthly cycle. Menstrual, ovulatory and pre-menstrual phases. (Figure 9).

Figure 9. Line Diagram A: S-VHI, SHE and K-MPAI – Normal Cycle (N=22)



Participant 1-8	Participant 9-18	Participant 19-22
Day 1 to Day 13 Cycle	Day 15 to Day 21 Cycle	Day 25-Day 31 Cycle

Note: The days of the month for the twenty-two participants are grouped as indicated in the table underneath the line diagram. No responses were recorded for cycle day 2 or 14 and no responses were recorded for cycle days 22 through 24. Note the positive correlation at the beginning of the monthly cycle for participants 1-8. These women were at the start of their menstrual cycles. The line diagram above at Figure 9 also suggests a relationship between SHE and K-MPAI during the mid-cycle or ovulatory phase of the normal reproductive cycle, that is, for participants ten through to fifteen.

Subset B included those who were in later Pregnancy, Menopausal, or who suffered from Hormonal Dysfunction–participants who were not experiencing fluctuating

cyclical hormones. Results from Subset B were significant. See Figure 43 Correlations, Subset B in Appendix C.

Figure 10. Descriptive Statistics: Subset B – P/M/D (N=10)

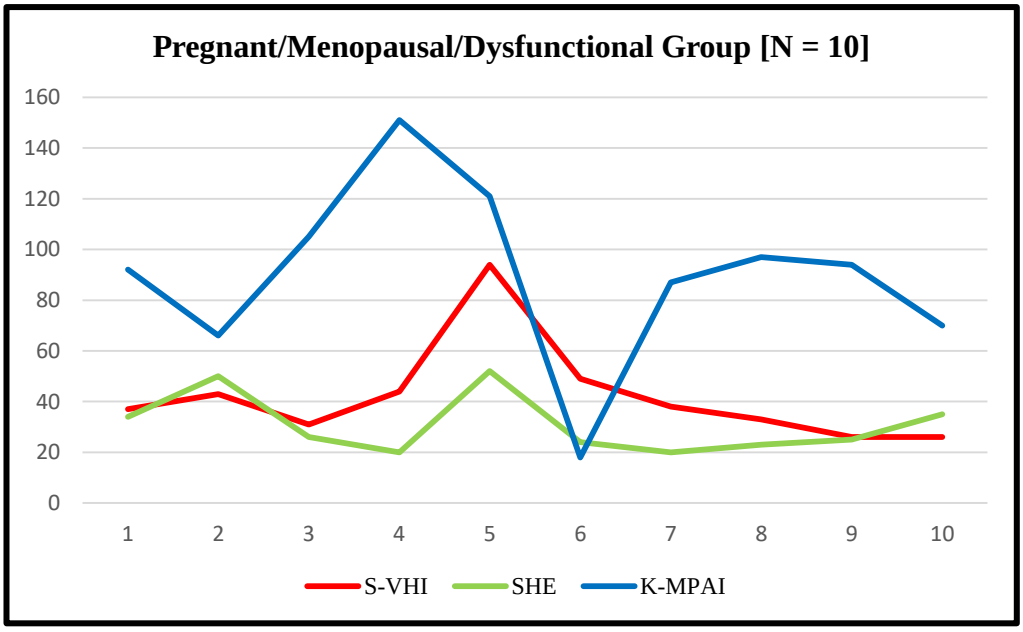
Subset B: P/M/D Group [N = 10]				
	S-VHI	***SHE***	***K-MPAI***	***TA***
Mean	39.60	22.80	90.10	44.20
Standard Deviation	7.44	7.00	35.19	4.10
Range	23	19	133	13
Minimum	28	15	18	38
Maximum	51	34	151	51

When looking at the range of scores in this subset, B compare the levels of hormone between this group and the other two subsets; the hormone scores for this subset are the lowest in the three groups. But the K-MPAI and S-VHI scores are comparable. Of note is the standard deviation from the mean of the S-VHI score–the lowest for all three subsets–while this group is experiencing the least disruption from fluctuating hormones. Clearly, the group expressed consistent perceptions with regard to some issues concerning Singing Voice Impairment.

K-MPAI and SHE continue to be positively correlated: 0.743 ($p, < 0.05$). There is negative correlation of -0.652 ($p, < 0.05$) between TA and S-VHI. However a negative relationship -0.462 between K-MPAI and S-VHI indicates that this subset is skewing downward the previous positive correlation result from the total sample. In this instance, perceived voice impairment is negatively related with performance anxiety. Hormone disruption and anxiety were reduced, but vocal impairment was not. Those experiencing pregnancy are listed as participants one and two below. The

two who experienced dysfunction are listed as participants nine and ten. The line diagram in Figure 11 shows the SHE, S-VHI and K-MPAI test totals for Subset B.

Figure 11. Line Diagram B: S-VHI, SHE, K-MPAI, P/M/D (N=10)



As expected, there is generally low levels of hormone disruption. The Highest K-MPAI score was recorded by participant 4 who was taking supplemental HRT, but this may or may not be significant.

The final group, Subset C, comprised those women who were inhibiting their natural hormones by taking hormonal contraceptives. This group displayed the most consistent positive relationships between SHE, S-VHI and K-MPAI. Clearly, the responses from this group impact the strong positive correlations that were evidenced between the variables in the total sample group. See Figure 45 Correlations, Subset C in Appendix C.

Results show significant positive correlations between the variables K-MPAI, S-VHI and SHE for those taking hormonal contraceptives. The Pearson correlation of 0.846 (p, < 0.01) was a significant increase in the relationship between K-MPAI and S-VHI by comparison with the overall cohort. Correlation of 0.643 (p, < 0.05) between SHE and S-VHI while that between SHE and K-MPAI was 0.732 (p, < 0.05).

Figure 12. Descriptive Statistics: Subset C – Contraceptive Cycle (N=10)

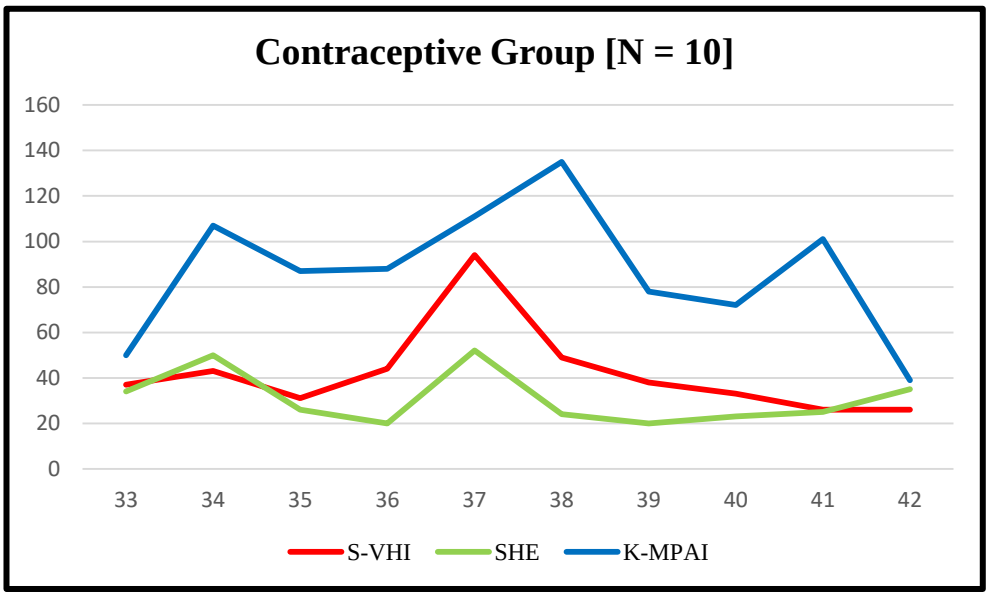
Subset C: Contraceptive Group [N = 10]				
	S-VHI	***SHE***	***K-MPAI***	***TA***
Mean	43.60	26.60	86.80	45.80
Standard Deviation	13.63	11.45	28.78	3.65
Range	39	36	96	14
Minimum	26	16	39	38
Maximum	65	52	135	52

Whilst the range of scores for this contraceptive group is not as wide as for the Normal Cycle group for K-MPAI and S-VHI, the mean scores are higher for this group with regard to Singing Voice Impairment than the scores of the Normal Cycle group. Also, although the mean of the K-MPAI for the Normal Cycle group is higher, it also has a larger standard deviation from the mean than displayed by this group who are taking oral contraceptives. This group has a range of scores comparable to the Normal Cycle group with regard to the disruption experienced due to SHE hormone effect.

It is of note when comparing between the 3 groups, that TA (trait anxiety) descriptive statistics show little variation in all measures across all three subset groups. The results imply that those taking contraceptive hormones are significantly correlated with feelings of anxiety, which are mirrored with perceptions regarding

the perceived impairment of their singing voices and their perception of disruption with regard to their hormones. (Figure 13).

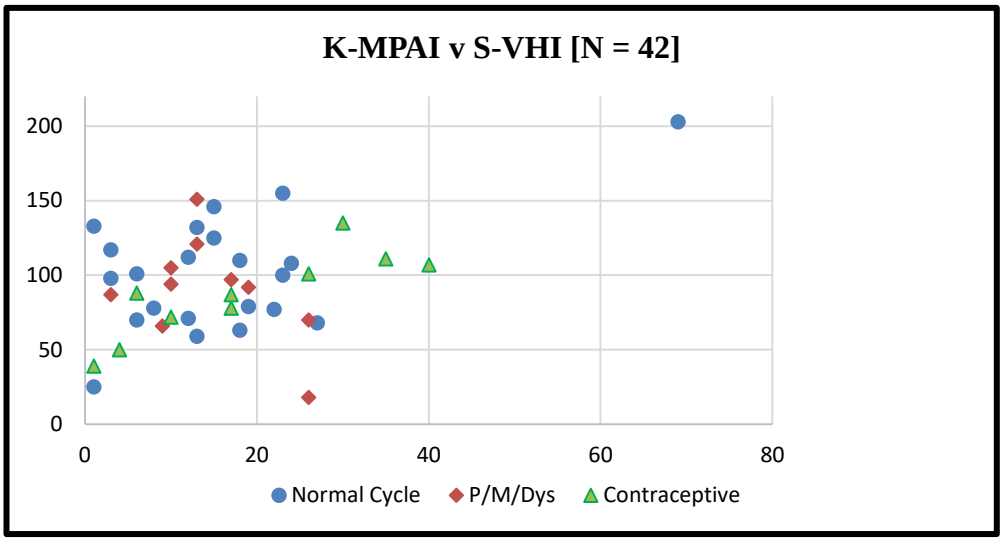
Figure 13. Line Diagram C: Contraceptive, S-VHI, SHE, K-MPAI, (N=10)



However, it must be remembered that the number of participants in both the Contraceptive and the Pregnant/Menopausal/Dysfunction subsets is relatively small– only ten participants in each group. Although the normal cycle participants were greater in number (N = 22), it is necessary to plot the spread of the data between K-MPAI and S-VHI within the subsets to identify whether there were any outliers which might have influenced the results.

Figure 14 represents the total sample (N=42) grouped by colour according to subset: Subset A– Normal Cycle (N=22) in blue circles, Subset B– Pregnant/Menopausal/Dysfunction Cycle (N=10) in red diamonds and Subset C– Contraceptive Cycle (N=10) in green triangles.

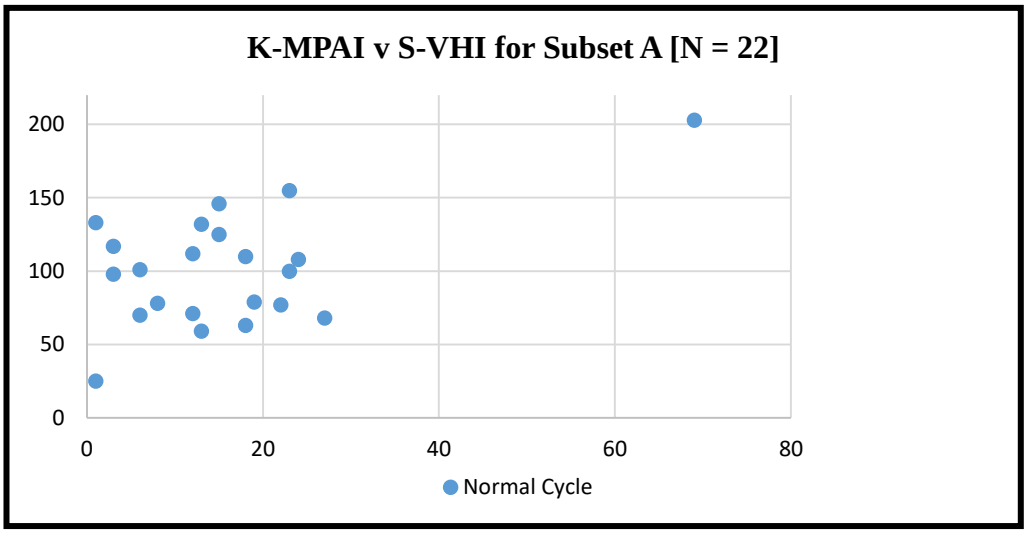
Figure 14. Scatterplot: K-PMAI v S-VHI Colour-Coded, Total Group (N=42)



It is perhaps difficult to discern a linear shape for the correlations with all the data grouped together. To clearly identify each set, it was necessary to generate them separately so the relationships between K-MPAI and S-VHI were more observable.

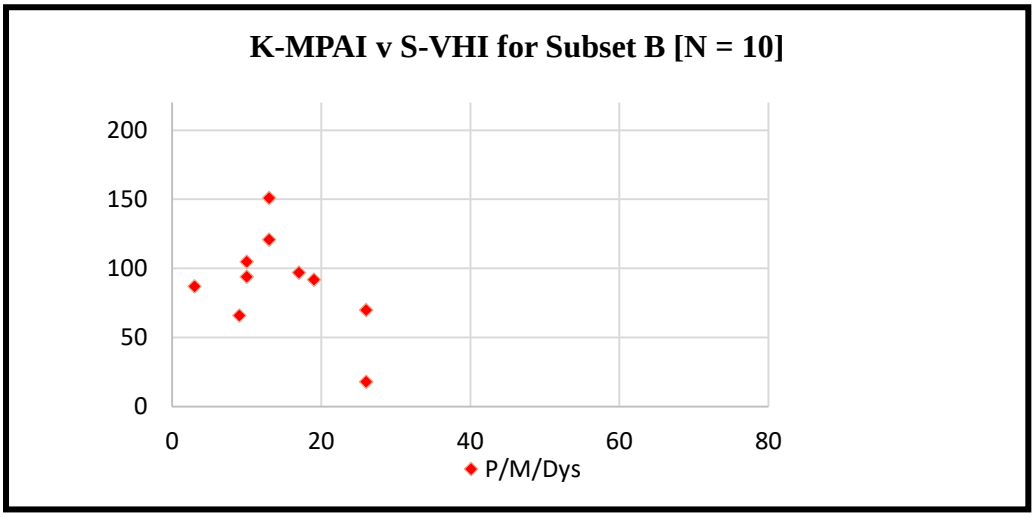
What follows are scatterplots generated in Excel which show the spread of results between the three subsets, categorised by their hormonal influence. The first spread of data plots the relationship between K-MPAI and S-VHI for the participants who report that they had normal menstrual cycles. As previously stated, the data analysis of the STAI/Trait indicates that the participants were not highly (but reasonably) anxious individuals. However, this does not take into account a very few individuals who did exhibit higher K-MPAI scores. Whilst there is a strong correlation (0.535) between the KMPAI and S-VHI scores, ($p, < 0.05$) the majority of the Normal Cycle (Subset A, N= 22) are grouped fairly close together. However, one extreme score is displayed here. See (Figure 15).

Figure 15. Scatterplot: K-MPAI v S-VHI, Subset A – Normal Cycles (N= 22)



The second group, subset B, were those with absence of menstruation–This group showed a positive Pearson correlation of 0.743 (p, < 0.05) between K-MPAI and SHE hormone but the relationship between K-MPAI and S-VHI was negative (-0.462) as illustrated in the scatterplot (Figure 16).

Figure 16. Scatterplot: K-MPAI v S-VHI Subset B – P/M/D (N= 10)

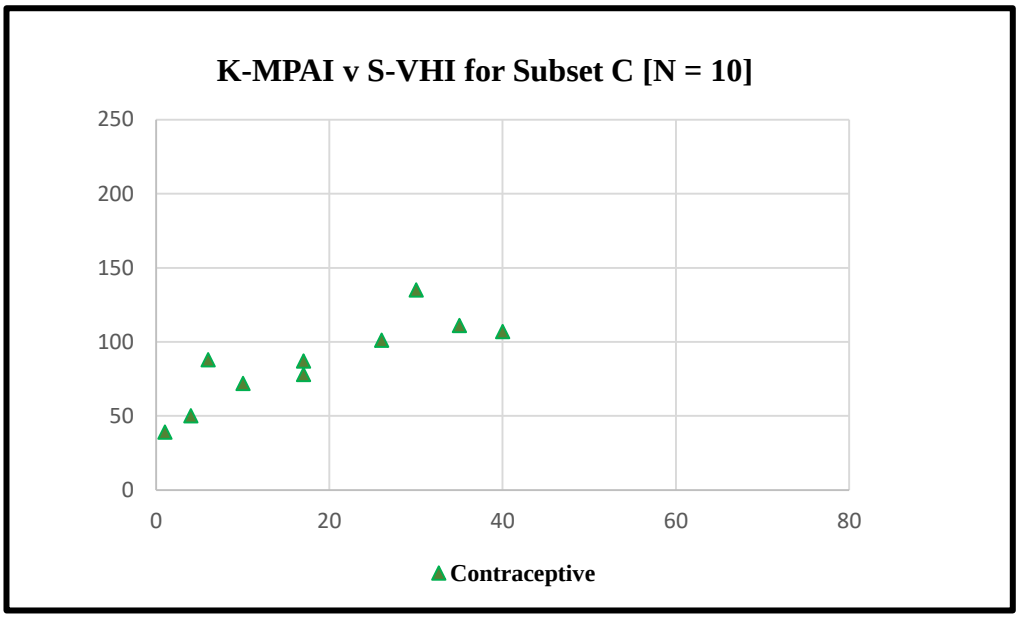


The range of the SHE scores for this group was significantly lower than for the other two sets. However, the mean of the S-VHI for this group was not dissimilar to the S-VHI mean score for the Normal Cycle group. Significantly, the standard deviation

from the mean for S-VHI in this subset was significantly lower than for the other two subsets. This group felt that their voices were disrupted, although their hormonal activation scores were low.

The range of scores affecting the K-MPAI is important here, and the standard deviation from the mean for this group relating to K-MPAI is large. This indicates that lower overall K-PMAI scores are correlated to the lower overall SHE hormone scores. It is not possible to speculate whether they are experiencing Singing Voice Impairment due to the low levels of hormone, although this indeed may be a factor. What is interesting is that they are not anxious. Their anxiety levels are lower generally, except for the influence of two anxious outliers which affected the overall group score. It is clear from the data that this group was the least anxious of all three subsets. It transpired that the highest K-MPAI score here was attributed to an individual who was taking supplemental HRT, which may or may not be significant. However, without a larger sample it is not possible to determine if this may be important. These issues require further research with a larger population. It must also be noted that the impact of anxious individuals on the correlations for this group is reflective of the limited group size under analysis (N=10). The scatterplot in Figure 17 is concerned with the final group, Subset C, and depicts a very strong positive correlation 0.846 ($p, < 0.01$) between K-MPAI and S-VHI.

Figure 17. Scatterplot: K-MPAI v S-VHI Subset C – Contraceptives (N= 10)



What is particularly interesting about this group is not just the significant positive correlation between K-MPAI and S-VHI, but also the significant correlations of 0.643 (p, < 0.05) between SHE and S-VHI and 0.732 (p, < 0.05) between the SHE and K-MPAI. The Scatterplots at Figure 18 and Figure 19 illustrate the positive correlations between SHE and S-VHI, and between SHE and K-PMAI for this final group, Subset C – Contraceptive.

Figure 18. Scatterplot: SHE v S-VHI Subset C – Contraceptive (N= 10)

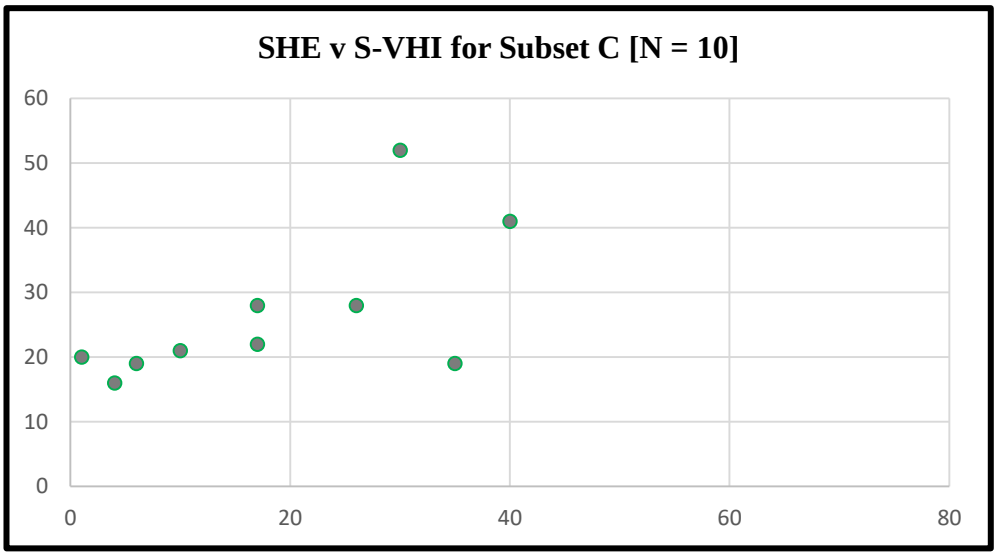
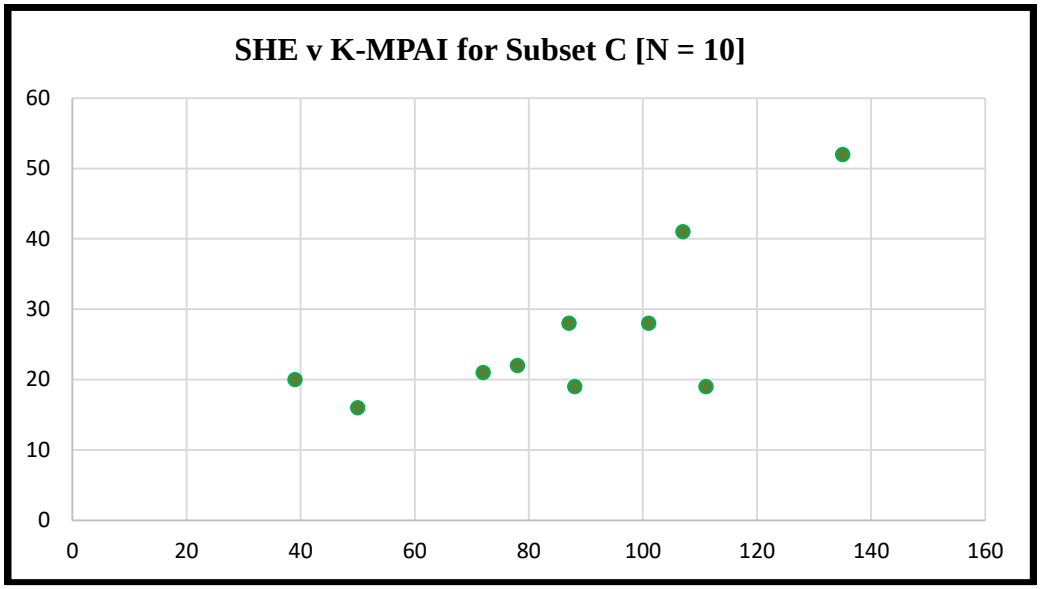
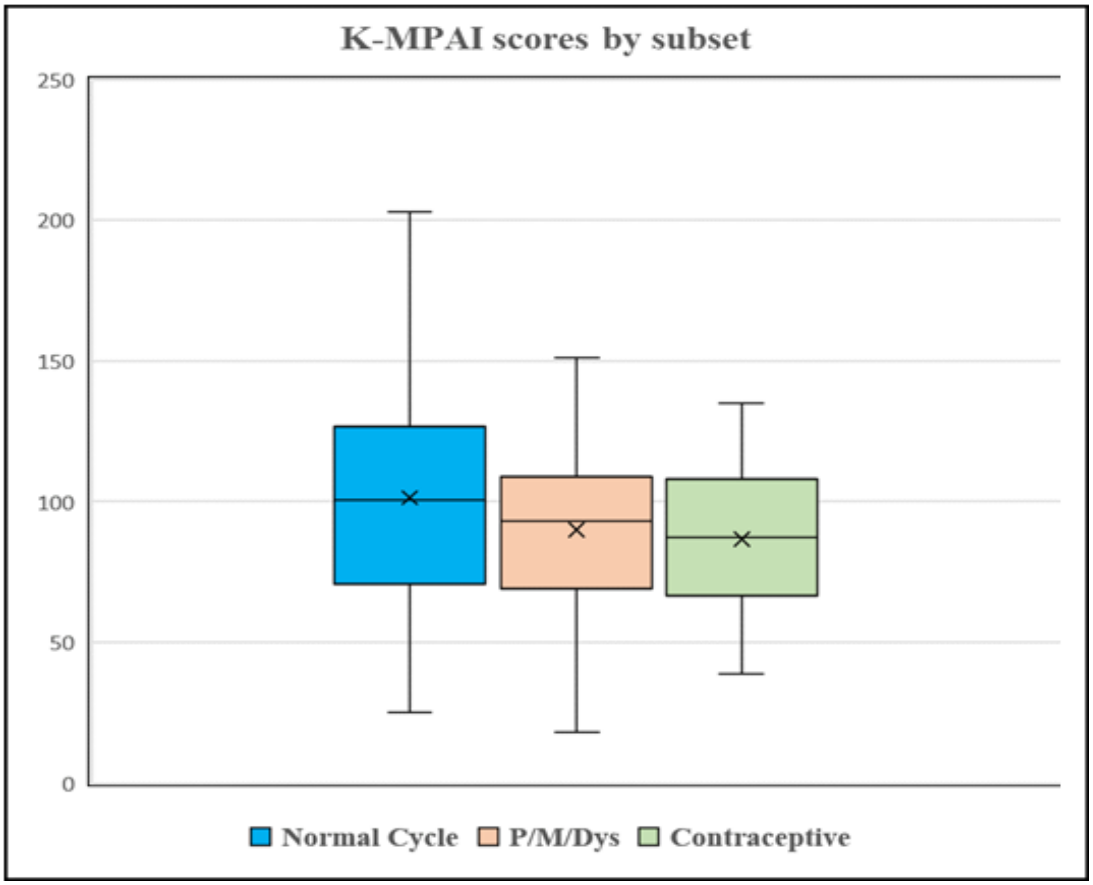


Figure 19. Scatterplot: SHE v K-MPAI Subset C – Contraceptive (N= 10)



To further illustrate the relationships, the K-MPAI, S-VHI, and SHE are presented below. See Boxplots Figures 20, 21 and 22.

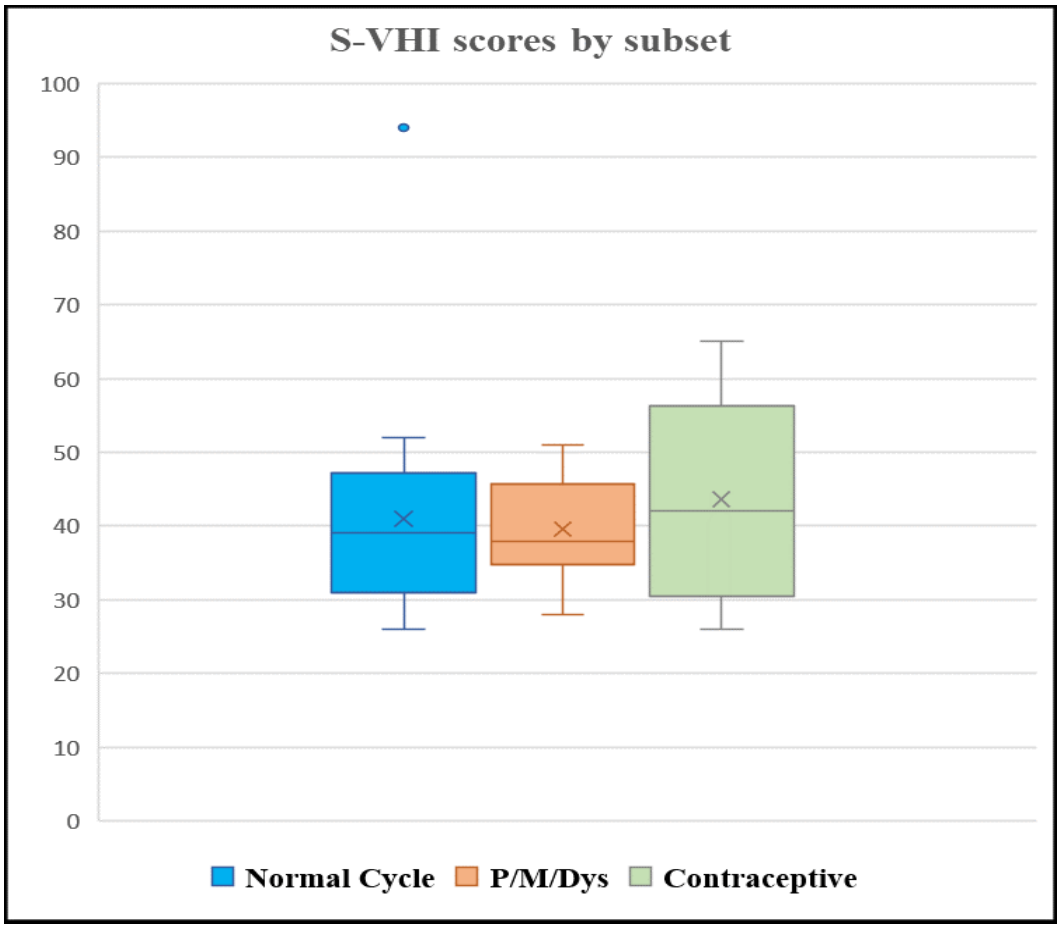
Figure 20. Boxplot: K-MPAI scores for all three subsets



The group median is represented by the bold line in the middle of the boxes and the minimum and maximum values are displayed by the whiskers. As is clearly shown, the median scores for K-MPAI are slightly lower, for the P/M/D and Contraceptive groups compared with the Normal Cycle group. In the P/M/D group we see that the upper quartile is skewed, with the larger part of the box represented below the median; the downward predominance means that this group experienced a somewhat greater spread of lower K-MPAI scores. This group is significantly less anxious than the other two groups. A difference can be observed for the Contraceptive group who have a higher baseline score of K-PMAI than the other two groups, but otherwise have a fairly even spread of Music Performance Anxiety scores over a much smaller

range than the other two groups. The greatest range can be seen within the Normal Cycle group; however, this was influenced to a large degree by some extreme values, as represented by the length of the upper whisker.

Figure 21. Boxplot: S-VHI scores for all three subsets

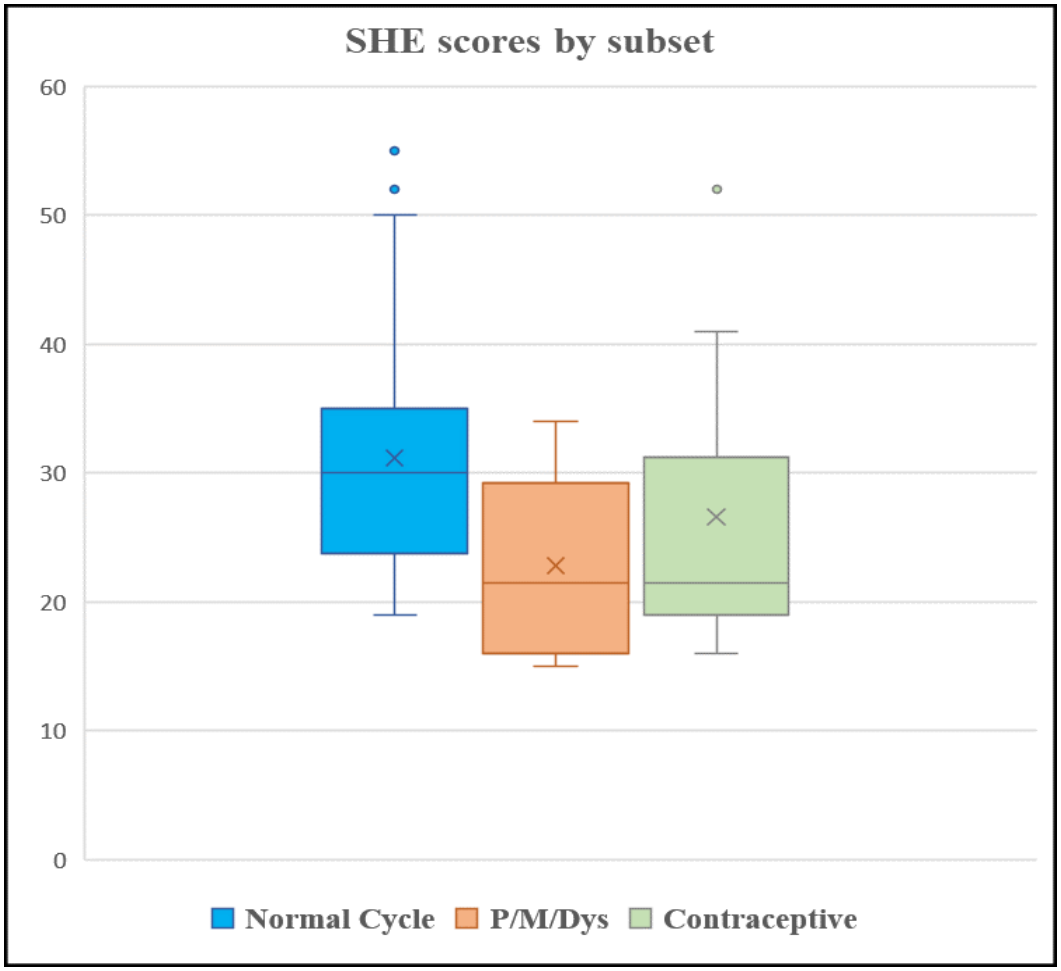


The S-VHI scores for the three subgroups are presented in Figure 21. As can be seen from the boxplot, there is an extreme score recorded for a participant within the Normal Cycle group scores. The Contraceptive group has a slightly higher median score than both other groups with regard to perceptions of Singing Voice Impairment. As can be seen, although the data is skewed somewhat in the P/M/D group, there is a greater clustering of scores around the median for Singing Voice Impairment in this group by comparison with the other two groups. It is noteworthy,

however, that the median score for the Normal Cycle group is roughly at the same level as for the P/M/D group.

Finally, (Figure 22) shows the SHE relationship between all of the sub-set groups.

Figure 22. Boxplot: SHE scores for all three subsets



As might have been expected, the Normal Cycle group shows the highest scores of hormonal disruption, with a higher range of scores and a higher median score. This group also had significant outliers above the mean. However, the median is positioned a little higher than midway in the box, indicating a slightly greater spread of scores below the median in the lower quartile. The P/M/D and Contraceptive groups show similar median scores, both of which are somewhat lower than for the Normal Cycle group. The median score of the Pregnant/Menopausal/Dysfunctional

subset is positioned midway in the box, whereas the median score for the Contraceptive group is skewed towards the bottom portion of the box. Combined with the relatively short whiskers for both of these groups, it means that the scores were more closely aligned in the lower half of each group. There is also a significantly high extreme score in the contraceptive group. Observing all of the data for the group taking oral contraceptives, there appears to be more Hormonal disruption, Singing Voice Impairment and Music Performance Anxiety being experienced, and to a more consistent degree, by this subset.

ANOVA – Analysis of Variance

The analysis of variance (ANOVA) table is presented in Figure 49, Appendix C. The means of the data sets for the different conditions S-VHI, K-MPAI and SHE are not statistically different from the mean in the general population of participants. The output clearly shows that the variation is attributable to the circumstances *within* the sub-groups Normal Cycle, P/M/Dys and Contraceptive rather than across the effects. In two cases (S-VHI and K-MPAI) the variance shows that the 'within group' value is much greater than the 'between groups' value. In the case of S-VHI it is over three times greater; in the case of K-MPAI it is approximately double. For the third condition (SHE) the opposite is the case. The 'between groups' difference is greater than the 'within group' difference. This may be due to the fact that you could expect the hormone disruption to be different in light of the different conditions between the categories (NC, P/M/Dys or C). Therefore, it is argued that the hypothesis (regarding the effect of hormones–on the S-VHI (Vocal impairment) and K-MPAI (Performance Anxiety) being related to the condition/category of hormonal situation (NC, P/M/Dys, or C)–is supported by the analysis. Similar results are obtained for

analysis of variance when the pregnant women are removed from Subset B, leaving the menopausal and hormonal dysfunction women only (N=8) in this group. See Figure 50: Analysis of Variance (N=40), Appendix C.

Qualitative Results – Informal Mixed Methods Survey

Global Recessionary Periods

The surveys were issued in the midst of a serious global economic crisis. When this sort of widespread economic depression occurs, funding within the industry from government, corporate and private sources is severely reduced. In cases such as these, those who specialise in concert work are especially hardest hit:

> There is an absolute disregard for the value of concert performances. When the economic crisis hit, the fees disappeared or were reduced greatly. To this day, they have not returned to the earlier norm. There is a lack of available support for concert and artistic recordings. The concert world is in a constant state of change and there is no help available to negotiate the changes. In my career it has been necessary to become a cultural manager in order to apply for funds and put on concerts. No help anywhere with the accompanying issues – PR in all forms. There is incredible loneliness to deal with and a lack of support from colleagues. Sometimes I feel I am the only singer who attends concerts in support of other singers and helps them to get further work.[1]

Loss of performing work is more potent than gain and precipitates different coping behaviours. One participant stated 'I am thinking of retiring as I have no work now that I have a child'.[2] Therefore, priorities change for women when they become parents. Results suggest women may be proactive in adapting the balance of their incomes towards other work such as teaching.

[1] Open comment–Respondent 2015094
[2] Open Comment–Respondent 2015090.

Underemployment

A total of 16 women report working exclusively as solo vocalists. However, 26 women were undertaking other employments in addition to singing. Over half, 22 women, were also teaching singing. A total of 4 women had non-music related additional employments.

Worry about Lack of Funds

Half of those surveyed, 21 women, regularly worried about a lack of funds, and of the remaining 21 women, 43% sometimes worried about money. As a population, this represents 39 women out of 42 who had experienced income concerns, leaving only 3 female soloists in the sample who never worried about being short of funds. A total of 9 women report that they generate sufficient incomes from employments to support themselves and their families. This leaves 33 women who report that they did not usually generate sufficient income from work. One respondent noted that: 'It can feel that all odds are stacked against the singer/ financial risk, vocal … Responsibility is not shared'.[3]

Problems with Social Support Networks

Over half of the respondents, 22 women, report that their singing career had created difficulties with their partners or spouses, and 24 women report that the career had influence over their ability to remain in close contact with family and friends. This represents a significant number of professional singers who struggle to maintain

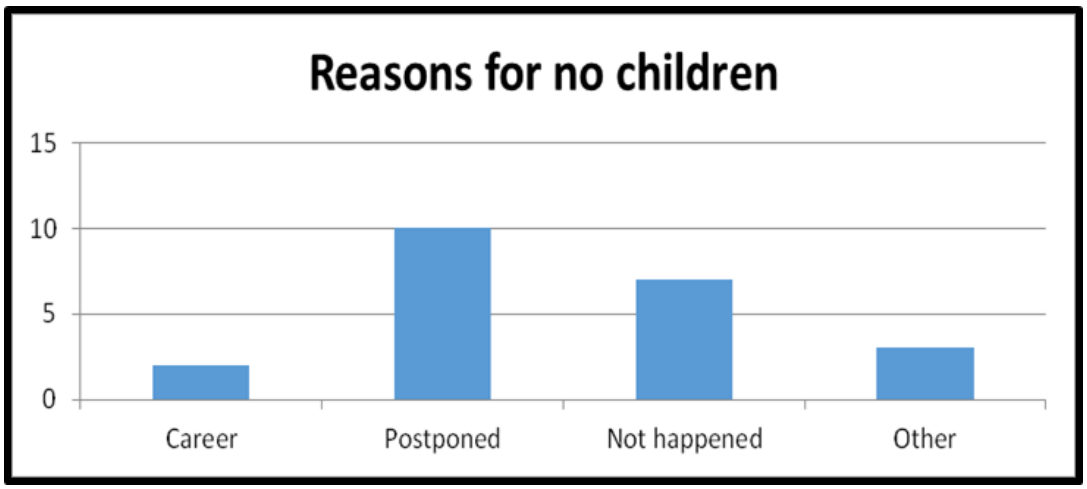
[3] Open Comment Respondent 2015063.

normal relationships due to the particular requirements of the career. Responses included: 'Problems maintaining relationships. Doing all work rather than work that suits. Money…'[4] and whilst this was a recurrent theme, it seems that most women did not regard a career in singing as a barrier to marriage and family. The rate of marital breakdown appears not to be outside what would be expected within the normal average population. However, it was not queried whether those who reported being married at the time of the survey had ever previously been married.

Children

A total of 20 women had children, compared to 22 who were without. Of the 22 women who had no children, two cited career reasons for not having children, 10 regarded having children as something they had postponed, 7 report that having children just had not happened, and 3 individuals recorded they had not wanted children–which is represented by 'other' responses illustrated in Figure 23.

Figure 23. Reasons for No Children (N=22)



[4] Open Comment Respondent 2015095.

Having children involves significant personal investment. A total of 3 women here had not wished to have children. But as can be seen, the vast majority of women either had children, intended to have children or wished to have had children and it just had not happened. Therefore, regardless of the possible future impact of children on career advancement, the majority of women in the profession do not deliberately avoid having children.

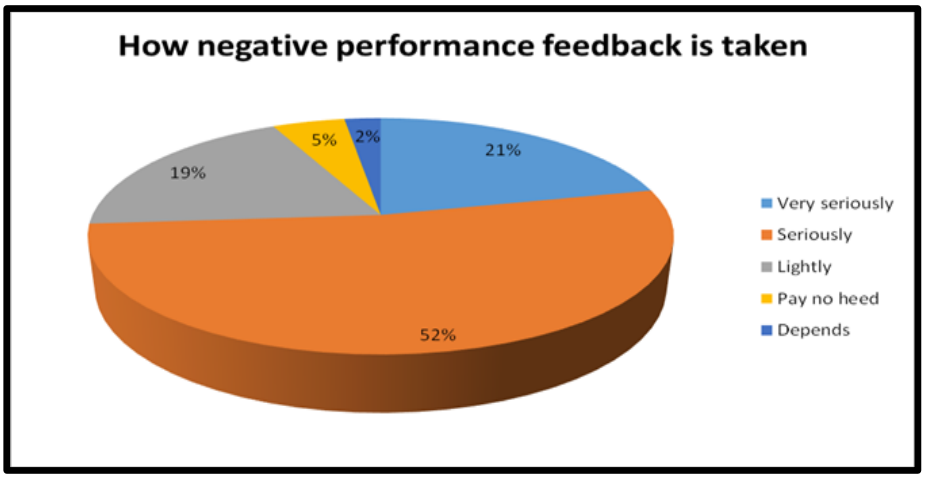
Age related vocal changes

A total of 85% (36 women) report that they noticed positive age-related changes to the voice as they matured. These changes were generally described in similar terms to that experienced during pregnancy: increases in the size and weight of the instrument; voice became warmer, darker, fuller; increased stamina; increased ease of singing; greater flexibility; and breaks across the registration disappeared. So, even those who did not experience pregnancy generally felt improvements to the instrument as time progressed.

Overly Critical Music Industry

The industry as a whole is regarded by singers as being extremely critical towards solo vocal artists. A total of 10 women felt they had received harsh or unjust critique from music critics in the press. The respondents were asked to rate how seriously they considered negative performance feedback (see Figure 24).

Figure 24. Reaction to Negative Performance Feedback (N=42)



A total of 21% or (9 singers) considered negative feedback very seriously, 52% or (22 women) stated that they considered negative feedback seriously, 19% (8 singers) took negative comments lightly, 5% (2 singers) paid no heed to negative performance critique whilst 1 woman stated that it depended on individual situations. When asked if negative press had ever affected respondents negatively in subsequent performances, one singer did not know, while 22 women claimed not to have let negative comments affect their subsequent performances. However, 19 women report that adverse comments had affected them negatively in later performances. This suggests that there is a quite a large population of professional singers who feel their work is being undermined by negative receptions.

Competitive Pressures

The informal survey encouraged personal reporting of experiences. Some singers used this facility to reveal undesirable experiences with regard to other female colleagues, and report being undermined whilst onstage by colleague behaviours and by other negative comments. Observations included ‘Singing colleagues behaving

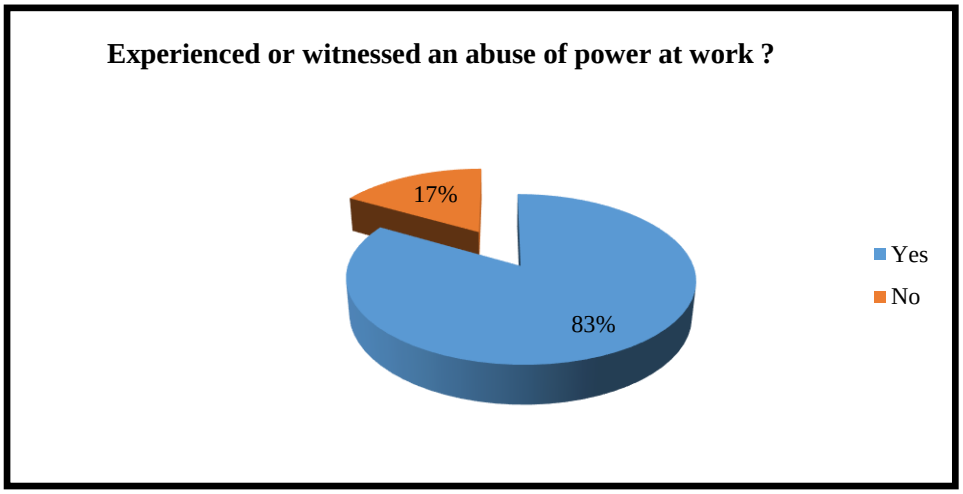
badly. Trying to compromise performances onstage.'[5] 'Bitchy behaviour from other female singers.'[6], and 'Bitchy, critical industry.'[7] Unfortunately, this type of behavior can occur within almost any type of organisational structure. Left to self-regulation by individual companies and due to the nature of temporary employments, this behaviour is difficult to prevent and can lead to abuses by colleagues, such as frequently mentioned by respondents in this study.

Abuses of Power

The researcher has both experienced and been witness to some negative experiences during her performing career. It seemed that it might be appropriate to investigate whether other singers had shared similar experiences. Participants were asked if they had felt personally targeted by harsh critique or witnessed what they would describe as abuses of power at work. Over half (23 women) of those surveyed felt that they had personally been targeted by individuals or management and subjected to harsh critique, and a staggering 35 women (approximately 83%) claimed to have witnessed an abuse of power at work, see (Figure 25).

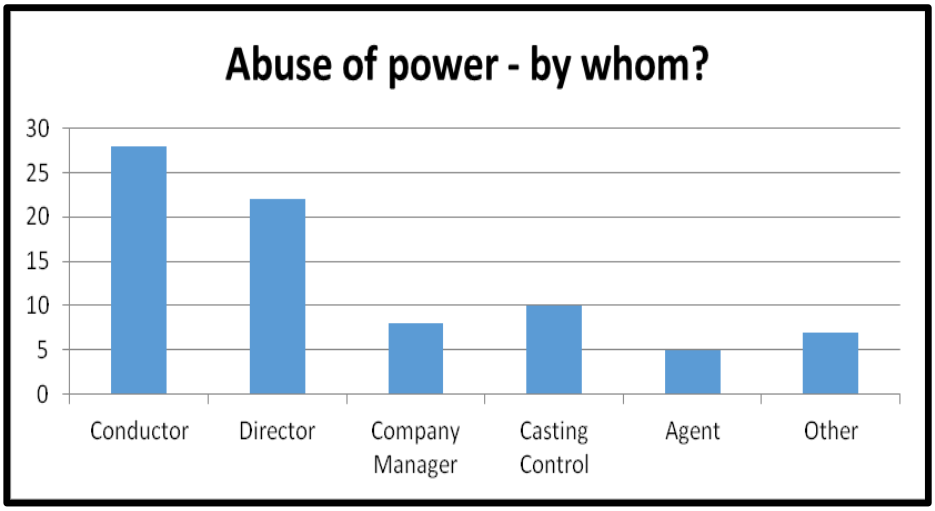
[5] Open Comment Respondent 2015030
[6] Open Comment Respondent 2015042
[7] Open Comment Respondent 2015080

Figure 25. Experienced or Witnessed an Abuse of Power at Work (N=42)



It was of interest to discover what roles within the working environment were responsible for the alleged abuse of power. Multiple answers were accepted (see the bar chart represented in Figure 26). Note: Occupations which recorded the most responses were conductors and directors. Other occupational roles included company managers, agents and casting control. The segment which depicts 'other' includes responses which referenced music critics and colleagues.

Figure 26. Abuse of Power at Work by Occupation



The conducting profession was credited with the largest number of complaints (69%) followed closely by directors (52%). Other requests can occur in opera, from management and directors outside of the normal professional singer's remit, that is to say being hired to perform and sing a role. A total of 15 women report they had been asked to undertake roles and appear either fully or semi naked on-stage. Depending on the personal attitudes of the singer, this can create undue pressure. Singers frequently described issues with casting being about appearance and networking, and not about vocal talent.

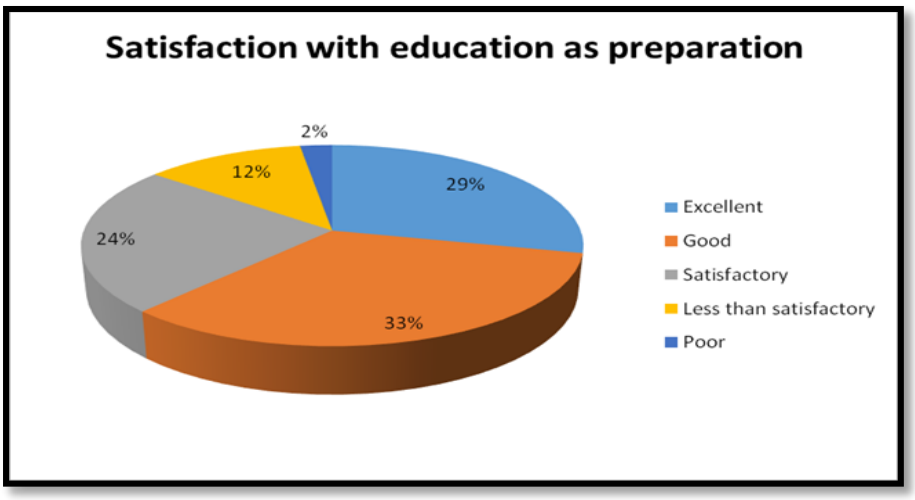
Thoughts about Quitting

A total of 20 women admitted they had considered retirement due to negative experiences. This represents almost half the singers canvassed. 6 women stated that they were still performing but felt they would like to be able to stop. Reasons cited for wishing to retire included voice loss, aging, negative comments, vocal injury, income, the amount of travel, and family reasons. Income, family and personal reasons were also cited as reasons for not being able to stop performing. A total of 8 singers had retired from operatic staged productions. 2 of these women had retired from opera at age thirty.

Educational Satisfaction

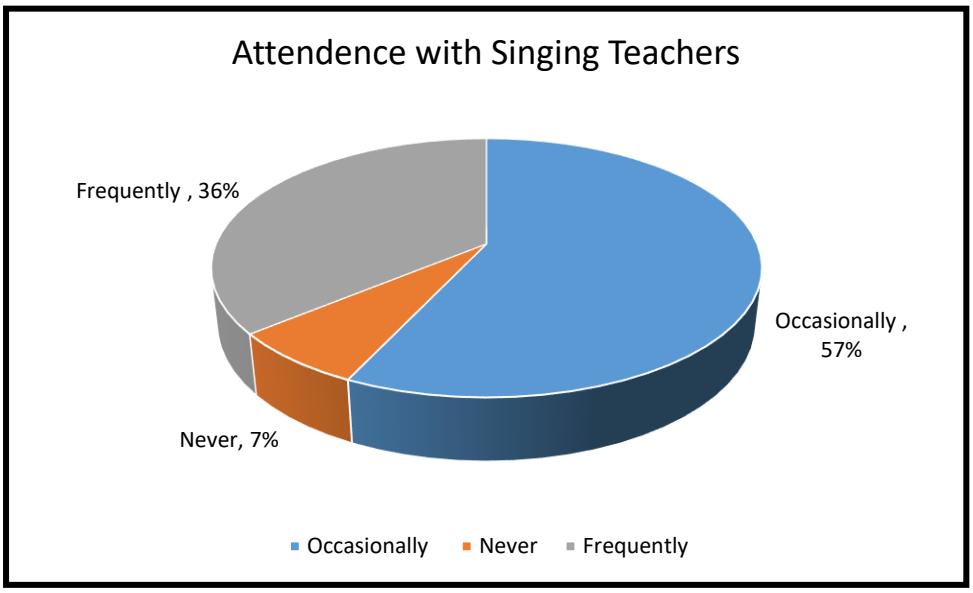
When looking at respondents' overall satisfaction rating of how well their education prepared them for the working environment, the majority were satisfied with their education, although 14% (6 women) were unhappy (see Figure 27).

Figure 27. Satisfaction with Singing Education as Preparation for Career (N=42)



The majority of participants report that they were satisfied with their singing education and there seemed to be a large proportion of singers from the group who occasionally and regularly continued to work with singing teachers and vocal coaches.

Figure 28. Attendance with Singing Teacher



With regard to professional singers continuing to take lessons with singing teachers 36% (15 women) frequently had lessons with teachers, 57% (24 women) occasionally has lessons and 7 % (3 women) never had lessons with teachers. In total 13 women frequently saw vocal coaches 27 women occasionally saw vocal coaches, only 2 never attended coaches. The particular music being learned is understandably the main focus of attention. However, the general lack of awareness of organisations which can assist with performance difficulties (86% of those surveyed; 36 women out of a total of 42 canvassed) is disturbing. It seems that, although a large percentage of singers continue to consult with singing teachers and vocal coaches, anxiety issues appear not to be discussed.

Confidence in Singing Techniques

The participants were asked to rate their confidence with regard to their singing techniques. A majority, 23 women, felt very confident; a further 18 were somewhat confident and one individual reports feeling nervous with regard to her technique. Quite a large number, 16 individuals, report that their technique had failed on occasion. The same number report losing their voice altogether. The reasons for voice loss were numerous and included illness and colds, prescription drugs, fertility treatments, monthly hormonal influence, acid reflux, muscle spasm, under-preparation, tiredness, bad technique, singing the wrong repertoire (not suited to the voice or being over ambitious with the repertoire chosen) and also excessive socialising.

Vocal Issues

A total of 4 singers indicated that they regularly accepted contracts too different vocally or too close together to learn properly, and a further 19 women indicated that this occurred sometimes. Difficulties with the German fest system, for example, included frequently not having enough rehearsal time and heavy schedules which included lots of back-to-back productions which in turn tested vocal stamina. 32 respondents admitted occasionally pushing their voices beyond what was comfortable and singing from positions which compromised their vocal supports, while one singer indicated that this occurred frequently. A total of 45% (19 women) claimed that it took their voices one day to recover after performances and an equal number said that their voice needed two days to recover after rigorous singing. A further two individuals claimed to require more than two days to recover. The remaining two, both concert singers, would never tax their voices beyond comfort. This would seem to indicate that operatic singing presents more opportunities for vocal abuse and that vocal rest is essential to assist recovery after taxing performances. 12 singers had developed vocal faults during their careers.

Vocal Injury

A total of 9 women had acquired a vocal injury, 1 in 5 of those surveyed. The majority simply required vocal rest or other non-invasive massage, speech therapy and retraining, whilst 3 singers had undergone vocal surgery. Of the contributing factors towards acquiring these injuries, respondents cited muscle tension, over-singing and speaking, acid reflux, the abuse of chest voice, and poor general advice. Furthermore, 81% (34 participants) report performing whilst in physical pain.

Reports of pain include muscle pain, back pain, ear-ache and aches from injuries, menstrual cramps, headaches, migraines, sprains, sore throats, rib pain and arthritis. A total of 26% (11 women) surveyed admitted the over-use of medications.

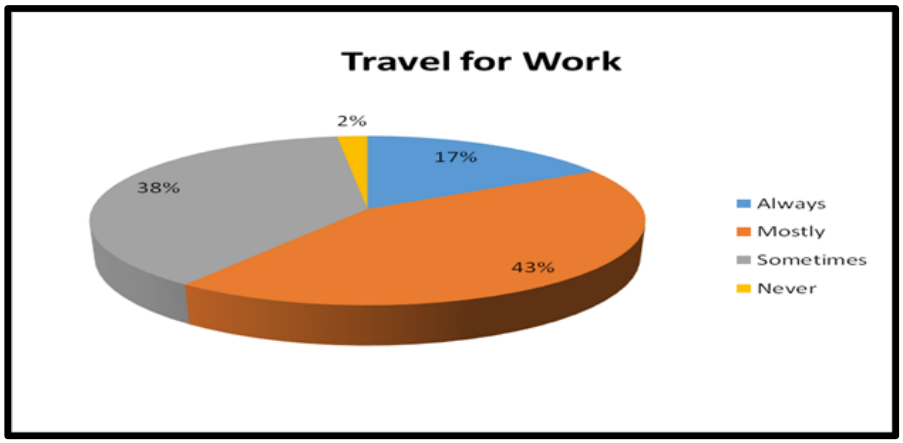
Onstage Accidents

It transpired that 8 singers had sustained injuries due to on-stage accidents. This is not uncommon–the stage can be a dangerous place. Some of the injuries reported included sprained ankle, broken arm, puncture wound from standing on glass, curtain tab malfunction causing head injury, faulty set, and numerous 'dying' injuries.
The survey enquired as to whether those affected by accidents felt their injuries had an effect on their future work. None of those who had suffered stage injuries felt that their work had been adversely affected. 5 women were happy at how the injury was handled by the respective company. However, 3 were unhappy with the treatment they received.

Travel

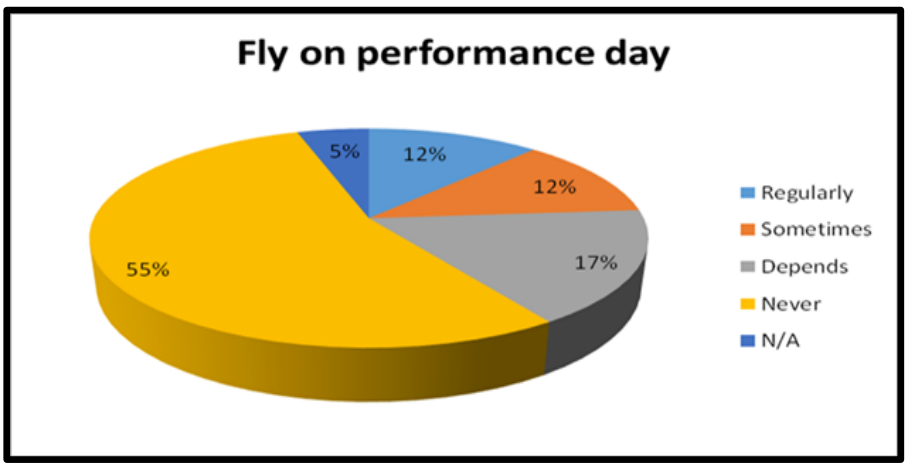
A total of 76% (32 respondents) regularly toured for work. Of these, 17 % (7 women) reported they always travelled, 43% (18 women) mostly travelled and 38% (16 women) sometimes travelled. Only one respondent, represented as (2%) below reports never travelling for work (see Figure 29).

Figure 29. Travel for Work (N=42)



Air travel accounted for a large proportion of travel; 66% (28 singers) in the group were taking regular flights. When asked how much they would rest after flights before singing, 19 singers said it would depend on variables involved in work, a further 19 women would rest overnight and 4 would rest a few hours after flying. The group was asked if they would consider flying on a day when they were performing a major role. N/A, (does not apply to me) represents the two singers who were involved in Lieder and Contemporary music (see Figure 30).

Figure 30. Fly on a Performance Day (N=42)

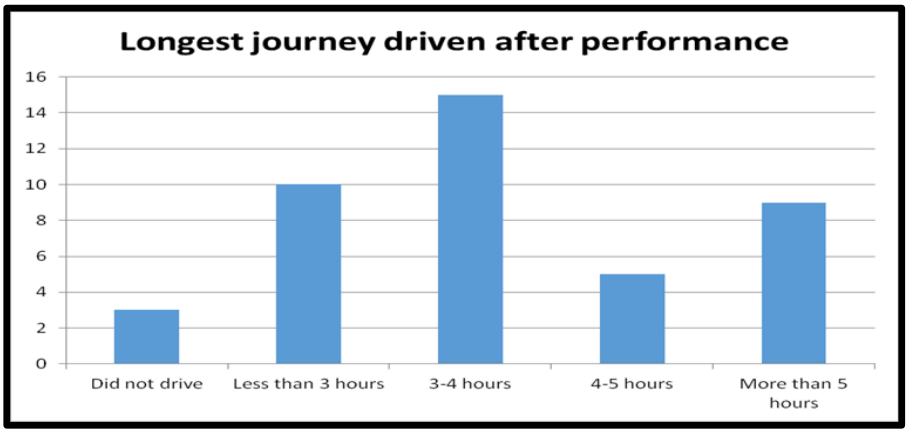


A total of 55% (23 women) would never fly on a day with a performance of a major role, 17% (7 women) said it would depend on circumstances, 12% (5 women) would sometimes travel; and another 5 women regularly took flights on a day when they were due to sing a major role. When asked if they made distinctions between rehearsing and performing in relation to vocal rest after flights, 17 women responded that they always would make this distinction, 22 women would occasionally make the distinction, and 3 women never made any distinction between rehearsing and performing when considering their vocal rest.

A majority, 33 women, enjoyed travelling; one woman did not feel she travelled enough to comment. This left the remaining 8 singers who did not enjoy the constant travel. In the western world, the normalcy of air-travel is demonstrated by virtue of the fact that 43%, or 18 respondents, would take a flight home if they received a day off work.

However, air travel is not the only form of transport regularly used by singers. The research group was asked if they would normally drive home after performances where this was possible. 73% (31 singers) agreed that they would. It was further requested from the total group of respondents, that they indicate the longest journey (in hours) which they had driven in order to return home after a performance (see Figure 31).

Figure 31. Longest Journey Driven After Performance (N=42)



Clearly, when on tour, travel behaviours exist among professional performers. The bar chart in Figure 31 perhaps illustrates how little singers consider their own comfort, choosing to return home at the expense of their personal physical rest. Granted, this is the longest journey travelled; that said 10 women travelled up to 3 hours, 15 women travelled 3-4 hours, 5 women 4-5 hours and 9 women report travelling in excess of 5 hours to reach home after performances.

Socialising for Work

Socialising is an important feature of working as a singer. Companies constantly court their corporate sponsors and post-performance receptions are a normal, if somewhat extended, requirement of being a soloist. These duties are undertaken with goodwill by singers, not for any further payments. Soloists are regularly asked to attend post-performance functions and mingle with guests to promote operatic companies. 74%, or 31 participants, would regularly socialise after performances and the same number considered that this was important for self-promotion.

A total of 8 women would always or frequently have alcohol, 30 women admitted to drinking alcohol sometimes, only 4 women would never have an alcoholic drink after performances.

Inadequate Sleep

In addition to these stressors, soloists are constantly on the move. Frequent travel between time zones and cultural displacement can create issues with sleep and feelings of isolation. Lack of sleep can also affect vocal support and memory consolidation. A total of 60% of the respondents (25 women) had, on occasion, suffered with prolonged insomnia.

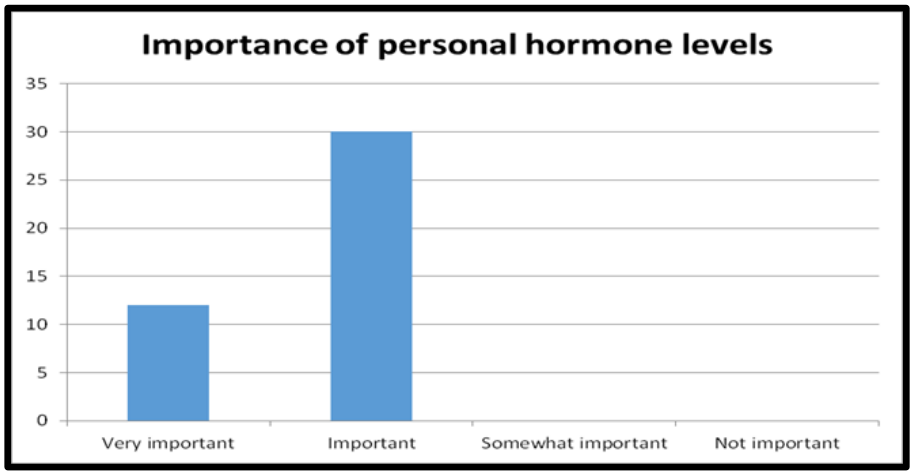
Joy of performing – Professionalism

All respondents, except for one singer, normally enjoyed being in front of an audience. 18 women surveyed did not report any difficulties with MPA. This is a very positive result, but it must be remembered that levels of professional experience do affect anxiety sensitivity. A total of 20 women experienced MPA only sometimes, while the remaining 4 women report experiencing MPA difficulties on an on-going basis. The group exhibited professionalism in the way they maintained their general fitness levels–83% (35 women) report participating in regular exercise and 89% (37 women) frequently employ meditative techniques like yoga, meditation and mindfulness to reduce and maintain their general stress levels. A total of 32 women regarded themselves as being of normal weight.

Personal Hormones

Considering the research is investigating the influence of ovarian hormones, participants were asked to comment on how relevant they felt their personal hormones were in relation to their singing, and to indicate the typical length of their reproductive cycles. See Figure 32.

Figure 32. Importance of Personal Hormones (N=42)



All of the respondents considered personal hormonal influence either very important or important. A total of 24 women report normal twenty-eight day cycles, 13 had normal cycles of less than twenty-eight days, 2 women had irregular cycles and one woman had normal cycles longer than thirty-two days. Two women had permanent hormonal dysfunction from their early teens which meant that they did not experience any hormonal cycles. A total of 59% (25 women) had some experience during their life-time of using hormonal contraceptives; this figure included those requiring HRT.

Oral Contraceptives and adverse voice effects

Of those who were not using hormonal contraception at the time of the surveys, 3 individuals did not continue with oral contraception because of adverse voice effects. Of those with experience of using oral contraceptives or HRT (the remaining 22 women), 9 individuals noticed no effect, a further 6 individuals indicated mild to no effect, and the remaining 7 individuals report that they did not know. 11 participants in total were recorded as taking contraceptives or HRT during the performance day tests–10 women on contraceptives and one menopausal woman.

Voice change due to menstrual issues

Of those who had normal cycles and were not using hormonal contraceptives (N=22), 88% (19 singers) noticed voice changes which correlated with menstrual issues. These women report feeling ill with pain and abdominal cramping, feeling sluggish, having increased tension, dryness, reduced range, thickened cords and vocal heaviness, lowering the dynamic range of the voice with corresponding loss of top notes, loss of agility and huskiness.

Assisted Fertility

A total of 5 women in the survey group needed assistance with fertility and had undergone fertility treatment, while a further 2 were about to embark on treatment. When asked how the fertility treatment affected them, only one individual noticed any significant adverse effects on the voice. 3 women, however, recorded marked emotional effects as part of the treatments.

Pregnancy and Career

A total of 20 women had children. For the vast majority of women surveyed there was worry about how pregnancy would affect their careers. The survey asked the participants if they had received any pressure from their families to cancel work when pregnant. A total of 6 respondents report that they had felt pressure to stop working. However, 4 women report that they had experienced pressure to continue working when pregnant.

> Pregnancy was of little real impact on career, but worry about the pregnancy was a waste of energy. It does complicate life. But pregnancies had positive effect in that they put things into perspective and diluted the soprano paranoia.[8]

A total of 12 women report on-stage pregnancy issues. These include problems associated with physical awkwardness, difficulties with breathing, acid reflux, nausea, vomiting, cramps, bladder issues, hoarseness and feelings of self-consciousness. A total of 10 women report changes in voice quality when pregnant. While these changes have been difficult to research in large populations of singers, it is widely understood by professional vocalists that they occur.[9] The changes in voice quality after pregnancy were regarded as positive by 13 women surveyed, and recognised as permanent by 9 of these women. Subsequent to pregnancy, women experience their voices becoming fuller, richer, warmer and weightier, and they became more aware of the muscles involved with breath control; as a result, after pregnancy, some report that they were better able to control their breathing.

[8] Open Comment from respondent 2015010.

[9] Adrienne B. Hancock and Heather E. Gross, 'Acoustic and Aerodynamic Measures of the Voice During Pregnancy', *Journal of Voice* 29 (2014), 53-58; Ziya Saltürk et al., 'Objective and Subjective Aspects of Voice in Pregnancy', *Journal of Voice* 30 (2015), 70-73.

Performance Cancellations

No one from the total respondents would cancel a performance due to disturbance over the monthly cycle. Certainly, the cost of investing in performance cancellation insurance might appear prohibitive to many, especially if fees for individual performances or durations of performing runs are not significant.

Levels of Insurance Cover

The majority of participants stated they did not have any performance protection insurance. Only 8% (3 singers) of those surveyed took out any insurance, and these policies were specified risk policies. Investing in performance insurance also creates an extra layer of administration and cost, an expense most singers wish to avoid. This left 92% of the group (39 singers) who did not have any insurance cover at all. Considering that 85% (36 women) admitted to feeling pressure to perform even when ill (this pressure was derived from companies, but mostly from themselves), it is most likely that fears regarding total loss of revenue due to cancellation of performances sometimes cause a large proportion of professional singers to sing when ill and risk possible injury.

Issues with work and caring for children

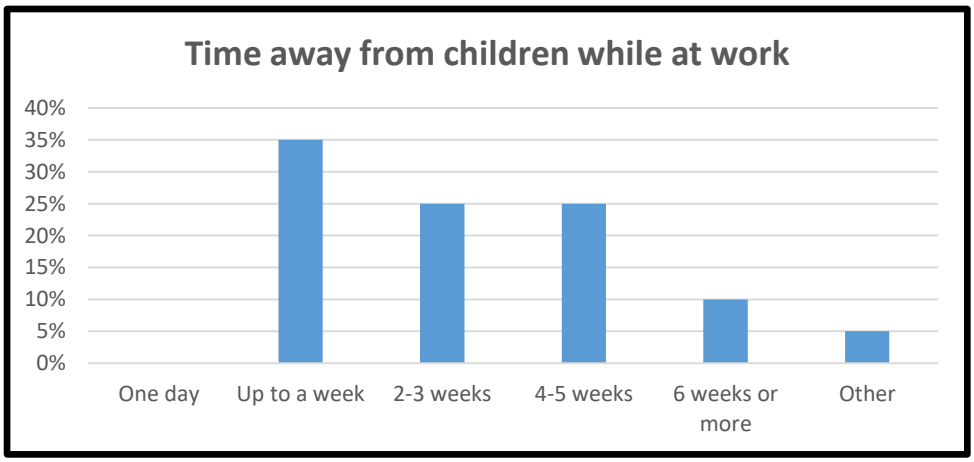
There were many problems highlighted concerning issues of work when caring for young children. One participant stated that there was always difficulty caring for family. ‘Balancing working life as a singer is always difficult even when the children

are older'.[10] Generally, the most difficult issues with infants were lack of sleep, scheduling, and separation from the baby. 7 women breastfed their babies and 4 women had expressed breastmilk whilst at work. A total of 3 women, however, report difficulties–including that companies were not open to breastfeeding.

Childcare and organisational home-life complexity

In all, 16 women sought help from family and combinations of grandparents, spouses and siblings when dealing with the care of their young children. The other 4 women reported use of combinations of family, crèches, childminders, au pairs, and even neighbours in a rainbow of childcare solutions. A total of 7 women had occasion to hire nannies to travel with mother and baby for the purposes of continuing with work. The most telling figures relate to the length of time mothers spent separated from young children due to work commitments (see Figure 33).

Figure 33. Time Away from Children Whilst at Work (N=20)



[10] Open Comment Respondent 2015072.

Figure 32 illustrates how many weeks' mothers would typically report as spent away from children. The individual who reports 'other' notes that they always brought the child (this individual was a new mother), 7 women report spending up to one week away, 5 spent between two and three weeks away, 5 women report stretches of four to five weeks away, and a further two women report that they would have spent stretches of over six weeks when they would have not seen their children. A total of 95% (40 women) would not cancel a performance if children or babies were ill. In open comment a respondent stated: 'Hard to combine a career with motherhood and I find networking difficult'.[11] Similarly, childbirth is a significant life event, which permanently changes the status and responsibilities of the woman. Another comment from a respondent included 'Hard to have a career and a family'.[12] Having small children can affect how rested female singers are during performances. As one participant comments 'Wanting to be in tip top condition and then family life intervenes, kids sick, sleepless nights.'[13]

Post Natal Depression

5 women in this group of professional singers, over 1 in 4, who had experienced pregnancy had suffered from post-natal depression (PND). This figure is somewhat higher than the general population.[14] 4 women continued to sing and perform whilst suffering from PND.

[11] Open Comment Respondent 2015020.
[12] Open Comment Respondent 2015008.
[13] Open Comment Respondent 2015037.
[14] Post-natal depression has been found to affect between ten and fifteen percent of the general population but this figure has been on the rise in western populations.

Menopause

10 individuals had some concerns regarding peri-menopause and menopause; of the 6 women who regarded themselves as experiencing menopause,[15] 2 had sought medical assistance.

Chronic Illness

A total of 10 women also suffer from some type of chronic illness. Of these 10 individuals, 9 were regularly taking medication and 8 of these report that this medication affects their voices. 4 women suffer from hypo-thyroid issues.

Loneliness and Depression

The participants were asked how regularly they were alone when working away from home. 2 women claimed to be always alone, 25 women were mostly alone, 10 women were alone sometimes, and 5 said they were never alone. 20 women claimed that being alone did impact their moods. As noted by a participant 'Loneliness is a factor.'[16] Because of the relationship between depression and MPA, participants were asked if they had ever suffered from depression. A total of 48% (20 women) almost half the entire survey group, replied that they had suffered from depression. A total of 24 women self-reported experiencing MPA.

[15] There may be a considerable number of years prior to menopause when menstrual periods become intermittent. However, women are only considered to be menopausal once a period of one year has elapsed since their last menstrual period. Women who are still having menstrual flow are considered to be normally cycling.
[16] Open Comment Respondent 2015083.

Emotional Life

Participants were asked about their emotional life; 38 women felt usually happy and 4 reported feeling always happy. A total of 38 women felt that their lives had been full of success. However, 4 women felt their lives had been full of failure. This failure response seems curious given that these individuals had successfully become soloist singers; perhaps perceptions regarding the level of success as a soloist was more the issue among these respondents since clearly, they had achieved success in their musical careers. It is perhaps worth noting that all 4 of these individuals had a previous history of depression. However, it is not possible, given the size of this group to make any further inferences. 2 of the individuals report suffering with MPA and 2 report that they were unaffected.

Personality and traumatic life events

The research participants were asked how they would describe their personalities. As might be expected with singers, 16 women described themselves as extrovert, 24 women described themselves as having a mixture of introvert and extrovert behaviours, while only 2 individuals, claimed to be introverted. Of the total number of participants, 32 women had suffered some sort of traumatic life event such as bereavement, separation or divorce; of this number 21 women felt that they had been able to deal with the life event trauma. A total of 3 women in the total group reported that they carry some unresolved emotion concerning life trauma which they had experienced.

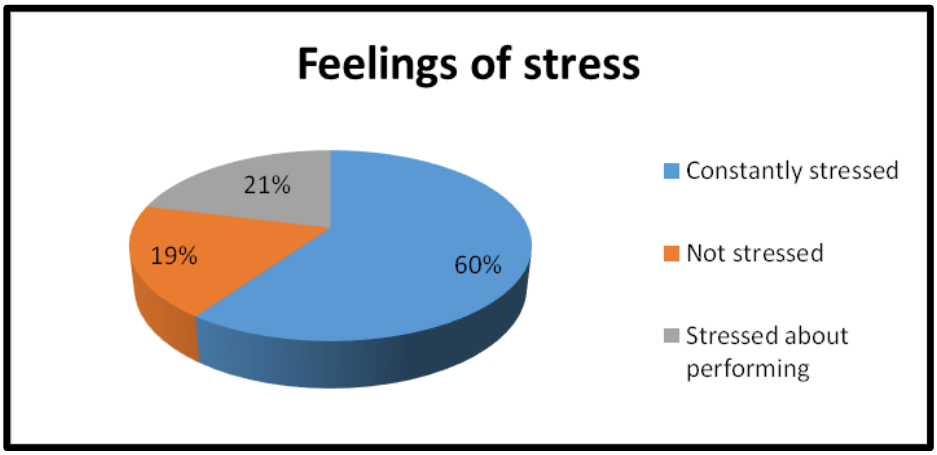
Perfectionism

When considering the group's attitudes to the importance of perfection in their personal performances, 81% (34 of the respondents) claimed that perfection was very important. However, when this figure was compared to the amount of time they devoted to personal practice, 30 women admitted to spending less than ten hours practising per week outside of normal rehearsals. Just 12 of those surveyed report devoting more than ten hours a week in practice, in addition to normal scheduled rehearsals. This implies that, although the group regarded themselves as perfectionist, the majority did not exhibit perfectionist tendencies in terms of personal practice, suggesting that this behaviour is largely adaptive. However, this also suggests that 1 in 3 singers did report perfectionist traits.

Stress

The participants were asked to rate their general levels of stress as either high, medium or low. A total of 13 women considered themselves in high stress states, 25 women considered their stress was at a medium level and 4 report low general stress. A total of 60% (25 women) felt that their stress was constant; this figure included 2 individuals who described their stress both as constant and being about performance. A total of 21% (9 women) felt their stress was due to performing, and a further 19% (8 women) report experiencing no stress (Figure 34). A total of 5 women had taken time off work due to stress issues.

Figure 34. Feelings of Stress (N = 42)



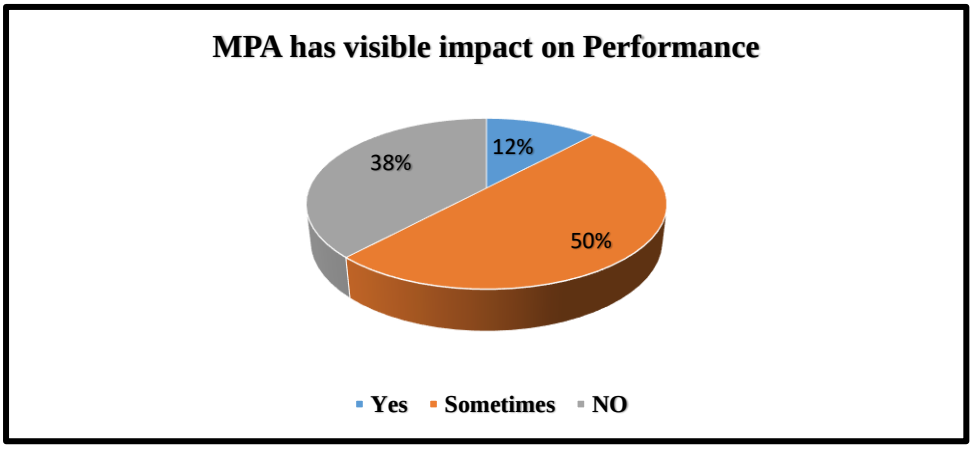
Drugs/Medications for stress

The participants were asked if they had ever taken any drugs to calm them when performing. A total of 3 women had taken medications to help with stress-related performance issues. Two of these admitted they were currently taking anti-depressant or beta-blocking medications, while the reported third indicated that she was not currently taking medications. The remainder, 39 women, said they had not taken medications. A total 37 women actively adopted some type of stress-relieving method; another 4 women claimed they practised no stress-relieving methods; and one participant, who had claimed previously during the survey not to use any drugs or medications, admitted to using Xanax to relieve stress. The respondents were asked if they felt they had been able to fully recover from stress episodes. A total of 14 women felt the question did not apply to them as they had not experienced serious stress episodes. Another 20 women said that they felt they had been able to make a full recovery, 7 women felt somewhat recovered and one individual, felt she had been unable to fully recover from an episode of acute stress.

MPA

A total of 24 women claimed to suffer with MPA (Q.65); 20 of these women currently had no symptoms and reported experiencing MPA only sometimes. This left the remaining 4 women, who reported suffering from MPA at the time the surveys were completed. The respondents were asked if anxiety had a visible impact on their performances (Q.66); 5 singers said MPA did have a visible impact on their performance, 21 women said that anxiety sometimes had a visible impact on performances, and 16 women said that anxiety had no visible impact on their performance. This implies that the respondents were referring to types of anxiety that were observably debilitating and not just pre-performance nervousness.

Figure 35. MPA & Visible Impact on Performance (N=24)



A total of 48% (20 respondents) had sought help with MPA. As there was little awareness of where to go to receive information and assistance from industry and organisational supports, this help was sought privately by individual singers at their own expense. Figure 36 shows the proportion of soloists who investigated help options.

Figure 36. Help Sought for Anxiety Issues (N=42)

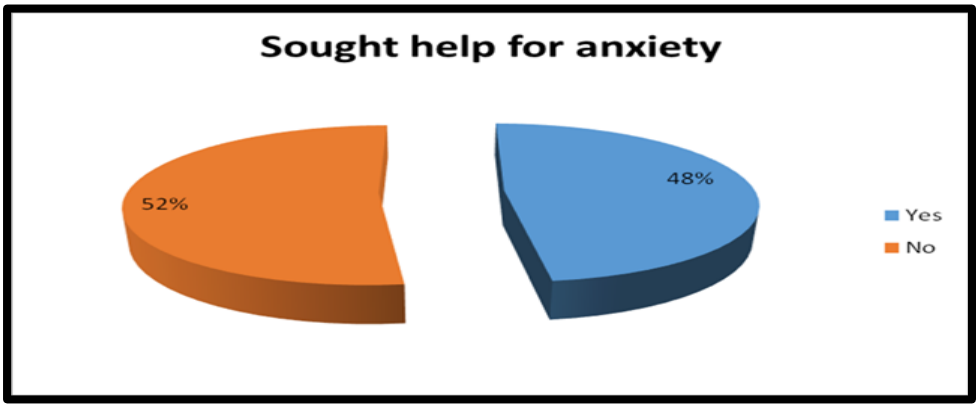


Figure 37. The Sources of Help Sought to Ameliorate Anxiety (N=20)

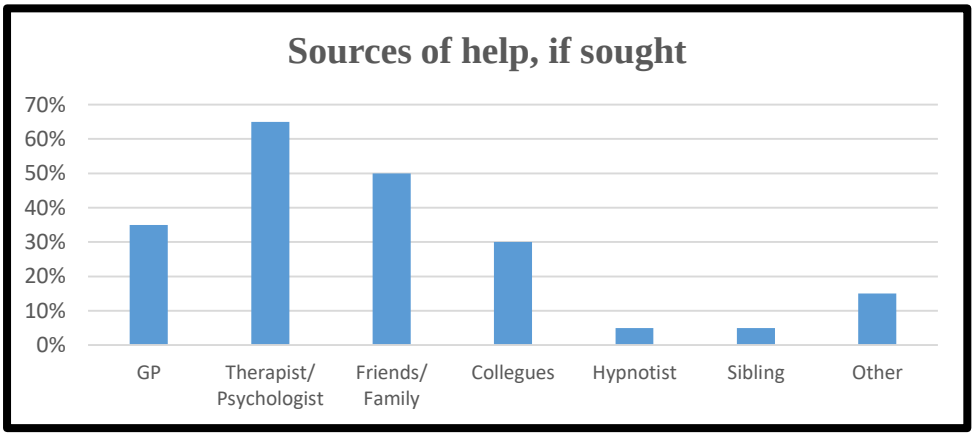


Figure 37 shows combinations of where help was sought for anxiety from the listed choices (multiple answers were accepted). A total of 35% of anxiety sufferers went to their general practitioner; 65% discussed their MPA with a psychologist or an alternative therapist; (it should be noted that singers have been recorded as seeking alternative treatments which have not been tested or determined as fit for purpose by the clinical community)[17] Half the women asked for help from friends and families,

[17] Jason B. Surow and Jeanette Lovetri '"Alternative Medical Therapy"' Use Among Singers: Prevalence and Implications for the Medical Care of the Singer', *Journal of Voice* 14 (2000), 398-409.

2 women specifically mentioned siblings, 13 or 30% discussed anxiety issues with colleagues, and 2 women 5% had consulted with hypnotists. A total of 6 women 15% described other sources of help; these included a sports psychologist, a priest, and self-help books. As can be seen from the chart above, while help for anxiety was sought from a variety of sources, a large proportion of the help sought was from non-professionals. This would suggest that singers are avoidant at addressing issues concerning anxiety. The respondents were asked how effective they felt the help they received with their anxiety issues had been. 2 women made no comment, 5 said the advice they received was fair, 9 claimed the advice was good, and 4 said the help they received was excellent.

The respondents were asked if they felt fearful about seeking help with anxiety. A total of 7 women said that they were afraid to ask for help. In total 18 women said they did not make their difficulties public knowledge. The respondents were asked if they continued to perform with anxiety; over half said that they continued to perform whilst continuing to experience anxiety issues.

Lack of knowledge of where to see help for anxiety

A total of 86% (32 women) could not name any organisations which provide information or support to help singers. Certain Fach or voice types[18] may experience more stress due to the complexity or exposure of the musical writing. As a result, they might be considered as experiencing higher degrees of stress than other voice

[18] Fach here refers to the German system of artist classification and is determined both by voice and other attributes, these attributes might include acting ability, for example.

categories. Certainly, it appears from open responses that individuals considered there was no organisational support which could help them with their specific issues:

> Due to overwork and singing high stress roles in the coloratura Fach, I suffered an ear/neck/shoulder tension problem due to stress and developed regular anxiety attacks. There was no foundation out there that could help so I did it all myself and endlessly researched meditation, yoga and breathing techniques - I purposefully stopped auditioning for a year so that I could get some time to recover. I would incorporate what I had learned during the work I had already committed to and used this work as experimentation towards my healing.[19]

Feelings of disposability- the exposome of stress in female elite singers

The superficiality of the industry, inflexibility and unsocial nature of work, difficulties with colleagues, issues involving spousal relationships, having and caring for family, hormonal impact on instrument, worries about aging, and feelings of being in a minority were of common concern to these women:

> There is very little credence or support given to the generation of modern women singers who are in the 'sandwich generation' i.e. caring for young children AND elderly parents. Often divorced, or with a partner working away from home. Opera is not an industry geared towards flexible working, so in real terms working away from home often entails a whole extra several layers of organisational work. To run a home and organise childcare from afar, before a singer even has time to concentrate on the job in hand, let alone address her physical and psychological needs, which the job of being a professional artistic performer demands. In addition to this, hormonal difficulties place a burden on women singers not experienced by their male counterparts. That is not taken into consideration by the industry. Also, as women age, they are discarded for younger, fitter, cheaper, and less domestically

[19] Open Comment Respondent 2015072

encumbered female singers by an industry that is predominantly run by both heterosexual and gay men![20]

[20] Open Comment Respondent 2015013

CHAPTER 5: Discussion

Summary of quantitative findings research instruments

The ANOVA findings suggest that ovarian hormones associated with life-course influence voice function and music performance anxiety. Both conditions are measured by (S-VHI- Singing Voice Handicap Index) and (K-MPAI- Kenny Music Performance Anxiety Index) respectively. 3 discrete hormone situations were investigated. Hormone disturbance is measured by (SHE–short term hormone effects). Subgroups include those with Normal menstrual cycles N=22, No menstruation (pregnant, in menopause, with dysfunction) N=10 and taking oral contraceptives N=10.

It was observed that women normally cycling had the greatest range of disturbance in hormones over the entire month of their menstrual cycle. This influenced the levels of S-VHI disturbance at different points throughout the month (there was a high disturbance extreme) but overall during the entire month, levels of vocal impairment (except for this single woman) were not higher than those who were taking oral contraceptives and only occasionally were more elevated than those who were in the no menstruating group. Worth mentioning, this woman admitted she was suffering from MPA in data gathered by the informal survey. Whilst the normal cycle group displayed some of the highest K-MPAI anxiety (this was also influenced by anxious extremes) MPA was experienced at different intensities over the women's monthly cycles, the spread of scores observable in this larger sample (N=22) demonstrates that the K-MPAI scores especially in the middle of the cycle are reasonably stable and generally lower than the scores for K-MPAI amongst the contraceptive group.

It was observed that women not menstruating (Pregnant, Menopause or Dysfunction) (N=10) had the lowest SHE hormone scores of the entire sample. These women were not reporting as much disruption due to their hormones as either NC or Contraceptive (OC) groups. However, these women had nearly as high measures of vocal impairment as the normal cycle group although less than the contraceptive group. These women had the lowest K-MPAI anxiety and this was inversely related to voice function. Therefore, even though they felt their voices were almost as much impaired as the NC group, the not menstruating group, experiencing the lowest disturbance from hormones were the least anxious. This implies that MPA in singers can be low even when the singer reports that the singing voice is impaired. This result addresses the question concerning whether anxiety is always positively correlated with voice impairment. These results suggest it is not. This implies anxiety is dependent on other factors. However, it is not clear if lower levels of MPA in the group of menopausal women are as a result of professional experience, due to the absence of ovarian influence, or other factors. Clearly, voice function was reported as impaired in this group. However, this could be as a result of taking prescription medications for chronic illnesses (as is evidenced by reports in the informal survey). Low levels of MPA are positively correlated to low levels of hormone disturbance however, leaving this group the least anxious of all 3 groups.

It was observed that the Contraceptive (OC) group (N=10) report lower SHE hormone disruption than the NC group, (there was an extreme). Hormone disturbance was appreciably higher, however, than the not menstruating group. (These women are suppressing their natural hormone by taking synthetic hormones). This group show the highest levels of S-VHI singing voice impairment compared to both the NC group and the not menstruating group. The range of scores for K-MPAI

music anxiety are also more closely grouped for this OC group. Overall the women in this group showed consistently higher scores for MPA. This implies those taking oral contraceptives report more problems regarding the functioning of their voices and are consistently more anxious than NC and not menstruating women. In the case of women taking contraceptives, levels of hormone, voice impairment and music performance anxiety are closely related. This result seems to contradict previous research, Amir, Kishon-Rabin and Muchnik (2002), Lã et al. (2006), and Lã et al. (2009), concerning improvement in vocal stability and improved functioning in voices as a result of taking hormonal contraceptives. Obviously more research is needed in this area to ascertain precisely what is occurring regarding oral contraceptives, perceptions of hormonal disruption, and voice impairment.

It must be noted that the sample size (N=42) is very small relative to clinical hormone analysis studies. Any inferences must be viewed with caution until further research is advanced in this area.

Summary of qualitative and quantitative findings, mixed methods

The predominant qualitative findings from this study suggest expert female singers feel ‘disposable’. Common amongst the critical voices of women involved in this profession is that supportive working and personal relationships are difficult to cultivate and maintain due to the superficiality of the industry. Working conditions are inflexible and unsocial, feelings of uncontrollability are evidenced by expressions concerning difficulties with colleagues (for example undermining behaviors of colleagues in performances) abuse of power by high-ranking persons such as conductors and directors, and negative receptions involving audience and critical press. Nearly half those surveyed had thoughts about quitting.

Issues between work and home include difficulty maintaining attachments, difficulties in spousal relationships, and other relationships with family and friends. In other words, women feel they lack social support. Expressions are of loneliness, feeling constant stress and occasionally even expressions of failure. High levels of depression are reported and high incidence of post-natal depression is reported amongst women with children, this is noticeably higher than levels in the general population.

Feelings are expressed concerning a lack of shared responsibility, between solo singers and the industry, and involving women and the home. These women shoulder a large proportion of costs incurred due to operating the career and continue to shoulder the greatest burden of organisational responsibility for home life, having and caring for family, children and on occasion, elderly parents.

Competitive pressures include maintaining youthful appearance and constant auditioning for work. Lack of sufficient singing engagements result in having to undertake supplemental employments, and often women feel that they are not in control of choosing work because of fiscal pressures. The majority of women singers juggle more than one job. Due to multiple employments women performers are likely experience time poverty caring for themselves physically and psychologically. Some try and organise concerts to create employment opportunities themselves. Multiple employments create increased fatigue. Lack of proper remuneration for work means constant worry about funds amongst the majority of women in the profession. A large proportion of soloists believe that they need to socialise for work to promote themselves, but this becomes more difficult as they get older and are encumbered by dependents. The majority would consume alcohol at social after-work events.

The willingness to travel long distances or take flights home for short periods evidences the burden women feel when away from family. Motherhood impacts personal freedoms. Large amounts of time are reported as having been separated from children. There is considerable cultural loading with regards to motherhood which permanently changes the status and responsibility of women. Indeed pregnancy and motherhood have a significant and permanent impact, altering the structure of the female brain. This is often overlooked. Family milestone occasions are regularly missed, due to unsocial working hours and frequent travel this creates feelings of inadequacy and uncontrollability. Guilt and uncontrollability are common emotions experienced by mothers–worry for children and concerns about being a good parent. Being constantly away can mean a loss of control in parental decision making and result in feelings of detachment. Separation from children for long periods, therefore, represents a considerable impact on family. Certainly, young children at home make socialising more infrequent. As the majority of networking occurs after hours at social events, motherhood can have an impact on personal promotion, especially if the networking aspect of the career, an accepted aspect of being a singer, is already challenging.

The hormonal impact on the instrument is recognised as placing additional burdens on women singers. This additional hormonal burden they feel, is not being recognised by the industry. These women do not cancel performances when having their monthly periods. Many singers do not invest in insurance cover to mitigate any losses from performance cancellations due to illness or indisposition. In opera, soloist singers normally receive one performance fee or an agreed fixed subsistence during the weeks of rehearsal to cover their accommodation and day-to-day expenses. Singers only begin making money once performances commence.

Considering that performance cancellations result in the total loss of the fee it is hardly surprising that there is a reluctance to pull out of performances.

Despite the press commentary regarding frequent cancellations, the majority of female singers do not cancel without very serious reasons. Almost all of the respondents in the present study report that they would not cancel a performance due to personal menstruation issues or personal illness. Neither would they cancel performances for illness of other members of the family, for example, children. It is clear from the responses that they self-medicate when ill and continue to sing.

The uptake of performing insurance is extremely low. Women admit to pushing their voices and one in three have acquired vocal faults, one in five have sustained a vocal injury. Considering the strong influence on vocal indisposition from the data arising from the SHE results these findings indicate that disregard for increases to the risk of injury due to hormonal influence and singing when the instrument is impaired can have serious consequences.

Stage injuries are also common. These women worry about aging. Insomnia which can affect vocal support and cause attentional issues is experienced by 25 women or 60% of those surveyed, obviously a cause for concern, although problems with insomnia and singers have been previously reported elsewhere, See chapter 2 Insomnia.

Women express feelings of being in a minority, they identify that positions of power are held predominately by men. Issues are voiced regarding negative trust at work, and not feeling willing to report problems when experiencing difficulties. Older women express feelings about being domestically encumbered and worry about being discarded in favour of younger fitter... less domestically complicated women. It is alternatively expressed by some, that singing work dries up after women have

children. Despite maintaining contact with teachers and coaches, a severe lack of awareness exists concerning any support organisations for performers amongst these singers.

The use of alternative or non-professional methods and treatments when seeking psychological or physical remedies is preferred. Friends, family and colleagues are consulted along with GP's and alternative therapists and psychologists. There is a large amount of engagement with therapists however, which suggests that psychological issues are taken seriously. However, half the women did not consult professional advice. As the majority of advice received came from unqualified sources, it may be unlikely that anxiety issues were completely resolved; therefore, general expressions of satisfaction with the effectiveness of advice suggests that singers look to methods which provide temporary relief.

It is admitted that there are issues with overusing medications when ill. Difficulties with music performance anxiety were expressed and levels chronic disease were evidenced at just under a quarter of all singers. The majority of chronic illness was treated by medications which affected voice production in 8 out of 10 of these women. It is curious that underactivity in relation to thyroid function should occur with frequency amongst individuals who experience high stress hormone levels over life-course. A total of 4 singers report suffering from hypothyroid complaints. However, thyroid issues are found regularly amongst middle aged women within the general population and this problem in relation to thyroid function is likely reflective of age-related disease and thus probably coincidental.[1] However, it has been

[1] Thyroid dysfunction affects approximately 15% of the population with a female-to-male predominance of 4:1, making it an exceedingly common endocrine disorder that is second only to diabetes. Voice users who suffer hyperthyroidism may present with an audible vocal tremor. Hypo-thyroid suffers may experience muffling of the voice, Julia A. Pfaff et al., 'Thyroid Disorders and their Treatments: What Singing Teachers Should Know', Journal of Singing 72 (2016), 578-579; Thyroid hormones effect metabolism and influence vocal timbre, when thyroid function is normal the

established that thyroid hormones are important neuroendocrine regulators which are affected by chronic stress.[2]

Overall the sample of singers displayed high degrees of personal professionalism which is reflected in expressions of problem solving, general levels of personal fitness and the frequent use of other stress relieving methods such as mindfulness and meditative techniques. Whilst it was reported by 34 respondents that perfection was very important in performances 30 women spent less than 10 hours per week practicing outside of normal rehearsals. This likely indicates that for the majority, adaptive type perfectionistic behavior, rather than maladaptive is being experienced.

Issues with conductors have been highlighted in previous studies.[3] Differing or unreliable tempos, lack of skill or unfamiliarity with repertoire leading to the orchestral sound being too loud, unjust critique or negative comments, all add to performance tension for singers who often feel the musical shaping is outside of their control. When considering the factors which influence the acquisition of MPA, loss of control is of significant importance. Conductors hold positions of authority and are often involved in the casting process. Due to crossover between performing disciplines, directors are occasionally more familiar working with straight actors and not classical singers. Directors may ignore or do not fully understand the requirement that singers may not wish to use their bodies in ways which compromise vocal support. As stage productions become increasingly more technical in nature,

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voice is dominated by sex hormones, oestrogens, progesterone, and androgens, Jean Abitbol 'Hormones and the voice', in Anthony F. Jahn (ed.), *The Singer's Guide to Complete Health* (2013), 116.

[2] Luciana Romina Frick et al., 'Involvement of Thyroid Hormones in the Alterations of T-Cell Immunity and Tumor Progression Induced by Chronic Stress', *Journal of Biological Psychiatry* 65 (2009), 935-942; Research suggests that thyroid hormones in the alteration of T-Cell immunity regulate tumour evolution and progression as induced and affected by chronic stress.

[3] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (2011), 276.

sometimes issues of safety (like ‘flying’) can create extra performance stress for singing actors. Likewise, choreographed fights and dying scenes can create considerable physical demands. Similar to situations arising from differences in artistic interpretations within the music, loss of control in staging decisions can result in compromised support and create anxious feelings for performers. Conductors and directors are often treated like superior beings within the music industry. This deferential treatment can cause some individuals to develop narcissistic traits. Like all career paths, certain personality types are often rewarded for this type of behaviour. The disparity in levels of respect that singers are accorded as musicians and actors amongst some conductors and directors, coupled with individual personality differences, can regularly result in discordant musical and stage relationships.

For singers, finding work and ensuring that companies will be nurturing environments and not exploitative regarding repetitive vocal use and suitability of roles offered is often challenging. Being asked to appear naked can put women under a huge amount of extra pressure. It was noted from this study that soloists assume all of the financial risk– paying for lessons, vocal coaching, travel, accommodation, auditions, agent fees, health, including care of voice and care of mental and physical fitness. Singers regard themselves as artists; the drive to perform, although linked to financial reimbursement, is not usually the principal motivator when embarking on performance careers. Singers are highly invested in the artistic nature of their art and gain satisfaction both from audience approval and from private evaluations of personal performance.

Considering the amount of time and money it takes to fully train a classical soloist it is hardly surprising that those who sing exclusively might feel unfit to undertake any

other work and chose to continue to perform despite experiencing dissatisfaction. Many singers simply do not wish to teach. Social status and 'identity' is of concern as much as maintaining revenue.

Issues with colleagues trying to compromise performances on stage, or simply that they were not competent in their own roles, added to the performance stress for soloists. As one respondent stated, the 'Shortcomings of others increases stress for singers. Focus and calm is vital.'[4] When considering the apparent frequency of alleged negative experiences perpetrated by and including colleagues, conductors, directors, casting control, company managers, vocal coaches and negative observations of a personal nature aimed at individual soloists by the critical press, it is hardly surprising that negative experiences involving work which were reported during this study are at the forefront of solo singers' concerns, and have influence regarding the acquisition of 'negative trust' issues between solo-singers, their colleagues and employers.

When it comes to critique from audience or critical press, solo singers must withstand comments not just about their singing and acting but also regarding other personal characteristics – including those regarding their personal appearance.

The British press was severely criticised internationally for the body-shaming comments which appeared about the young Irish mezzo-soprano Tara Erraught after her debut in *Der Rosenkavalier* at Glyndebourne in 2014.[5] Unfortunately, this occurs more frequently in modern times. The operatic product has begun to be marketed like the cinematic product. Indeed, live streaming and productions for cinema make opera

[4] Open Comment Respondent 2015054

[5] Gordon Rayner, 'Singers point the finger at critics in Glyndebourne Opera Festival sexism row', *The Telegraph* 21May 2014 <www.telegraph.co.uk/culture/music/opera/10845186/Singers-point... > [Accessed 24 May 2016].

not predominantly about singing or vocal talent but about creating spectacle. Casting decisions are more recently being made according to visual aesthetics.

The incident involving Tara Erraught illustrates singers protesting in defence of another singer, which created a firestorm of publicity that launched a global response. This was not an industry-led response, but was instigated by a number of committed high profile singers rallying to a colleague's defence. Their actions left these individuals subsequently vulnerable to critical backlash from those same music critics, who obviously did not enjoy the negative criticism when it was directed towards themselves. However, it is difficult to defend against unjust comments in the press. As with all professional performers, on occasion relations between solo singers and the musical press can become strained.

Implications

It is widely accepted that oral contraceptives have been instrumental in the empowerment of women. There are huge positives to be gained from the personal control of fertility. The refinement of oral contraceptives since they were first introduced has meant that they have less overt negative side effects for a higher portion of the population. Relief from other health ailments are also identified as a consequence of taking oral hormones, and the development of parallel treatments for other illnesses and diseases has greatly advanced medical knowledge, which in turn has helped millions of women.

Singers may feel that there are benefits to be derived from the use of contraceptives. Many singers are prescribed OC's to specifically help assist with voice problems. Vocal stability is reported to increase using contraceptives. Voice function can be

seriously altered during menstruation, especially for those who suffer from severe symptoms of PMS. It is advised that all who take contraceptive medications be closely monitored, as certain combinations of contraceptives can affect particular individuals by inducing depressed mood. Also, it is not fully known exactly what other implications arise for women, in other parts of the body other than the reproductive system when under the influence of contraceptive medications.

Given the levels of vocal injury reported by professionals, (1 in 5 women in this study) clearly, from a vocal health perspective, there are times when the prudent thing may be not to perform. Contrary to previous reporting, performers surveyed here possess a 'show must go on' mentality. In the case of female soloists, it is therefore suggested that perhaps system and attitudes towards cancellation, (due to the significant increased risks of injury for women during menstrual flow) may require an industry-wide review. Whilst some companies in Germany continue to observe 'Grace Days' and allow women two days off each month. Those singers who freelance cannot be assured that all companies observe the same care.

The cumulative impact of cognitive and physical overload and associated undesirable health implications are often exclusive to careers in the performing arts, and have relevance to the industry and broader musical community. These issues need to be addressed. However, training to ensure emotional wellness is not universally prioritised at collegiate level and in conservatory institutions where other performance skills are trained and refined. Recognising that to sustain a career over a period of many decades requires custodial skills involving coping with adversity ought to be recognised as part of training.

This study provides an analysis of data from singing professionals pertaining to an arts lifestyle which reports a deficit of knowledge regarding some important career skill-

sets. It is suggested these skills should be addressed with students and given as much priority within collaborations between students and teachers as the more traditional performance elements. Within the educational environment, the pursuit of therapeutic measures and treatments for MPA should be accepted, encouraged and openly discussed in an effort to diminish the stigmatising nature of these frequently-experienced performance issues. Given that modules in specific techniques, like Alexander Technique and Feldenkrais, are often provided within professional practice modules, it is suggested that a more integrative approach concerning emotional wellness–which incorporates new thinking regarding memory, mental imagery, narrative thinking, deconstruction, mindfulness and CBT for musicians – might provide practical training in self-efficacy going forward. More research into the specific tailoring of combinations of existing techniques could be attempted if educational institutions made the emotional wellness of their student cohort a priority within the educational syllabi and incorporated this training towards furthering curriculum development within their institutions. Further performance research, a core strength of education institutions, could be directed towards ameliorating these performance issues. Failing to recognise and address these issues as part of normal conservatory training, it is suggested, comes at far greater cost in the long run.

Fertility and pregnancy are considered important milestones affecting women over the duration of their stage careers. As previously indicated, almost half of the survey respondents had children. Two women were pregnant during the study. However, fertility decreases in the latter half of the thirties and many women find, when they are finally ready to begin a family, that their fertility has diminished and they require assistance. This is not a concern which is exclusive to female singers; many women

in the western world are leaving it later in life to start their families. However, it is especially relevant to women in the singing professions because fertility treatments can impact the voice and certainly can have considerable effects on emotions. Two women surveyed commented that they were about to embark on such treatments. This particular issue needs to be raised within the broader educational environment. These women tend to spend their early twenties finishing their education and trying to forge their reputations as solo performers. Many women in the profession remain oblivious to the impact these hormonal interventions might have in relation to their singing.

It may be important to take account of the role of hormones in fear processing amongst women when devising treatments or therapies to combat MPA in performers. This should be related both to age category and discrete chemical influence (with or without contraceptives). Therapies, especially those based on exposure would need to take account of the female hormonal situation.

Limitations of the study

The researcher recognises the issues with self-reporting measures. There are further drawbacks with regard to the size of the current sample and the research design. It is recommended further research be undertaken involving larger populations of performers. On this occasion it was not possible to obtain physical samples of actual levels of hormones in blood or saliva. This certainly is something which could be attempted in future studies.

There are some other mitigating factors to consider which limit the scope of the current study. Not every solo performance is equally stressful. The singer also considers the difficulty of, and familiarity with, the repertoire, role size, venue size,

perceived importance of audience and degree of exposure to critical evaluation when considering the degree to which performance stress is experienced. Rehearsal opportunities and exposure in a solo concert differ greatly from a rehearsed opera. Homogeneity in regard to the test stressor might be considered in future studies. Survey design was restricted due to the disparate locations of the research population, lack of funding, time constraints, and due to the work being carried out by a single researcher. The intended scope of this study was to discover if there is sufficient evidence to pursue future studies along this avenue of investigation.

Future research

Future isolated or comparative research might investigate issues concerning stress acquisition and vocal impairment in male singers.

There may be many reasons why female singers find it difficult to financially sustain solo singing careers: Traditionally there is gender imbalance between women and men in payments for work in the arts and indeed elsewhere; the seasonal nature of work – most operatic seasons occur in short bursts. There may be some months where artists have no engagements or concerts. It can be difficult being away from home on a full-time basis, once married with a family. There are perhaps societal expectations that women would not prioritise their careers once married. Issues of this nature concerning gender roles in western traditions cannot be disregarded. The number of professional singers who also teach means that incomes derived from solo performing do not sustain the majority of singers. Having diversified working endeavours, there is perhaps a subsequent opportunity cost involved in taking time away from the more consistent revenue of teaching in order to perform. Singing students expect teachers to make themselves fully available for lessons. Future studies investigating working

habits and payment structures for men and women in professional singing might be explored, including the typical age at retirement from operatic stage work of professionals of both genders. Loss of performing work precipitates different coping behaviours. In times of economic crisis, the impact of conserving of resources, including the decline in relation to performing work, may impact women slightly differently to men, according to Ünal-Karagüven (2009). This study supports the suggestion that this aspect of the career may require further investigation.[6] Women from this study seem to be proactive in adapting the balance of their incomes. It would be interesting in future studies to compare both male and female professional singers with regard to other employments during both expansive and retracting economic conditions.

Travel behaviours reported here raise some serious questions about excessive fatigue and personal safety amongst habitual performers. In future studies, it would be necessary to investigate both sexes and other performers within the wider music profession in order to get a clearer picture of whether this travel behaviour is the norm. It has been raised in previous studies, for example Harvey and Saxon (2003), that physical tiredness amongst singers is a serious risk which impacts vocal support and technique.[7] Extreme tiredness can also affect an individual's ability to deal with stressful situations. Carroll et al. (2016) indicate that inadequate quality and duration of sleep may impact the diurnal release of neuropeptides and can be a potential

[6] M. Hülya Ünal-Karagüven, 'Psychological Impact of an Economic Crisis: A Conservation of Resources Approach', *International Journal of Stress Management* 16 (2009), 177-194.
[7] Vocal consequences of fatigue included difficulty with breath support, reduced vocal endurance/voice tried easily, huskiness/roughness of the voice, greater time required to warm up and reduced ability to focus and concentrate, Pamela Harvey and Keith G. Saxon, 'Sleep and the Singer, Part 2', Journal of Singing 60 (2003), 168.

mechanism through which lack of sleep can accelerate biological aging and influence disease risk.[8]

Further research is recommended regarding the menstrual cycle involving stress reporting by women. In relation to research in professional singing. Day 2 of the menstrual cycle is broadly understood by singers to be most disruptive with regards the singing voice. Research in relation to voice parameters indicates that the menstrual cycle has an effect on the voice, with women's voices reporting changes over perhaps four phases: pre-menstruation, menstruation, post-menstruation and ovulation respectively.[9] The present study considers the menstrual cycle over three phases: menstruation, ovulation and pre-menstruation. Research involving stress reporting and hormone level over the menstrual cycle requires further detailed scrutiny. Further research involving vocal and emotional effects in populations undergoing fertility treatments, it is suggested, may help illuminate hormonal influences.

It is recommended that the influence of hormones be further investigated in relation to vocal function and fear both in women with normal menstrual cycles and women taking oral contraceptives. It is advised this be undertaken with much larger samples. It would be recommended that blood hormone levels be measured in relation to oestrogen and progesterone as part of this research and that synthetic hormones be further investigated in relation to fear processing.

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[8] Judith E. Carroll et al., 'Epigenetic aging and immune senescence in women with insomnia symptoms: Findings from the Women's Health Initiative Study Epigenetic Age and Insomnia', *Journal of Biological Psychiatry* (2016), 3, Article in Press 10 July 2016 http://dx.doi.org.dcu.idm.oclc.org/10.1016/j.biopsych.2016.07.008 [Accessed 25 August 2016].

[9] E. C. Tatar et al., 'Normative Values of Voice Analysis Parameters With Respect to Menstrual Cycle in Healthy Adult Turkish Women', *Journal of Voice* 29 (2015), 1-7. This study was submitted as an oral presentation at the 10th Congress of the European Laryngological Society, 9–12 April, 2014, Antalya, Turkey.<http://dx.doi.org.dcu.idm.oclc.org/10.1016/j.jvoice.2015.04.014 > [Accessed 12 December 2015]; D. A. Puts et al., 'Women's attractiveness changes with Estradiol and progesterone across the ovulatory cycle', *Journal of Hormones and Behavior* 63 (2013), 13–19 ; M. L. Shoup-Knox and R. N. Pipitone, 'Physiological changes in response to hearing female voices recorded at high fertility', *Journal of Physiology & Behaviour* 139 (2015), 386–392.

Previous reports of vocal effects involving hormonal contraceptives include swelling and thickening of vocal chords, vocal fatigue, dryness, and loss of range. The broader implications of hormonal contraceptive use within the female population with regard to anxiety acquisition requires detailed clinical research. As evidenced by this study hormonal contraceptives demonstrate significant relationships concerning perceptions of hormonal disruption, vocal impairment and anxiety. The influence of synthetic hormone; its function, (depressing the production of natural oestrogen), and the resultant impact on the female nervous system involving psyche would benefit from further behavioural and clinical tracing studies. Future research, it is suggested, ought to include other hormonal interventions, such as, emergency contraception and hormonal abortion, as the episodic use of these agents may prove to produce permanent consequences to the female brain and reproductive systems.

Androgen function with regard to fear processing in menopausal women would warrant further research. Clearly, in early menopause (again timing may be critical) androgens play a role in maintaining systems when levels of both oestrogens and progesterone are in decline. Obviously for professional voice users, androgens can cause masculinisation of the voice and are not recommended. It is important to understand the circumstances effecting the group who were predominantly experiencing menopausal effects as they are the least anxious. It is understood that the HPAA axis response is blunted in advanced pregnancy to protect the foetus from the effects of maternal stress.

Recommendations

Age related changes in stress perception should be considered when undertaking future research. Currently some studies do take this into consideration, however as mentioned previously, methods vary widely between studies. It is recommended that all future

studies investigating stress in performance take age into account and differentiate between women who are taking OCs or HRT and those who are not. The numbers of women in the western population who are routinely taking hormonal contraceptives in order to regulate their fertility is considerable.

The action of OCs in the body is not confined to the reproductive organs or the voice and it is not yet fully known if OCs permanently impact brain morphology or behaviour. For this reason, the researcher advises both menstrual cycle phase as well as the use of OCs be controlled for when studying sex differences in human behaviour, as these hormones modulate the response to stressful stimuli, brain structure and function. Given the suggested impact of hormonal contraceptives on fear extinction, these considerations should be factored in when developing directed treatments for women suffering from depression and anxiety. Certainly, should the effect of hormonal agents like contraceptives, emergency contraception, or hormonal abortion prove to cause permanent irreversible changes in the female hippocampus influencing behaviour, this may have far reaching implications regarding the evolutionary process.

Recapitulation of main findings

This study reports findings from a sample of 42 expert 'coping as best as possible', female singers. These singers are under the highest influence of performance stress as they are professional soloists. The sample reports high levels of physical fitness and the women engaged in many stress reducing techniques. However, 20 women, nearly half, report suffering from depression and more than half 24 individuals had experienced MPA. Post-natal depression occurred in 1 in 4 women who had children, significantly higher than in the general western population which reports incidences of

PND between 10 and 15 percent. Occupational vocal injuries were experienced by 9 women, roughly 1 in 5 of those surveyed. 3 women had undergone vocal surgery. A total of 8 singers had been physically injured due to on-stage accidents. The group report frequent negative experiences at work, including undermining behaviours from colleagues and sometimes management. Negative reporting by the critical press and negative receptions impact just under half the group, 19 women. This generates overall expressions of 'negative trust' between vocal performers and the industry. Singers expressed feeling pressure due to aging and are highly concerned about their personal appearance. Fear of being replaced by younger singers is regularly expressed. This indicates these women are seriously concerned about a lack of job security. The burden of family can limit participation in social networking, which is considered essential for self-promotion. It is necessary to audition for scarce employments in competition with singing colleagues. The costs of operating the career were considered unequally shared between industry and these professionals. The majority did not earn enough to comfortably sustain their family situation despite engaging in other work. A total of 33 women reported worry about lack of sufficient incomes. In all 26 singers admitted undertaking other work in addition to performing. Of these, 22 women taught singing. The women report shouldering the greatest responsibility for organisation in the home. They consider travelling late at night over great distances in order to return home. Women therefore are likely to experience time poverty between home and work. The unsocial nature of work and frequent travel away from home effects the ability to cultivate and maintain relationships with spouses, friends and family. Women report feeling lonely and isolated by the superficiality of the industry. It is interpreted, that generally women in the profession feel an overall lack of social support and perceive there is conflict between the demands of home and the demands of work. Chronic

illness affected 10 women, and medications prescribed to maintain health induced adverse voice effects in 8 of these singers. All of the women agreed that their hormones were important or very important. However, it was expressed that the added burden of hormonal influence on the instrument was not recognised by the majority of organisations in the industry. The experiences of women working freelance evidence that treatment of individual workers may vary considerably amongst companies. The classical western music industry is largely self-regulated and open to abuses.

The hypothesis that variations in personal hormone are reflected in expressions of MPA and singing voice impairment is strongly evidenced. Observations included voice and stress reporting effects across the menstrual cycle. It was observed that those taking oral contraceptives were the most disturbed by hormones and report the greatest voice impairment and anxiety. The women with the lowest disturbance from hormones were those either pregnant, menopausal or experiencing dysfunction. It may be argued that the situation of hormones is substantially different in pregnant women. When the pregnant women are excluded from the data the relationship between the variables remains the same. The women in group B who were not menstruating, being either menopausal or suffering from dysfunction, (low hormone disturbance), report similar voice impairment to the normal cycle group, however, menopausal women suffer the lowest levels of anxiety in performance. Thus, vocal impairment does not always induce anxiety amongst singers.

Conclusions

Considering what is known from previous research regarding occupation, hormonal influence, gender differences affecting women, health, medications, music performance anxiety and brain functioning–and using the exposome model to

understand environmental stress, and how these influencers interact with the body over life-course–with regards chronic type stress, every thought and feeling translates via chemical hormones interacting via neural networks between the brain and body. Therefore, environment has huge ramifications with regards to the dysregulation of health. The constraints of gender including the sometimes overlooked cultural and physical loading of motherhood and cumulative pressures (including the perceived lack of genuine social support) implies that being a professional performer involves operating in an environment which may be seriously damaging to the health of the majority of women.

Practical Implications

Increasing the awareness of organisational supports for all singers including free-lancing soloists is something which needs to be addressed within the private and public educational environment, amongst operatic companies, and the wider music industry. A list of predominantly U.K., Irish and American organisations which provide services is provided in Appendix F.

This research may benefit future studies regarding the influence of personal ovarian hormones and the physical and psychological concerns of elite female performers. The research may help highlight the importance of tailoring sex specific treatments relating to the management of MPA.

The research may be of benefit to the wider western female population and inform future research involving the behavioural effects of ovarian hormones, particularly the effects of medications, such as oral contraceptives which influence brain function. The research may illuminate further avenues of investigation for other researchers interested in factors relating to the acquisition of depression and disease.

Appendix A: Ethics Approval

ROYAL IRISH ACADEMY OF MUSIC **Research Project 2014/15**

BOARD OF STUDIES

RESEARCH ETHICS **Application No.** (*Office use only*)

Royal Irish Academy of Music

APPLICATION FOR APPROVAL OF A PROJECT INVOLVING **HUMAN PARTICIPANTS**

PROJECT TITLE	**Investigating how professional singers perceive the effects of fluctuating hormone levels in relation to their general health, vocal impairment, stress sensitivity and music performance anxiety**
PRINCIPAL INVESTIGATOR (S) *The named Principal Investigator is the person with primary responsibility for the research project. In the case of Taught Masters projects the supervisor is the Principal Investigator.*	**Imelda Drumm**
START AND END DATE	**20th November 2014 – end July 2015**
LEVEL OF RISK ***Please indicate whether the project requires (a) Expedited or (b) full committee review. Justification for your choice is required.***	**(a) Expedited** **There are no known risks associated with this research**

Please confirm that <u>all</u> supplementary information is included in your application (in electronic copy). Format amended from DCU research and information support content Sept 2014

My application has been collated as one electronic file which includes the following documentation:	INCLUDED (mark as YES)	NOT APPLICABLE (mark as N/A)
Bibliography	YES	
Recruitment advertisement		N/A
Plain language statement/information letter	YES	
Informed Consent form	YES	
Evidence of external approvals related to the research		N/A
Questionnaire/Survey	YES (Draft)	
Interview /Focus Group Questions		N/A
Debriefing material		N/A

1. ADMINISTRATIVE DETAILS

PROJECT TYPE: Research Project: Student
Quantitative and Qualitative Questionnaire
Research project PhDPerf

1.1 INVESTIGATOR CONTACT DETAILS

NAME: Denise Neary (Supervisor) RIAM DeniseNeary@riam.ie
NAME: Imelda Drumm (DMusperf –candidate)
Imeldadrumm@hotmail.com

(1.1) **Research will be conducted via email from home residence of student researcher via a password protected computer**

(1.2) **This protocol is not being submitted to another ethics committee and has not been previously submitted to an ethics committee**

DECLARATION BY PRINCIPAL INVESTIGATORS (S)

The information contained herein is, to the best of my knowledge and belief, accurate. I have read the current research ethics guidelines, and accept responsibility for the conduct and procedures set out in the attached application in accordance with DCU university guidelines, policy on Conflict of Interest, Code of Good Research Practice and any other condition laid down by the RIAM Board of Studies Committee. I have attempted to identify all risks related to the research that may arise in conducting this research and acknowledge my obligations and the rights of the participants.

I understand if there exists any affiliation or financial interest for researcher in this research or its outcomes or any other circumstances which might represent a perceived, potential or actual conflict of interest this should be declared in accordance with policy on Conflicts of Interests.

Principal investigator(s): _____

Print Name(s) here: _____

Date: _____

2. PROJECT OUTLINE

2.1 LAY DESCRIPTION

It is common for all professional musicians to experience music performance anxiety at some point during their careers. For some, the sensations are very debilitating. Others find ways to mitigate these anxious feelings. This research focuses on solo operatic female singers. Self-reporting by individuals as having suffered anxiety has been consistently high amongst the female performing population across performing disciplines. At puberty, hormonal change has been seen to produce both physical change in the vocal instrument and change in brain connectivity. Women singers' experience fluctuating hormonal influence affecting the instrument over every monthly cycle. A career performing, creates high levels of adrenaline. This is the bodies flight or fight response. How we perceive danger as females, influences the level of physical response to perceived threats. Over time constant heightened hormonal response to threatening stimuli can affect the immune system, alter our brains sensitivity to feelings of anxiety and affect overall health and wellbeing. Previous research in music performance anxiety has targeted student or chorus singer populations. Professional soloists are likely to experience consistently higher levels of performance stress. Because of the disparate nature of individuals, sufficient samples of professional solo artists have not thus far been enlisted for research purposes. These performers are the focus of this study. Participants will be asked to complete two short email questionnaires, the first upon recruitment, and the second on a day when they have a public performance.

2.2 AIMS AND JUSTIFICATION FOR THE RESEARCH

The research seeks to determine what occupational and life stressors (emotional and physical) influence female solo classical singers. How prevalent within this cohort is the experience of music performance anxiety. Further to this, it seeks to determine to what effect, if any, female hormones disturb personal perceptions about anxiety in performance and influence the perceived functioning of the vocal instrument. The research seeks to discover whether any consequences to health emerge as a result of heightened long term hormonal response to high stress over a lifetime participating in professional performance. It is hoped findings will show MPA (music performance anxiety) in relation to hormonal situation as experienced by female soloists. Should the findings reflect that female hormone heightens stress sensitivity and perceptions about vocal impairment this may be significant for directing future research and developing gender specific treatments designed at mitigating the experience of MPA. Problems identified due to the specifics of gender and physiology may further enhance the growing interrelatedness and sharing of research between sister disciplines concerned with the health and wellbeing of all performing music

professionals. The research would have relevance for curriculum development in educational institutions, industry responsibility in the care of singers participating in young artist programmes and on contract, and teachers involved in individual singing instruction. The research will attempt to quantify the incidence of illness and injury and raise awareness of health issues arising from high levels of prolonged personal and occupational stress and other general health and vocal health management issues over career duration for elite singers.

2.3 DESCRIBE THE METHODOLOGY BEING USED TO ACHIEVE YOUR STATE AIMS

All tasks will be completed and overseen by the researcher Imelda Drumm. A general background questionnaire measuring singers' experiences relating to environmental conditions within the industry, singing as an occupation for women, the impact of adverse personal life events on stress levels, coping techniques etc., will be administered in an effort to determine career challenges including the management of MPA and other health and hormonal issues over the lifetime of the singers career. This includes open ended questions for personal comments.

This preliminary questionnaire is in two parts and should take no more than 30-40 minutes to complete. The first part measures general questions as above and the second part will measure the trait anxiety of the participant (STAI) Spielberger et al., (1970).

A second questionnaire is included comprising four short parts, participants will be asked to complete it on the day of their next public performance. This should take no more than 12-15 minutes to complete. This element of the study seeks to quantify where possible, the music performance anxiety, stress sensitivity of hormonal influence and perceived singing voice handicap amongst solo operatic professionals. Previously validated research instrument's examining levels of self-reported state anxiety (STAI), Spielberger et al., (1970), music performance anxiety, (K-MPAI), Kenny,(2009), vocal injury/impairment, (S-VHI) Cohen et al., (2007) and hormonal effect, (SHE), Heinemann (2009), will be completed on a day of public performance by each soloist. The measurement of short term hormonal effect may highlight correlations regarding state anxiety, music anxiety and perceived vocal impairment under performance conditions. Following analysis of this survey, the participants will be assigned into smaller groups depending on their hormonal situation.

The research project should take participants no more than one hour of their time in total to complete. The data will be analysed by use of the IBM SPSS 21 statistical analysis programme. It is of interest to this research to see if those who self-report music performance anxiety, are affected by their situational hormones and perceived singing voice impairment. It is of interest whether anxiety is recorded in the absence of voice impairment and what, if any, are the effects of hormone on both anxiety and singing voice.

2.4 PARTICIPANT PROFILE

Participants are female classical soloists aged twenty years or over, with no upper age limit. The survey is open to those actively singing and those who may have already retired from large scale public performance but who continue to perform in public on a limited basis. The aim is to achieve a sample of at least one hundred participants. It is felt that with this sample size, it will be possible to achieve the stated aims. Due to the interest in fertility issues, gender is a specific focus of the research, all males are excluded and no children are involved.

2.4 (a) PARTICIPANT VULNERABILITY

Whilst there are no known risks to participating in this survey, the researcher is aware that some questions deal directly with feelings of stress and anxiety, both personal and performing. There will be no participants with diminished cognitive ability and no children will be asked to participate in the research. Participants will be asked in the initial survey if they have experienced any adverse emotional events. If any participant is deemed to be especially vulnerable to excessive distress during the research, they will have been informed, that they can at their request, be forwarded to specialist assistance for counselling support and treatment. Participants can withdraw from the research, without having to provide reasons. There are no known power issues between the researcher and prospective participants. In the unusual circumstance that any participant expresses significant emotional distress, the researcher will seek to provide appropriate support and may determine it best to exclude those participants from the research study.

2.5 EXPLAIN HOW THE PARTICIPANTS ARE TO BE RECRUITED

The researcher is herself a successful performing singer soloist in a career that has spanned over twenty years. During this time she has encountered hundreds of solo professionals with whom she has remained in contact. It is proposed that participants who are known to the researcher will be personally contacted via email and asked to participate. Those contacts may be in a position to further assist with other contacts that the researcher will then personally contact via email. Whilst it is acknowledged that this will not be a random sample, it will, by virtue that some participants may not be personally known to the researcher be a random sample of general acquaintance.

2.6 PLEASE EXPLAIN WHEN, HOW, WHERE AND TO WHOM RESULTS WILL BE DISSEMINATED, INCLUDING WHETHER PARTICIPANTS WILL BE PROVIDED WITH ANY INFORMATION AS TO THE FINDINGS OR OUTCOMES OF THE PROJECT?

The data will be reported in a doctoral thesis prepared by Imelda Drumm available in hard copy at the Royal Irish Academy of Music in Dublin and online via educational thesis registers, any data reported in research documents and publications will be presented in ways that do not identify any participants. Code names will be used throughout the study so that individual names do not appear in any electronic datasets or research reports. A summary of results will be offered to participants who will be asked to confirm whether they wish to receive this on their completion of the consent form and by providing an email so that they may be forwarded with this information.

2.7 ARE OTHER APPROVALS REQUIRED TO GAIN ACCESS TO ANOTHER LOCATION, ORGANISATION ETC.?

No other approvals are required to gain access to another locations or organisations.

2.8 HAS A SIMILAR PROJECT BEEN PREVIOUSLY APPROVED BY THE RIAM BOARD OF STUDIES?

No.

3. RISK AND RISK MANAGEMENT

3.1 JUSTIFICATION OF STATED LEVEL OF RISK TO RESEARCH PARTICIPANTS

There are no known risks caused by this study. However, there is a chance that the questionnaires may raise concerns about the participant's experiences of music performance anxiety. In the unusual circumstance that any participant were to experience significant worry and emotional distress, a referral to an appropriate support service may be arranged at their request.

DOES THE RESEARCH INVOLVE

	YES or NO
• use of questionnaire? (attach copy?)	Yes
• interviews (attach interview questions)?	No
• observation of participants without their knowledge?	No
• participant observation	No
• audio- or video-taping interviewees or events?	No
• Access to personal and/or confidential data (including student, patient, or client data) without the participant's specific consent?	No
• Administration of any stimuli, tasks, investigations or procedures which may be experienced by participants as physically or mentally painful, stressful or unpleasant during or after the research process?	No
• performance of any acts which might diminish the self-esteem of participants or cause them to experience embarrassment, regret or depression?	No
• investigations of participants involved in illegal activities?	No
• procedures that involve deception of participants?	No
• administration of any substance or agent?	No
• use of non-treatment placebo control conditions?	No
• collection of body tissue or fluid samples?	No
• collection and/or testing of DNA samples?	No
• participation in a clinical trial?	No
• administration of ionising radiation to participants?	No

3.1.1 POTENTIAL RISKS TO PARTICIPANTS AND RISK MANAGEMENT PROCEDURES

There are no known physical, social, legal or economic risks associated with this research, any psychological risks are likely to be minor and every effort will be made to minimise any psychological discomfort which might arise in the course of enquiries to participants. In the unusual circumstance that any participant would experience emotional distress, they can be referred at their request to appropriate specialist support.

3.2 ARE THERE LIKELY TO BE ANY BENEFITS (DIRECT OR INDIRECT) TO PARTICIPANTS FROM THIS RESEARCH?

No.

3.3 ARE THERE ANY SPECIFIC RISKS TO THE RESEARCHERS?

No.

3.4 DEALING WITH ADVERSE/UNEXPECTED OUTCOMES

There are no unexpected outcomes predicted, but if in the unlikely event any participant experiences undue emotional distress the researcher can refer them to a qualified psychotherapist. One such experienced professional is currently employed as a singing teacher at the RIAM and also has a personal psychotherapy practice.

3.5 HOW WILL THE CONDUCT OF THE PROJECT BE MONITORED?

The project will be supervised at all times by Denise Neary.

3.6 SUPPORT FOR PARTICIPANTS

Participants may be referred to a qualified psychotherapist.

3.7 DO YOU PROPOSE TO OFFER PAYMENT OR INCENTIVES TO PARTICIPANTS?

No.

3.8 DO ANY OF THE RESEARCHERS ON THIS PROJECT HAVE A PERSONAL, PHILOSOPHICAL, FINANCIAL OR COMMERCIAL INTEREST IN ITS OUTCOME THAT MIGHT INFLUENCE THE INTEGRITY OF THE RESEARCH, OR BIAS THE CONDUCT OR REPORTING OF THE RESEARCH, OR UNDULY DELAY OR OTHERWISE AFFECT THEIR PUBLICATION? No.

3.9 INVESTIGATORS' QUALIFICATIONS, EXPERIENCE AND SKILLS

Imelda Drumm holds a primary degree in Business Studies from DCU and has experience with statistical analysis programme SPSS. Imelda also has over twenty years international performance experience as a professional operatic soloist and has over five years' experience training young singers. It is felt that having this background she will be able to sufficiently identify and understand any emergencies, unexpected outcomes or contingencies that may arise.

4. CONFIDENTIALITY/ANONYMITY

4.1 WILL THE IDENTITY OF THE PARTICIPANTS BE PROTECTED?

Yes. The identities of participants will be protected at all times.

If you answered YES to 4.1, PLEASE ANSWER THE FOLLOWING QUESTIONS:

4.2 HOW WILL THE ANONYMITY OF THE PARTICIPANTS BE RESPECTED?

Code names will be used to protect the identity of source information so that no individual will be identified in electronic datasets or research reports and all data will be stored on a password-protected computer or on paper files in a locked filing cabinet in the residence of Imelda Drumm.

4.3 LEGAL LIMITATIONS TO DATA CONFIDENTIALITY

Whilst there are legal limits to Data confidentiality, (i.e., it is possible for the data to be subject to subpoena or freedom of information claim or mandated reporting of some professions) In the case of this research, it is deemed highly unlikely that the information being requested would be subject to such requests. However participants have been advised on the information and consent form that the data is subject to the requirements of law.

5. DATA/SAMPLE STORAGE, SECURITY AND DISPOSAL

5.1 HOW AND WHERE WILL THE DATA/SAMPLES BE STORED?

Password protected computer. Locked personal filing cabinet in personal residence. The researcher works predominately from home.

5.2WHO WILL HAVE ACCESS TO THE DATA/SAMPLES?

Imelda Drumm and project supervisor Denise Neary

5.3 IF DATA /SAMPLES ARE TO BE DISPOSED OF, PLEASE EXPLAIN HOW, WHEN AND BY WHOM THIS WILL BE DONE?

After a period of six years the data will be shredded and permanently erased.

6. FUNDING? This project is not funded.

7. PLAIN LANGUAGE STATEMENT

PLEASE CONFIRM WHETHER THE FOLLOWING HAVE BEEN ADDRESSED IN YOUR PLAIN LANGUAGE STATEMENT/INFORMATION SHEET FOR PARTICIPANTS:

	YES or NO
Introductory Statement (PL and researcher names, school, title of the research)	Yes
What is the research about?	Yes
Why is the research being conducted?	Yes
What will happen if the person decides to participate in the research study?	Yes
How will their data be protected?	Yes
How will the data be used and subsequently disposed of?	Yes
What are the legal limitations to data confidentiality?	Yes
What are the benefits of taking part in the research study (if any)?	Yes
What are the risks of taking part in the research study?	Yes
Confirmation that participants can change their mind at any stage and withdraw from the study	Yes
How will participants find out what happens with the project?	Yes
Contact details for further information (including contact details)	Yes

8. INFORMED CONSENT FORM

Yes.

Appendix B: First and Second Questionnaires

Consent Form

Doctoral Studies in Music Performance

THIS CONSENT FORM WILL BE HELD FOR A PERIOD OF SIX YEARS

Title of Project: Investigating how female professional singers perceive the effects of fluctuating hormone levels in relation to their general health, vocal impairment, stress sensitivity and music performance anxiety.

Researcher: **Imelda Drumm**

Participants: **Professional Operatic Soloists**

- I have read and understood the Participant Information sheet describing the aims and content of this study.
- I have had an opportunity to ask questions and have them answered.
- I understand that I am volunteering to take part in completing two questionnaires.
- I understand that the project involves a total of one hour of my time.
- I understand that my responses will be confidential and remain anonymous and protected within the limitations of the law.
- I understand that I may withdraw myself from the research at any time without giving reason.
- I understand that I am free to withdraw my information up to the time that I complete the final questionnaire, but that my responses cannot be withdrawn from the study after that time.
- I understand that, if the information I provide is included in any report or publication, it will be done in a way that does not identify me as its source.
- I agree to have my data stored in a password-protected database for a period of six years.

- I understand that a general summary of the results of this study will be sent to any participant if requested.
- I wish to receive a summary of results and have provided the researcher with a current mailing or emailing address to which to send it. ☐ Yes ☐ No
- I agree to take part in this research under the terms indicated in the Participant Information Sheet.

Participant's Name:	
Participant's signature:	
Date (dd/mm/yyyy)	/ /
Participant's email address	

In order to protect your privacy and to help with data analysis, we would like you to select a codename to use on the questionnaires. It can be any name you like – a pet's name, a favourite food, favourite teacher, or any other codename – as long as it is a name that will be easy for you to remember.

Please indicate your project codename below.

CODENAME:	

What follows is a general questionnaire consisting of 150 occupational and gender-specific questions. The boxes ☐ can be 'ticked' by clicking in the box ☒; a second click will 'un-tick' the box. Where text boxes are provided for a response, these will expand as you type, if more space is needed. This questionnaire should take you no more than 30-40 minutes to complete. If possible, can you set aside some time for completing this questionnaire when you know you are not going to be interrupted?

Thanks in advance. Imelda.

General Questionnaire

Date (dd/mm/yyyy)		/		/	

CODENAME:		*Number:*		*2015*

1. In what year were you born? ☐

2. Are you…?

☐ Single ☐ Married ☐ Separated ☐ Divorced ☐ Widowed

3. What is/was your voice type? [Tick the appropriate box (es).]

Soprano:	☐ Soubrette	☐ Coloratura	☐ Lyric	☐ Dramatic
Mezzo soprano:	☐ Light lyric	☐ Lyric	☐ Dramatic	
Contralto:	☐ Lyric	☐ Coloratura		

4. What sort of stage work do you normally do? [Tick the appropriate box (es).]

☐ Concert
☐ Oratorio
☐ Opera

5. In Opera, what type of roles do you normally sing? [Tick the appropriate box (es).]

☐ Title
☐ Supporting
☐ Small role / understudy
☐ Small role/ understudy and occasional chorus

6. Where have you worked? [Tick the appropriate box (es).]

☐ British Isles
☐ Europe
☐ U.S.A/ Canada
☐ Asia
☐ Global

7. Would you regard singing as your main income?

☐ Yes ☐ No

What, if any, other jobs do you do?

8. What route do you consider assisted you to 'make it' as a soloist?
[Tick the appropriate box (es).]

- ☐ Competitions
- ☐ College
- ☐ Audition
- ☐ Understudying
- ☐ Young Artist Programme
- ☐ Other (Please specify)

9. Would you still accept understudy work?

☐ Yes ☐ No

10. When understudying would you accept roles that suited you (voice, age, look, technique) or aspirational roles?

☐ Role that suited ☐ Aspirational

11. Did you ever feel pressurised by a company or agent to accept a role or understudy of a role that you felt you were not vocally ready for?

☐ Yes ☐ No

12. How would you rate your singing education in preparing you for life as an operatic artist?

- ☐ Excellent
- ☐ Good
- ☐ Satisfactory
- ☐ Less than satisfactory
- ☐ Poor

13. Do you continue to work regularly with a singing teacher or vocal coach?

☐ Frequently ☐ Occasionally ☐ Never

14. How often would you work with an accompanist repetiteur or language coach?

☐ Frequently ☐ Occasionally ☐ Never

15. How would you describe your personality?

☐ Extrovert ☐ Introvert ☐ Mixture ☐ Don't Know

16. How would you describe your stage persona?

☐ Confident ☐ Calm ☐ Nervous

17. Does/did the size of modern theatres affect your singing?

☐ Yes ☐ No

18. How confident are/were you normally that the conductor could get the balance right in the orchestra without you having to strain to be heard?

☐ Confident
☐ Somewhat confident
☐ Not confident
☐ Depends on the conductor

19. How often might/have you pushed your voice beyond what feels comfortable?

☐ Frequently
☐ Occasionally
☐ Never

20. When acting a role have you ever been asked to sing from a position which compromised your support/technique?

☐ Frequently
☐ Occasionally
☐ Never

21. Do/did you normally tour for work?

☐ Yes ☐ No

22. Do/did you have an agent?

☐ Yes ☐ No

23. How important do/did you rate the work of your agent?

- ☐ Extremely Important
- ☐ Very Important
- ☐ Somewhat Important
- ☐ Not Important
- ☐ Not of much use, but it's better than having no agent

24. What is/was your agent's most valuable role? (Order these roles by using numbers 1–6, where 1 is the most important.)

	Getting Work
	Talking to companies
	Dealing with clashes in your diary
	Financial Management
	Logistics
	Providing personal emotional support

25. If you manage your taxes yourself, do you employ the help of an accountant?

☐ Yes ☐ No

26. Has your income from singing always been sufficient to sustain yourself and your family?

☐ Yes ☐ No

Questions 27 to 60 to deal with personal fertility and family issues

27. What is/was the length of your normal reproductive cycle every month?

- ☐ Less than 28 days
- ☐ 28 -32 days
- ☐ More than 32 days
- ☐ Irregular
- ☐ Other Please specify

28. Do/did you take contraceptive medication?
(If 'No', skip to question 33.)

☐ Yes ☐ No

29. What were the main reasons for you choosing to take contraceptive medication?

☐ Fertility
☐ Vocal
☐ Other Please specify

30. What type of contraceptive do/did you take?

☐ Progesterone only ☐ Oestrogen/progestrone

Please specify.

31. Do/did you notice whether taking contraceptive medication affects your voice?

☐ Yes ☐ No ☐ Don't know

If 'Yes', please specify.

32. Do/did you notice any difference in your singing during menstruation/ovulation?

☐ Yes ☐ No

If 'Yes', please specify.

33. Have you ever cancelled a performance due to it being the 'wrong time of the month'?

☐ Yes ☐ No

34. Have you ever had fertility treatment?

☐ Yes ☐ No [If 'No', skip to Question 37.]

35. Did your fertility treatment have an effect on your voice?

☐ Yes ☐ No

36. Did your fertility treatment have an effect on your emotions?

☐ Yes ☐ No

37. Do you have any children?

☐ Yes ☐ No

38. If you answered‘Yes’to Q. 37, how many children do you have? ☐

39. If you answered ‘No’ to Q. 37, was not having children a deliberate choice in order to pursue your singing career?

☐ Yes ☐ No

If ‘No’ please select below

☐ Having children is just postponed until later.
☐ I would have liked children but it just did not happen.

If you do not have any children, please skip to Question 61.

40. Up to how many weeks prior to delivery of your baby/babies did you perform onstage or audition? (Tick all that apply and use 1, 2, 3, etc. to indicate the number of pregnancies.)

Number of Weeks	**Number of Pregnancies**
☐ 16 or more	☐
☐ 12-15	☐
☐ 8-11	☐
☐ 4-7	☐
☐ 2-3	☐
☐ 1	☐
☐ Other	☐
Please specify how many weeks ☐	

41. Did you experience any difficulties onstage whilst pregnant?

☐ Yes ☐ No

42. Which of the following were for you the most difficult aspects of singing professionally when pregnant? [Tick the appropriate box (es).]

☐ Breathing

☐ Acid Reflux

☐ Physical co-ordination

☐ Self-consciousness

☐ Other Please specify

43. Did you feel pressure, from work or family, to cancel work when pregnant?

☐ Yes ☐ No

44. Did you feel pressure, from work or family, to keep working when pregnant?

☐ Yes ☐ No

45. Do you feel your pregnancy had any effect on the quality of your voice?

☐ Yes ☐ No [If 'No', skip to Question 49.]

46. If you did notice a change in your voice, was this a permanent change?

☐ Yes ☐ No

If you did notice a change in your voice, please describe.

47. Do you regard the changes to your voice since your pregnancy positive or negative?

☐ Positive ☐ Negative

48. What was the method of delivery of your baby/babies? (Tick all that apply and use 1, 2, 3, etc. to indicate the number of pregnancies.)

Method of delivery	**Number of Pregnancies**
☐ Normal	
☐ Forceps	
☐ C-section	
☐ Suction cup	
☐ Other Please specify	

49. How long did you recover after the birth before returning to the stage? (Tick all that apply and use 1st, 2nd, 3rd, etc. in the box to differentiate between pregnancies.)

	Number of Weeks	Pregnancies
☐	16 or more	
☐	12-15	
☐	8-11	
☐	4-7	
☐	Less than 4	
☐	Other	

Please specify how many weeks

50. Who cares/cared for your children while you work? [Tick the appropriate box (es).]

- ☐ Spouse or partner
- ☐ Grandparents
- ☐ Other family
- ☐ Paid nanny or childminder
- ☐ Crèche
- ☐ Other Please specify

51. For how long a period normally would you be absent and away from the children while you were at work?

- ☐ One day
- ☐ Up to a week
- ☐ 2-3 weeks
- ☐ 4-5 weeks
- ☐ 6 weeks or more
- ☐ Other Please specify how long

52. Have you ever employed a nanny or family member to travel with you if travelling abroad with your children from where you normally reside, for work purposes?

☐ Yes ☐ No

53. Did you ever experience post natal depression?

☐ Yes ☐ No [If 'No' skip to Question 56.]

54. Did you continue to sing whilst recovering from post natal depression?

☐ Yes ☐ No

55. What did you find was the most difficult aspect of returning to work after having your baby/babies? [Tick the appropriate box (es).]

☐ Lack of sleep and fatigue
☐ Scheduling work vs home life
☐ Separation from the baby
☐ Physical recovery
☐ Other Please specify

56. Did you breastfeed your baby/babies?

☐ Yes ☐ No [If 'No', skip to Question 60.]

57. Was your working environment open to you having a baby at work for the purposes of breastfeeding?

☐ Yes ☐ No

58. Did you express milk for the baby whilst at work?

☐ Yes ☐ No

59. Did you ever cancel performances if your baby was ill?

☐ Yes ☐ No

60. How would you rate your general level of stress?

☐ High ☐ Medium ☐ Low

61. Would you describe your work life generally as full of success or failure?

☐ Success ☐ Failure

62. Would you say that you feel constantly stressed in your life or are you just stressed about performing?

☐ Constantly Stressed ☐ Not stressed ☐ Stressed about performing

63. Have you ever taken time off work due to stress?

☐ Yes ☐ No

64. Would you say that music performance anxiety is a problem for you?

☐ Yes ☐ No ☐ Sometimes [If 'No', skip to Question 73.]

65. Do eposides of anxiety ever have a visible or audible impact on your performance?

☐ Yes ☐ No ☐ Sometimes

66. Did you ever seek help about feelings of anxiety? If 'Yes', where did you seek help?

[If 'No', skip to Question 69.]

☐ Yes ☐ No

☐ Friend/ Family
☐ Colleague
☐ General practioner
☐ Alternative therapist/ psychologist
☐ Hypnotist
☐ Sibling
☐ Other Please specify

67. How effective do you feel was the help you received?

☐ Excellent
☐ Good
☐ Fair
☐ Poor

68. Have you felt that you were able to fully recover from acute stress episodes?

☐ Yes ☐ No ☐ Somewhat

69. Did you feel fearful about asking for help?

☐ Yes ☐ No

70. Did you make your performance anxiety public knowledge?

☐ Yes ☐ No

71. Do you continue to perform whilst suffering from feelings of acute anxiety?

☐ Yes ☐ No

72. Have you ever taken any drugs or medications to calm you whilst performing?

☐ Yes ☐ No

73. Are you currently on any anti-depressants, anxiolytic or beta blocking medications?

☐ Yes ☐ No

If 'Yes', please specify.

74. Do you practise any stress relieving methods? [Tick the appropriate box (es).]

☐ Meditation	☐ Yoga	Deep breathing
☐ Exercise	☐ Tai Chi	Progressive muscle relaxation
☐ Counselling	☐ Mindfulness	Feldenkrais method
☐ Alexander Technique	☐	

☐ Other Please specify

☐ None of the above

75. Have you felt under pressure to perform when ill?

☐ Yes ☐ No

- ☐ From yourself
- ☐ From companies
- ☐ From agents
- ☐ Other Please specify

76. Did pressure to perform when ill ever prompt you to over-use medications?

☐ Yes ☐ No

77. How much time per week do you devote to personal practice, outside of group rehearsals?

☐ Less than 10 hours ☐ More than 10 hours

78. How important to you is the pursuit of perfection in your singing?

☐ Very important ☐ Somewhat important ☐ Not important

79. Have you ever suffered a traumatic life event or loss – bereavement/divorce/ accident? [If 'No', skip to Question 82.]

☐ Yes ☐ No

80. Would you say you have been able to deal with traumatic life events?

☐ Yes ☐ No

81. How regularly would you be alone when working away from home?

☐ Always ☐ Mostly ☐ Sometimes ☐ Never

82. Does/did being alone for long periods impact your mood?

☐ Yes ☐ No

83. Have you ever suffered from depression?

☐ Yes ☐ No

84. Do you feel pressure or worry about a lack of work/funds as a consequence of pursuing a career as a professional singer?

☐ Sometimes ☐ Regularly ☐ Never

85. Have you ever accepted contracts too differently vocally or perhaps too soon after other work to properly memorise new roles?

☐ Sometimes ☐ Regularly ☐ Never

86. How seriously do you take negative performance feedback?

☐ Very Seriously ☐ Seriously ☐ Lightly ☐ Pay no heed

87. Has a bad review or negative audience reaction ever affected you in your subsequent performances of the same role or other roles?

☐ Yes ☐ No

88. In your emotional life would you say you feel happy?

☐ Always ☐ Usually ☐ Never

89. Who normally provides you with emotional support?

[Tick the appropriate box (es).]

☐ Parent
☐ Spouse/Partner
☐ Friends
☐ Colleagues
☐ Other Please specify

90. Did you or have you ever considered retiring from singing as a result of negative stage experiences? If 'Yes', what main issue(s) surrounded your contemplation of retirement?

☐ Yes ☐ No

- ☐ Age
- ☐ Income
- ☐ Family
- ☐ Anxiety on stage
- ☐ Injury
- ☐ Loss of voice
- ☐ Travel
- ☐ Other Please specify

91. What do you consider gives/gave you the will to continue performing?

☐ Myself ☐ Another person ☐ Professional support

92. Are you still performing and would like to stop, but feel you cannot?

☐ Yes ☐ No [If 'No', skip to Question 95.]

93. If you feel you have no choice about whether to stop singing, what are the reasons?

- ☐ Income
- ☐ Personal
- ☐ Family
- ☐ Other Please specify

94. Is menopause an issue for you as yet?

☐ Yes ☐ No [If 'No', skip to Question 98.]

95. If 'Yes', please specify below

☐ Pre-menopausal ☐ Menopausal ☐ Post-menopausal

96. Have you sought any medical help to assist with diminishing female hormone in order to prolong your vocal instrument and singing career?

☐ Yes ☐ No

97. What, for you, were the most debilitating symptoms of menopause?

98. Are you retired from professional operatic stage work?

☐ Yes ☐ No

If 'Yes', please specify how old you were when you retired.

99. As you matured over your lifetime, have you noticed any changes in the quality of your voice?

☐ Yes What were they?

☐ No

100. Do you suffer from any chronic illnesses, like asthma or diabetes, or any other illness?

☐ Yes Please describe:

☐ No

101. Are you taking any medication for your illness?

☐ Yes Please specify:

☐ No

102. Did/does your illness/medication affect your singing?

☐ Yes Please specify how:

☐ No

103. Would you regard yourself as being overweight?

☐ Yes ☐ No

104. Do you take regular exercise?

☐ Yes What exercise(s) do you do?

☐ No

105. Generally how often would you travel for work?

☐ Always ☐ Most of the time ☐ Sometimes ☐ Never

106. Tick which of the following forms of transport you regularly take/took to work. [Tick the appropriate box (es).]

☐ Bicycle
☐ Bus
☐ Car
☐ Tram /Metro
☐ Train
☐ Ferry
☐ Aeroplane

107. How long do/did you normally rest after flights before rehearsing /performing/ auditioning?

☐ A few hours ☐ Overnight ☐ More than 48 hours ☐ Depends

108. Do/did you make a distinction between rehearsing and performance when making decisions regarding your physical and vocal rest?

☐ Always ☐ Occasionally ☐ Never

109. How long does/did it normally take your voice to recover after singing a major role?

☐ One day ☐ Two Days ☐ More than two days

110. Would you fly on the day of performance before singing a major role?

☐ Regularly ☐ Sometimes ☐ Depends on role ☐ Never

111. How much of your working life is/was away from your home?

☐ All ☐ Mostly all ☐ Some ☐ None

112. Do/did you enjoy travelling for work?

☐ Yes ☐ No

113. When rehearsing an operatic production away from home, what type of accommodation have you normally stayed in?

☐ Hotel ☐ B&B ☐ House/Apartment ☐ Room Rent
☐ Other Please specify

114. Where do/did you normally stay when touring with operatic productions?

☐ Hotel ☐ B&B ☐ Rented House/Apartment

☐ Other Please specify

115. Do you normally enjoy performing in front of an audience?

☐ Yes ☐ No

116. Would you regularly socialise after performing?

☐ Yes ☐ No

117. Do you feel socialising after an event is an important aspect of self-promotion crucial to career development?

☐ Yes ☐ No

118. How often would you drink alcohol when socialising after performances?

☐ Always ☐ Frequently ☐ Sometimes ☐ Never

119. When on tour would/did you normally drive home after a performance if the drive was commutable?

☐ Yes ☐ No

120. What is the longest journey you have driven to get home after a performance?

☐ Less than 3 hours ☐ 3-4 hours ☐ 4-5 hours ☐ More than 5 hours

121. Have you ever lost your voice after singing a performance?

☐ Yes What do you think was the cause?

☐ No

122. Would you perform when in physical pain?

☐ Yes ☐ No ☐ Sometimes ☐ Regularly

123. What type of pain do you experience, or have you experienced, when performing?

124. How confident are you about your singing technique?

- ☐ Very confident
- ☐ Somewhat confident
- ☐ Not confident
- ☐ Nervous

125. Does/did your singing technique ever fail you?

☐ Yes ☐ No ☐ Sometimes ☐ All the time

126. Can you name any organisations that assist singers with injury/anxiety issues?

☐ Yes ☐ No [If 'No', skip to Question 128.]

127. Where did you hear about these organisations?

- ☐ Companies
- ☐ Colleagues
- ☐ Medical Profession
- ☐ Internet
- ☐ Other Please specify

128. Do you experience, or have you ever experienced, prolonged insomnia?

- ☐ Yes, frequently
- ☐ Yes, occasionally
- ☐ No

129. Have you ever switched facher during your career as a professional singer? If yes, how long did it take you to make the transition?

☐ Yes

Length of transition

☐ No

130. Have you ever suffered any vocal injury? What was the injury?

☐ Yes

What was the injury

☐ No [If 'No', skip to Question 136.]

131. What contributory factors do you regard caused you to suffer your vocal injury?

132. Did you seek medical or other advice regarding your vocal injury?

☐ Yes ☐ No

133. Did your injury require surgery?

☐ Yes ☐ No

134. What was the treatment?

135. Did your injury affect the tone or quality of your instrument and was this change permanent?

☐ Yes ☐ No

- ☐ Temporary
- ☐ Permanent

136. How important do you feel are your personal hormone levels as they influence the quality of your singing?

☐ Very important ☐ Important ☐ Somewhat important ☐ Not important

137. Has your voice developed any faults which you have been able to correct over your career?

☐ Yes

Please specify

☐ No

138. Have you ever been involved in an on-stage accident which caused you to be physically injured? If yes, what were your injuries? [If 'No', skip to Question 143.]

☐ Yes

Describe the injury.

☐ No

139. How long did it take you to fully recover from your physical injuries?

- ☐ Less than one week
- ☐ Less than one month
- ☐ More than one month
- ☐ More than three months
- ☐ More than six months
- ☐ Other Please specify

140. Did your work injury affect your ability to secure work after you had recovered?

☐ Yes ☐ No ☐ Don't know

141. Did the company involved offer you any compensation for your injuries?

☐ Yes ☐ No

142. Were you satisfied that the incident was handled in an appropriate manner by the company?

☐ Yes ☐ No

143. Do you have, or did you have, performance insurance to cover you for loss of earnings when ill?

☐ Yes ☐ No

144. Have you ever felt that you were personally targeted by harsh or unjustified critique when rehearsing or performing?

☐ Yes ☐ No

145. Would you say that you have experienced or seen any instances of abuse of power at work?

☐ Yes ☐ No

If Yes. From whom?

- ☐ Conductor
- ☐ Director
- ☐ Company manager
- ☐ Casting control
- ☐ Agent
- ☐ Other Please specify by job title.

146. Have you ever been approached by a company or director to appear naked or partially naked on stage to play your character in an opera production?

☐ Yes ☐ No

147. If rehearsing or performing abroad, would you/have you taken a flight home if you got a day off?

☐ Yes ☐ No

148. Would you say that your singing career has impacted your ability to remain in close contact regularly with your friends and family?

☐ Yes ☐ No

149. Has your career ever caused any difficulty between yourself and your partner/spouse?

☐ Yes ☐ No

150. Would you like to share any other thoughts about the challenges you have encountered during your career as a professional opera singer?

Please indicate when your next performance is due (so that I can send a reminder for the performance day questionnaire).

☐ 0-2 weeks ☐ 2-4 weeks ☐ 4-6 weeks ☐ 6-8 weeks

☐ Don't Know

Trait Questionnaire

Self- Evaluation Questionnaire

STAI Form Y-2

DATE (dd/mm/yyyy)		/		/	
CODENAME:					

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then make your selection by ticking the appropriate choice to indicate how you generally feel. There are no right and wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	Almost never	Sometimes	Often	Almost always
1. I feel pleasant.	☐	☐	☐	☐
2. I feel nervous and restless.	☐	☐	☐	☐
3. I feel satisfied with myself.	☐	☐	☐	☐
4. I wish I could be as happy as others seem to be.	☐	☐	☐	☐
5. I feel like a failure.	☐	☐	☐	☐
6. I feel rested.	☐	☐	☐	☐
7. I am 'calm, cool, and collected'.	☐	☐	☐	☐
8. I feel that difficulties are piling up so that I can't overcome them.	☐	☐	☐	☐
9. I worry too much over something that doesn't really matter.	☐	☐	☐	☐
10. I am happy.	☐	☐	☐	☐
11. I have disturbing thoughts.	☐	☐	☐	☐
12. I lack self-confidence.	☐	☐	☐	☐
13. I feel secure.	☐	☐	☐	☐
14. I make decisions easily.	☐	☐	☐	☐
15. I feel inadequate.	☐	☐	☐	☐
16. I am content.	☐	☐	☐	☐
17. Some unimportant thought runs through my mind and bothers me.	☐	☐	☐	☐
18. I take disappointments so keenly that I can't put them out of my mind and that bothers me.	☐	☐	☐	☐
19. I am a steady person.	☐	☐	☐	☐
20. I get in a state of tension or turmoil as I think over my recent concerns.	☐	☐	☐	☐

Please complete the following on a day when you have a public performance, ensuring that you have up to 15 minutes where you will not be interrupted. It does not matter if the performance is not operatic, just that you are doing something which requires your vocal solo and your day is centred on your performance.

By clicking in the appropriate box for each item, a tick mark is displayed. If you change your mind, click in the box again to remove the tick mark.

There are no wrong answers.

Please indicate the setting, (venue) and what you are singing today, on the bottom of the first page.

Thank you for agreeing to take part in the research! Imelda.

State Questionnaire (pre-performance)

Self- Evaluation Questionnaire

STAI Form Y-1

CODENAME: Date:

DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then make your selection by ticking the appropriate box to indicate how you feel right now, that is, at this moment. There are no right and wrong answers. Do not spend
too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not at all	Somewhat	Moderately so	Very much so
1. I feel calm	☐	☐	☐	☐
2. I feel secure	☐	☐	☐	☐
3. I am tense	☐	☐	☐	☐
4. I feel strained	☐	☐	☐	☐
5. I feel at ease	☐	☐	☐	☐
6. I feel upset	☐	☐	☐	☐
7. I am worrying over possible misfortunes	☐	☐	☐	☐
8. I feel satisfied	☐	☐	☐	☐
9. I feel frightened	☐	☐	☐	☐
10. I feel comfortable	☐	☐	☐	☐
11. I feel self-confident	☐	☐	☐	☐
12. I feel nervous	☐	☐	☐	☐
13. I am jittery	☐	☐	☐	☐
14. I feel indecisive	☐	☐	☐	☐
15. I am relaxed	☐	☐	☐	☐
16. I feel content	☐	☐	☐	☐
17. I am worried	☐	☐	☐	☐
18. I feel confused	☐	☐	☐	☐
19. I feel steady	☐	☐	☐	☐
20. I feel pleasant	☐	☐	☐	☐

In relation to today's performance, please indicate:

Where it is taking place	☐	Concert hall	☐	Church	☐	Opera house	☐	Other*
What type of singing	☐	Concert	☐	Oratorio	☐	Operatic role	☐	Other*
How large is your part	☐	Small	☐	Medium	☐	Large		
What type of venue	☐	Small	☐	Medium	☐	Large		

* If 'Other' please comment in the space below.

(K -MPAI) Music Performance (pre-performance) Note: * (-) = Reverse scored

(For these questions, please indicate the degree to which you disagree/agree with that question or statement by ticking the
appropriate box.)

	Strongly Disagree	***Somewhat Disagree***	***Disagree***	***Neutral***	***Agree***	***Somewhat Agree***	***Strongly Agree***
1. I often feel that I am not worth much as a person.	☐	☐	☐	☐	☐	☐	☐
2. Sometimes I feel depressed without knowing why.	☐	☐	☐	☐	☐	☐	☐
3. I often feel that I have nothing to look forward to.	☐	☐	☐	☐	☐	☐	☐
4. I often feel that life has not much to offer me.	☐	☐	☐	☐	☐	☐	☐
5. I often find it difficult to work up the energy to do things.	☐	☐	☐	☐	☐	☐	☐
6. Sometimes I feel anxious for no particular reason.	☐	☐	☐	☐	☐	☐	☐
7. I worry that one bad performance may ruin my career.	☐	☐	☐	☐	☐	☐	☐
8. I am often concerned about a negative reaction from the audience.	☐	☐	☐	☐	☐	☐	☐
9. I find it easy to trust others. (-)*	☐	☐	☐	☐	☐	☐	☐
10. Thinking about the evaluation I may get interferes with my performance.	☐	☐	☐	☐	☐	☐	☐
11. During a performance I find myself thinking about whether I will get through it.	☐	☐	☐	☐	☐	☐	☐
12. I often prepare for a concert with a sense of dread and impending disaster.	☐	☐	☐	☐	☐	☐	☐
13. Even in the most stressful performance situations, I am confident that I will perform well. (-)*	☐	☐	☐	☐	☐	☐	☐
14. My worry and nervousness about my performance interferes with my focus and concentration.	☐	☐	☐	☐	☐	☐	☐
15. Even if I work hard in preparation for a performance, I am likely to make mistakes.	☐	☐	☐	☐	☐	☐	☐
16. Prior to, or during a performance, I experience increased heart rate like pounding in my chest.	☐	☐	☐	☐	☐	☐	☐
17. Prior to, during a performance, I experience shaking or trembling or tremor.	☐	☐	☐	☐	☐	☐	☐
18. Prior to, or during a performance I feel sick or faint or have a churning in my stomach.	☐	☐	☐	☐	☐	☐	☐
19. Prior to, or during a performance, I get feelings akin to panic.	☐	☐	☐	☐	☐	☐	☐
20. Prior to, or during a performance, I have increased muscle tension.	☐	☐	☐	☐	☐	☐	☐

	Strongly Disagree	*Somewhat Disagree*	*Disagree*	*Neutral*	*Agree*	*Somewhat Agree*	*Strongly Agree*
21. Prior to, or during a performance, I experience dry mouth.	☐	☐	☐	☐	☐	☐	☐
22. I remain committed to performing even though it terrifies me.	☐	☐	☐	☐	☐	☐	☐
23. My parents were mostly responsive to my needs. (-)*	☐	☐	☐	☐	☐	☐	☐
24. My parents listened to me. (-)*	☐	☐	☐	☐	☐	☐	☐
25. My parents encouraged me to try new things. (-)*	☐	☐	☐	☐	☐	☐	☐
26. When performing without music, my memory is reliable. (-)*	☐	☐	☐	☐	☐	☐	☐
27. I am confident singing from memory. (-)*	☐	☐	☐	☐	☐	☐	☐
28. After the performance I replay it in my mind over and over	☐	☐	☐	☐	☐	☐	☐
29. I worry so much before a performance, I cannot sleep.	☐	☐	☐	☐	☐	☐	☐
30. One or both my parents were overly anxious.	☐	☐	☐	☐	☐	☐	☐
31. Excessive worrying is a characteristic of my family.	☐	☐	☐	☐	☐	☐	☐
32. As a child I often felt sad.	☐	☐	☐	☐	☐	☐	☐
33. I am concerned about my own judgement of how well I will perform.	☐	☐	☐	☐	☐	☐	☐
34. After the performance, I worry about whether I sang well enough.	☐	☐	☐	☐	☐	☐	☐
35. I am concerned about being scrutinized by others.	☐	☐	☐	☐	☐	☐	☐
36. I generally feel in control of my life. (-)*	☐	☐	☐	☐	☐	☐	☐
37. I never know before a concert whether I will perform well.	☐	☐	☐	☐	☐	☐	☐
38. I give up worthwhile performance opportunities due to anxiety.	☐	☐	☐	☐	☐	☐	☐
39. I find it difficult to depend on others.	☐	☐	☐	☐	☐	☐	☐
40. From early in my music studies, I remember being anxious about performing.	☐	☐	☐	☐	☐	☐	☐

SHE Questionnaire - Hormone Effect

Self-Evaluation Questionnaire

Did one or more of the following symptoms/complaints apply to you during the last month and if so, how frequent, severe, intense, or strong was it?

Please tick the appropriate box for each symptom. If items 10, 11 and 12 do not apply to you, i.e. if you have no menstrual bleeding, tick the boxes marked "NB" (= no bleeding) and do not answer in the "No" or "Yes" coloured section. If you normally experience menstrual flow, answer in the coloured section. Please check each line.

Complaints or symptoms		Not/Never (= No)	Applied to me (= Yes) Please indicate how severe, intense or strong?			
			Mild	Moderate	Severe	Very severe
1. Had depressive mood (feeling down, sad, on the verge of tears, mood swings)		☐	☐	☐	☐	☐
2. Felt worried (anxious, feeling panicky)		☐	☐	☐	☐	☐
3. Felt restless or irritable (nervousness, feeling fidgety, inner tension, easily upset about little things)		☐	☐	☐	☐	☐
4. Experienced increase in appetite, sometimes food craving		☐	☐	☐	☐	☐
5. Felt that my weight increased		☐	☐	☐	☐	☐
6. Observed swelling of extremities (arms, legs)		☐	☐	☐	☐	☐
7. Experienced abdominal pain attacks (underbelly)		☐	☐	☐	☐	☐
8. Observed cramps of guts or bladder		☐	☐	☐	☐	☐
9. Observed cyclic bleedings from gut or bladder		☐	☐	☐	☐	☐
10. Had strong menstrual bleeding	**NB** ☐	☐	☐	☐	☐	☐
11. Had painful menstrual period	**NB** ☐	☐	☐	☐	☐	☐
12. Had significant premenstrual complaints that improved when menstrual flow began	**NB** ☐	☐	☐	☐	☐	☐
13. Had less sexual fantasies or thoughts		☐	☐	☐	☐	☐
14. Had less satisfaction or enjoyment with the sexual act		☐	☐	☐	☐	☐
15. Observed reduced sexual arousal		☐	☐	☐	☐	☐

*Choose **one** below which applies to you.*

a. I am menopausal.	☐
b. Please indicate what day of the month you are today in your normal monthly cycle.	
c. If on contraceptives, please indicate what day of the month you are today in your cycle.	

S-VHI Singing Voice

Self- Evaluation Questionnaire

S – VHI, Singing Voice Handicap Index

These are statements that many people have used to describe their singing and the effects of their singing on their lives. Circle the response that indicates how frequently you have had the same experience in the last month.

		Never	Almost never	Sometimes	Almost always	Always
1.	It takes a lot of effort to sing	☐	☐	☐	☐	☐
2.	My voice cracks and breaks	☐	☐	☐	☐	☐
3.	I am frustrated by my singing	☐	☐	☐	☐	☐
4.	People ask “What is wrong with your voice?” when I sing	☐	☐	☐	☐	☐
5.	My ability to sing varies from day to day	☐	☐	☐	☐	☐
6.	My voice “gives out” on me while I am singing	☐	☐	☐	☐	☐
7.	My singing voice upsets m	☐	☐	☐	☐	☐
8.	My singing problems make me not want to sing/perform	☐	☐	☐	☐	☐
9.	I am embarrassed by my singing	☐	☐	☐	☐	☐
10.	I am unable to use my “high voice”.	☐	☐	☐	☐	☐
11.	I get nervous before I sing because of my singing problems	☐	☐	☐	☐	☐
12.	My speaking voice is not normal	☐	☐	☐	☐	☐
13.	My throat is dry when I sing	☐	☐	☐	☐	☐
14.	I’ve had to eliminate certain songs from my singing performances	☐	☐	☐	☐	☐
15.	I have no confidence in my singing voice	☐	☐	☐	☐	☐
16.	My singing voice is never normal	☐	☐	☐	☐	☐
17.	I have trouble making my voice do what I want it to do	☐	☐	☐	☐	☐
18.	I have to “push it” to produce my voice when singing	☐	☐	☐	☐	☐
19.	I have trouble controlling the breathiness in my voice	☐	☐	☐	☐	☐
20.	I have trouble controlling the raspiness in my voice	☐	☐	☐	☐	☐
21.	I have trouble singing loudly	☐	☐	☐	☐	☐
22.	I have difficulty staying on pitch when I sing	☐	☐	☐	☐	☐
23.	I feel anxious about my singing	☐	☐	☐	☐	☐
24.	My singing sounds forced	☐	☐	☐	☐	☐

		Never	Almost never	Sometimes	Almost always	Always
25.	My speaking voice sounds hoarse after I sing	☐	☐	☐	☐	☐
26.	My voice quality is inconsistent	☐	☐	☐	☐	☐
27.	My singing voice makes it difficult for the audience to hear me	☐	☐	☐	☐	☐
28.	My singing makes me feel handicapped	☐	☐	☐	☐	☐
29.	My singing voice tires easily	☐	☐	☐	☐	☐
30.	I feel pain, tickling, or choking when I sing	☐	☐	☐	☐	☐
31.	I am unsure of what will come out when I sing	☐	☐	☐	☐	☐
32.	I feel something is missing in my life because of my inability to sing	☐	☐	☐	☐	☐
33.	I am worried my singing problems will cause me to lose money	☐	☐	☐	☐	☐
34.	I feel left out of the music scene because of my voice	☐	☐	☐	☐	☐
35.	My singing makes me feel incompetent	☐	☐	☐	☐	☐
36.	I have to cancel performances, singing engagements, rehearsals, or practices because of my singing	☐	☐	☐	☐	☐

Appendix C: Data-Sets Results

Figure 38. Mean & Standard Deviation: Full Cohort (N=42)

Descriptive Statistics – Full Cohort [N = 42]					
	S-VHI	SHE	K-MPAI	TA	SA
Mean	41.26	28.10	95.21	44.90	44.14
Standard Deviation	12.60	10.17	35.73	3.93	5.19

The correlations were extracted on the full set of totals for each of the research instruments S-VHI, SHE, K-MPAI, STAI/ Y-2 (TAQ_Sum), STAI/ Y-1(SAQ_Sum), Figure 39 below.

Figure 39. Correlation: S-VHI, SHE, K-MPAI, TRAIT, STATE (N=42)

Correlations – Full Cohort [N = 42]						
		S-VHI	SHE	K-MPAI	TA	SA
S-VHI	Pearson Correlation	1	.431**	.432**	.186	.038
	Sig. (2-tailed)		.004	.004	.239	.812
SHE	Pearson Correlation	.431**	1	.650**	.080	.009
	Sig. (2-tailed)	.004		.000	.617	.957
K-MPAI	Pearson Correlation	.432**	.650**	1	.168	-.103
	Sig. (2-tailed)	.004	.000		.289	.518
TA	Pearson Correlation	.186	.080	.168	1	.124
	Sig. (2-tailed)	.239	.617	.289		.434
SA	Pearson Correlation	.038	.009	-.103	.124	1
	Sig. (2-tailed)	.812	.957	.518	.434	

** Correlation is significant at the 0.01 level (2-tailed).

Figure 40. Mean & Standard Deviations: Normal Cycle – Subset A (N = 22)

Descriptive Statistics – Subset A [N = 22]					
	S-VHI	**SHE**	**K-MPAI**	**TA**	**SA**
Mean	40.95	31.18	101.36	44.82	44.14
Standard Deviation	14.22	10.02	39.00	4.08	5.50

Figure 41. Correlations A: S-VHI, SHE, K-MPAI, TRAIT, STATE (N=22)

Correlations – Subset A (Normal Cycle) [N = 22]						
		S-VHI	**SHE**	**K-MPAI**	**TA**	**SA**
S-VHI	Pearson Correlation	1	.485*	.535*	.212	.177
	Sig. (2-tailed)		.022	.010	.344	.430
SHE	Pearson Correlation	.485*	1	.615**	.025	.161
	Sig. (2-tailed)	.022		.002	.911	.473
K-MPAI	Pearson Correlation	.535*	.615**	1	.057	-.084
	Sig. (2-tailed)	.010	.002		.802	.710
TA	Pearson Correlation	.212	.025	.057	1	.116
	Sig. (2-tailed)	.344	.911	.802		.608
SA	Pearson Correlation	.177	.161	-.084	.116	1
	Sig. (2-tailed)	.430	.473	.710	.608	

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Figure 42. Mean and Standard Deviations: Subset B – P/M/D (N = 10)

Descriptive Statistics – Subset B [N = 10]					
	S-VHI	**SHE**	**K-MPAI**	**TA**	**SA**
Mean	14.60	22.80	90.10	44.20	45.00
Standard Deviation	7.44	7.00	35.19	4.10	4.69

Figure 43. Correlations B: S-VHI, SHE, K-MPAI, TRAIT, STATE (N=10)

Correlations – Subset B (P/M/Dys) [N = 10]						
		S-VHI	**SHE**	**K-MPAI**	**TA**	**SA**
S-VHI	Pearson Correlation	1	-.260	-.462	-.652*	.086
	Sig. (2-tailed)		.469	.179	.041	.813
SHE	Pearson Correlation	-.260	1	.743*	-.304	-.287
	Sig. (2-tailed)	.469		.014	.393	.421
K-MPAI	Pearson Correlation	-.462	.743*	1	.255	-.053
	Sig. (2-tailed)	.179	.014		.477	.885
TA	Pearson Correlation	-.652*	-.304	.255	1	.416
	Sig. (2-tailed)	.041	.393	.477		.232
SA	Pearson Correlation	.086	-.287	-.053	.416	1
	Sig. (2-tailed)	.813	.421	.885	.232	

* Correlation is significant at the 0.05 level (2-tailed).

Figure 44. Mean & Standard Deviations: Subset C – Contraceptives (N = 10)

Descriptive Statistics – Subset C [N = 10]					
	S-VHI	**SHE**	**K-MPAI**	**TA**	**SA**
Mean	18.6	26.6	86.8	45.8	43.3
Standard Deviation	13.63	11.45	28.78	3.65	5.33

Figure 45. Correlations C: S-VHI, SHE, K-MPAI, TRAIT, STATE (N=10)

Correlations – Subset C (Contraceptive) [N = 10]						
		S-VHI	**SHE**	**K-MPAI**	**TA**	**SA**
S-VHI	Pearson Correlation	1	.643*	.846**	.593	-.279
	Sig. (2-tailed)		.045	.002	.071	.434
SHE	Pearson Correlation	.643*	1	.732*	.450	-.091
	Sig. (2-tailed)	.045		.016	.192	.803
K-MPAI	Pearson Correlation	.846**	.732*	1	.524	-.253
	Sig. (2-tailed)	.002	.016		.120	.481
TA	Pearson Correlation	.593	.450	.524	1	-.054
	Sig. (2-tailed)	.071	.192	.120		.883
SA	Pearson Correlation	-.279	-.091	-.253	-.054	1
	Sig. (2-tailed)	.434	.803	.481	.883	

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Figure 46. Descriptive Statistics: Subset A – Normal Cycle (N=22)

Descriptive Statistics – Subset A Normal Cycle [N = 22]					
	S-VHI	**SHE**	**K-MPAI**	**TA**	**SA**
Mean	40.95	31.18	101.36	44.82	44.14
Standard Deviation	14.22	10.02	39.00	4.08	5.50
Kurtosis	9.101158	0.950492	1.028714	-0.69047	-0.5134
Skewness	2.519006	1.190946	0.58319	-0.16167	-0.24364
Range	68	36	178	15	20
Minimum	26	19	25	36	34
Maximum	94	55	203	51	54

Figure 47. Descriptive Statistics: Subset B – P/M/D (N=10)

Descriptive Statistics – Subset B P/M/DYS [N = 10]					
	S-VHI	**SHE**	**K-MPAI**	**TA**	**SA**
Mean	14.60	22.80	90.10	44.20	45.00
Standard Deviation	7.44	7.00	35.19	4.10	4.69
Kurtosis	-0.48295	-1.09081	1.673117	-0.50518	1.074675
Skewness	0.378387	0.564542	-0.43946	0.459983	1.13061
Range	23	19	133	13	15
Minimum	3	15	18	38	40
Maximum	26	34	151	51	55

Figure 48. Descriptive Statistics: Subset C – Contraceptive Cycle (N=10)

Descriptive Statistics – Subset C Contraceptive [N = 10]					
	S-VHI	**SHE**	**K-MPAI**	**TA**	**SA**
Mean	18.6	26.6	86.8	45.8	43.3
Standard Deviation	13.63	11.45	28.78	3.65	5.33
Kurtosis	-1.34306	1.774532	-0.18695	2.222812	-1.26177
Skewness	0.268094	1.548743	-0.14979	-0.60827	0.406476
Range	39	36	96	14	15
Minimum	1	16	39	38	36
Maximum	40	52	135	52	51

Figure 49. Results of ANOVA Analysis of Variance N=42

Analysis of Variance (ANOVA) [N = 42]						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
S-VHI	Between Groups	84.365	2	42.182	.256	.775
	Within Groups	6419.755	39	164.609		
	Total	6504.119	41			
SHE	Between Groups	512.346	2	256.173	2.679	.081
	Within Groups	3729.273	39	95.622		
	Total	4241.619	41			
K-MPAI	Between Groups	1801.481	2	900.740	.695	.505
	Within Groups	50543.591	39	1295.990		
	Total	52345.071	41			
TA	Between Groups	13.146	2	6.573	.413	.664
	Within Groups	620.473	39	15.910		
	Total	633.619	41			
SA	Between Groups	14.452	2	7.226	.259	.773
	Within Groups	1088.691	39	27.915		
	Total	1103.143	41			

Figure 50. Results of ANOVA Excluding Pregnant Women (N=40)

ANOVA Analysis of Variance [N = 40]						
		Sum of Squares	df	Mean Square	F	Sig.
S-VHI	Between Groups	74.520	2	37.260	.216	.806
	Within Groups	6368.855	37	172.131		
	Total	6443.375	39			
SHE	Between Groups	425.227	2	212.614	2.126	.134
	Within Groups	3700.548	37	100.015		
	Total	4125.775	39			
K-MPAI	Between Groups	1557.409	2	778.705	.577	.566
	Within Groups	49897.566	37	1348.583		
	Total	51454.975	39			
TA	Between Groups	13.027	2	6.514	.397	.675
	Within Groups	607.748	37	16.426		
	Total	620.775	39			
SA	Between Groups	9.709	2	4.855	.170	.844
	Within Groups	1054.191	37	28.492		
	Total	1063.900	39			

Note: The ANOVA of variance without the two pregnant women does not alter the conclusion that in the case of S-VHI and K-MPAI the *within* group variance is greater than the *between* group variance. SHE hormone variance *between* the groups is greater than *within* the groups. Differences in S-VHI and K-MPAI are accounted for within the conditions NC, Menopause/dysfunction and OC use.

Appendix D: Resources for Singers – MPA Management and Treatments

What is presented here is intended to be a brief explanation of terms and an overview of current treatment options and performance strategies which are available to help singers manage issues with performance anxiety. It is not intended to be exhaustive nor will it provide in-depth analysis of each method, but will merely state briefly and explain what each method entails and perhaps comment in a generalised way regarding the efficaciousness of the treatments. Many of the following approaches to managing anxiety may be adapted for use in the voice studio and assist in further developing teaching methods.[1]

There are numerous factors relevant to anxiety development amongst individuals. Some of these are related to personal traits.[2] When dealing with debilitating symptoms there is a strong bias in clinical communities and within the research towards cognitive behavioural therapies (CBT) to treat anxiety disorders and depression. However, treatment options need to be both effective and cost-effective. As a result, mental health providers have concentrated on short-term symptom focused, manualised therapies to treat those presenting in their clinics. Problems with this type of approach, based on symptoms, are the growing concerns related to

[1] Heather Hunnicutt and Scott A. Winter, 'Musical Performance Anxiety: Adapting Psychotherapy Techniques of Desensitization to the Voice Studio, Part 1', *Journal of Singing* 67 (2011), 331-336; Heather Hunnicutt and Scott A. Winter, 'Musical Performance Anxiety: Adapting Psychotherapy Techniques of Cognitive Restructuring to the Voice Studio, Part 2', *Journal of Singing* 67 (2011), 445-450; Heather Hunnicutt and Scott A. Winter, 'Musical Performance Anxiety: Adapting Multiple Cognitive Behaviour Therapy Techniques to the Voice Studio, Part 3', *Journal of Singing* 68 (2011), 67-73.

[2] Kevin J. Eschleman et al., 'A Meta-Analytic Examination of Hardiness', *International Journal of Stress Management',* 17 (2010), 277-307; Hasida Ben-Zur, 'Coping Styles and Affect', *International Journal of Stress Management* 16 (2009), 87-101; M. Rutter, 'Resilience in the face of adversity. Protective factors and resistance to psychiatric disorder', *The British Journal of Psychiatry* 147 (1985), 598-611.

patient relapse on follow-up resulting from these sorts of (CBT) treatments. The newer psychodynamic oriented therapies which have developed from earlier modes of CBT have more recently been indicating better results. The individual nature and length of commitment required to properly diagnose and treat disorders is the main problem, in addition to the cost. High levels of patient drop-out make determining the effectiveness of different treatment trials difficult. There have been some studies undertaken to try and determine the effects of short-term mental skills intervention towards reducing music performance anxiety.[3]

Behavioural, Cognitive, and Cognitive Behavioural Therapy (CBT)

Behavioural therapies involve the redirecting of destructive thought patterns that typically cause maladaptive behaviour. In addressing the psychological causes for anxiety, physical issues like muscle tension and tremors are reduced. Cognitive therapy is based on the cognitive model, which states that thoughts, feelings and behaviour are all connected, and that individuals can move towards overcoming difficulties and meet their goals by identifying and changing unhelpful or inaccurate thinking, problematic behaviour, and distressing emotional responses. Cognitive Behavioural Therapy (CBT) is a talking therapy approach and emphasises self-instruction and attention focused on eliminating the faulty thinking and behaviour. This improves the individual's self-efficacy beliefs which in turn improve

[3] Sophie L. Hoffman and Stephanie J. Hanrahan, 'Mental Skills for Musicians: Managing Music Performance Anxiety and Enhancing Performance', *Journal of American Psychological Association* (2011), 1-12.

behavioural responses and cognitions in future stressful situations. CBT can be used both in individual and in group settings.[4]

Rational Emotive Behavioural Therapy/ Cognitive Restructuring

Rational emotive behavioural therapy is a form of cognitive restructuring that involves the interruption and subsequent replacement of negative or irrational thought patterns with more positive perspectives. It teaches individuals to challenge, dispute and rationalise groundless beliefs and negative self-talk. Albert Ellis[5] designed this technique on the basis that people's moods are influenced by what they believe or tell themselves. If individuals adopt hopeful, cheerful, optimistic mind-sets their mood improves. When individuals adopt the opposite attitude, depression follows which stimulates the self-defeating behaviours and can lead to anxiety and the manifestation of perfectionistic tendencies. This therapy depends on the patients' efforts to adopt a more positive, rational perspective in their entire life experience.[6]

New wave CBT Therapies

Developments in CBT therapies involve combining or pairing cognitive therapy with behavioural or other therapies, for example, the pairing of CBT and behavioural

[4] David Westbrook, Helen Kennerley and Joan Kirk, *An Introduction to Cognitive Behaviour Therapy: Skills and Applications* (London: Sage Publications Ltd., 2nd edn 2011).
[5] Albert Ellis died in 2007, he was an American psychologist who developed rational emotive behavior therapy. He is generally considered to be one of the originators of the cognitive revolutionary paradigm shift in psychotherapy and the founder of cognitive-behavioral therapies. A prolific author he was considered by American and Canadian professional psychologists surveyed in the nineteen eighties to rank among the likes of Sigmund Freud and Carl Rodgers as one of the most influential psychotherapist's in history.
[6] Albert Ellis A., 'Reflections on rational-emotive therapy' *Journal of Consulting and Clinical Psychology* 61 (1993), 199-201; Albert Ellis, A. and Windy Dryden, *The Practice of Rational Emotive Behavior Therapy* (New York: Springer Publishing Company Inc., 1997).

therapy, or self-instruction with attentional training, have been found to be more useful in altering cognitive patterns. The important goals of any MPA treatments are to support and increase the individual's self-esteem and self-efficacy beliefs. CBT therapies are effective because they inspire a greater sense of positivity and self-belief either through actual experience (as in exposure therapy) or through simulation (guided imagery, mental practice). In the past few decades there have been developments in cognitive behavioural therapies for the mood (anxiety and depression) disorders which have incorporated the acceptance and mindfulness principles within interventions. Mindfulness therapy, acceptance and commitment therapy and dialectical behaviour therapy are three examples of third–wave cognitive behavioural treatments.

Mindfulness-based Stress Reduction

Mindfulness originated in the Buddhist tradition in India over 2500 years ago and is the outcome of training in meditative techniques. It is a state of heightened awareness in which the focus is the reality of the present moment without thoughts or judgements about it. It is a self-regulatory tool to train attention and bring mental processes under greater voluntary control. There are different types of meditation; most use an object of focus such as an image, idea, word, phrase or one's breath. Participants learn through work-shops that thoughts and feelings are mental events, not part of the self, and do not necessarily reflect reality.[7]

[7] Virginia Ann Farnsworth-Grodd, 'Mindfulness and Self-Regulation of Music Performance Anxiety' (PhD dissertation, University of Auckland, 2012); Martha Elliott, 'Singing and Mindfulness', *Journal of Singing* 67 (2010), 35-40.

Acceptance and Commitment Therapy

Acceptance–based models of therapy acknowledge the universal experience of negative emotions and encourage the development of equanimity–despite the content of current experience.[8]

Dialectical Behaviour Therapy

Dialectical behaviour therapy is a psychotherapy which combines behavioural science with Zen concepts like acceptance and mindfulness. This therapy was devised by Marsha M. Linehan,[9] in the late nineteen eighties and is centered on four modules, mindfulness, interpersonal effectiveness, distress tolerance, and emotion regulation. This therapy involves open-minded thinking. Dialectical means that two ideas can both be true at the same time. For example, there is always more than one way to see a situation, and more than one opinion, idea, thought or dream. Two things that seem like, or are, opposites can both be true. Life has both comfortable and uncomfortable aspects: happiness and sadness, anger and peace, hope and discouragement, fear and ease … for example. Many points of view can have both true and false within them.[10]

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[8] Kristen E. Riley and Crystal L. Park, 'Problem-focused vs. Meaning-focused coping as mediators of the Appraisal-adjustment relationship in chronic stressors', *Journal of Social and Clinical Psychology* 33 (2014), 587-611; David G. Juncos and Emily J. Markman, 'Acceptance and Commitment Therapy for the treatment of music performance anxiety: A single subject design with a university student', *Psychology of Music* 44 (2015), 1-18.

[9] Marsha M. Linehan is a Professor of Psychology, Adjunct Professor of Psychiatry and Behavioral Sciences at the University of Washington in Seattle and Director of the Behavioral Research and Therapy Clinics. Linehan has received several notable awards, including those for career achievement, contributions to education and in praise of her work towards suicide prevention.

[10] Marsha M. Linehan, *The DBT Skills Training Manual* (New York: The Guilford Press, 2nd edn, 2015), 361.

Meditation

Meditation techniques have been found to be ideal for performance because of the ability of this technique to relax the brain and body whilst maintaining alertness, allowing the performer to focus on the technical aspects of their performance without losing connection with the artistic. Meditation allows the individual to design a self-regulatory routine, training attention to bring mental processes under increased voluntary control. Meditation is a form of consciousness alteration designed to enhance self-knowledge and well-being through controlled self-awareness.[11]

Schema Therapy

Schema Therapy is a therapeutic combination of cognitive therapy, behaviour therapy, interpersonal, experiential, and psychoanalytic therapies into one synthesised model to address self-defeating patterns that are typically established in childhood. Both Rational Emotive behavioural therapy and Schema Therapy focus on self-talk–the internal conversation that influences how an individual feels and behaves. Schema refers to the irrational beliefs of an individual, the self-defeating life patterns of perception, emotion and physical sensation. Schema Therapy was designed by Dr. Jeffery Young,[12] and is a psychotherapy that draws on CBT but also revisits earlier life experiences. Not all musicians suffering from Music Performance

[11] Peter Lin et al., 'Silent illumination: a study on Chan (Zen) meditation, anxiety, and musical performance quality', *Psychology of Music* 36 (2008), 139-155; Steven K. H. Aung, 'Meditation and Relaxation Techniques' in Anthony F. Jahn (ed.), *The Singers Guide to Complete Health* (New York: Oxford University Press, 2013), 309-319.

[12] Jeffrey E. Young is an American psychologist best known for having developed the schema therapy. He is the founder of Schema Therapy Institute. He has written numerous books on cognitive behavioural therapy and schema therapy.

Anxiety are afflicted with severe emotional disturbances. However, this therapy is useful for pinpointing the possible underlying psychological causes for performance distress.[13]

Multimodal Therapies

Multimodal therapy (MMT) is an approach to psychotherapy devised by psychologist Arnold Lazarus.[14] It is based on the idea that humans are biological beings that think, feel, act, sense, imagine, and interact–and that psychological treatment should address each of these modalities. Multimodal assessment and treatment follows seven reciprocally influential dimensions of personality: behaviour, affect, sensation, imagery, cognition, interpersonal relationships, and drugs/biology. According to MMT, each individual is affected in different ways and to different degrees by each dimension of personality. This treatment involves recognising that individuals are products of the interplay between genetic endowment, physical environment, and social learning history. In this regard, classical conditioning,[15] and operant conditioning,[16] are two central concepts in MMT. Multimodal therapy is a CBT based therapy.[17]

[13] David Westbrook, Helen Kennerley and Joan Kirk, *An Introduction to Cognitive Behaviour Therapy: Skills and Applications* (2011), 355-363.
[14] Arnold A. Lazarus, Ph.D., ABPP, is Distinguished Professor Emeritus of Psychology at Rutgers University, and President of the Centre for Multimodal Psychological Services. He has served as the President of several professional societies and has authored, co-authored, or edited 18 books and well over 300 scientific articles.
[15] Classical conditioning, also known as Pavlovian or respondent conditioning, is a learning process in which a response to a potent stimulus comes to be elicited in response to a previously neutral stimulus; this is achieved by repeated pairings of the neutral stimulus with the potent stimulus.
[16] Operant conditioning also called instrumental conditioning is a type of learning in which the strength of a behavior is modified by its consequences, such as reward or punishment, and the behavior is controlled by antecedents called discriminative stimuli which come to signal those consequences.
[17] Arnold A. Lazarus, *The Practice of Multimodal Therapy: Systematic, Comprehensive, and Effective Psychotherapy* (Baltimore USA: John Hopkins University Press, 1989).

Emotion-Focused Therapy (EFT)

Emotionally focused therapy (EFT), also known as emotion-focused therapy and process-experiential therapy, is a usually short-term (8–20 sessions) structured psychotherapy approach to working with individuals, couples, or families. It includes elements of gestalt therapy,[18] person-centred therapy,[19] constructivist therapy,[20] systemic therapy,[21] and attachment theory.[22] Emotionally-focused therapy proposes that human emotions have an innately adaptive potential that, if activated, can help clients change problematic emotional states or unwanted self-experiences. Emotions themselves do not inhibit the therapeutic process, but an individual's inability to manage emotions and use them well is seen as the problem. In EFT an important goal is to arrive at the lived experience of a maladaptive emotion (for example, chronic fear and shame) in order to transform it. The transformation comes from the

[18] Gestalt therapy is an existential/experiential form of psychotherapy that emphasises personal responsibility, and that focuses upon the individuals experience in the present moment, the therapist–client relationship, the environmental and social contexts of a person's life, and the self-regulating adjustments people make as a result of their overall situation. Gestalt therapy was developed by Fritz Perls, Laura Perls and Paul Goodman in the 1940s and 1950s.

[19] Person-centered therapy (PCT) is also known as person-centered psychotherapy, person-centered counselling, client-centered therapy and Rogerian psychotherapy. PCT is a form of talk-psychotherapy developed by psychologist Carl Rogers in the nineteen forties and fifties. The goal of PCT is to provide clients with an opportunity to develop a sense of self where they can realise how their attitudes, feelings and behaviour are being negatively affected.

[20] Constructivism is a theory that suggests people construct their own realities and find meaning based on life experience. In other words, experience constructs reality, affecting our knowledge and understanding of the world and our place in it. In clinical psychology, the theory of constructivism focuses on human meaning-making and promotes a person's proactive participation in his or her life in order to create change. The theory of constructivism has influenced many disciplines from education to medicine.

[21] Systemic therapy has its roots in family therapy or, more precisely, family systems therapy as it later came to be known. In particular, systemic therapy traces its roots to the Milan school of Mara Selvini Palazzoli. These early schools of family therapy represented therapeutic adaptations of the larger interdisciplinary field of systems theory which originated in the fields of biology and physiology.

[22] Attachment theory is a psychological model that attempts to describe the dynamics of long-term and short-term interpersonal relationships between humans. However, 'attachment theory addresses only a specific facet', how human beings respond within relationships when hurt, separated from loved ones, or perceiving a threat. Essentially, attachment depends on the person's ability to develop basic trust in their caregivers and self. In infants, attachment as a motivational and behavioral system directs the child to seek proximity with a familiar caregiver when they are alarmed, with the expectation that they will receive protection and emotional support.

individual accessing a new primary adaptive emotional state in the therapy session. Using the notion of transforming emotion with emotion, the therapist guides clients to express emotions that pull for compassion and connection.

Self-Talk

Negative thinking is a hallmark of depressive illness. This strategy aims to limit the impact negative thoughts have by practising specific strategies for thinking more constructively.[23] Self-talk strategies involve the acknowledgement, challenging, interrupting and replacement of destructive thoughts with positive thoughts. Positive use of self-talk has proven very useful in the area of sports and can be applied in many different areas of human endeavour. Instructional self-talk can be beneficial to improve technique, and motivational self-talk assists strength-and endurance-based tasks and by improving confidence.

[23] Antonis Hatzigeorgiadis et al., 'Mechanisms underlying the self-talk-performance relationship: The effects of motivational self-talk on self-confidence and anxiety', *Psychology of Sport and Exercise* 10 (2008), 186-192.

Deep Breathing

Deep breathing is a basic skill of nearly every relaxation therapy and is ideally suited to singers. Diaphragmatic breathing helps calm the body and reduces heart rate, increases the amount of oxygen in the blood, giving energy to the muscles and preparing both the mind for imagery exercises and the body to perform.[24]

Progressive Muscle Relaxation

Progressive muscle relaxation is a technique for learning to monitor and control the state of muscular tension. It was developed by American physician Edmund Jacobson,[25] in the early 1920s. Progressive muscle relaxation involves the tensing and subsequent relaxation of individual muscles so that tension can be better detected and eliminated by the individual. According to many sports psychologists, being relaxed is one of the chief characteristics of peak performances. Relaxation in singing also has the added benefit that the air within the frame is allowed to vibrate freely, the body frame being relaxed allows the singer to use the whole body in the creation of the sound, which is a truly exhilarating experience. However, the levels of arousal at which each individual experiences peak performance is subjective. Whilst some individuals need to experience increased heart rates in order to energise performances and may find benefit from autogenic training and biofeedback, others might require a greater sense of relaxation–thus meditation, yoga or progressive

[24] Diana Rhea Deen, 'Awareness and breathing: Keys to the moderation of musical performance anxiety' (PhD dissertation, University of Kentucky, 1999).
[25] Edmund Jacobson died in 1983 and was an American physician in internal medicine and psychiatry and a physiologist. He was the founder of the Progressive Muscle Relaxation and of Biofeedback. He introduced the application of psychological principles to medical practice which was later called psychosomatic medicine.

muscle relaxation might be more beneficial. Relaxation techniques are either mind to muscle or muscle to mind. A cognitive approach to relaxation, such as meditation, makes relaxation the consequence of the mind, while techniques like stretching involve the body. If the root cause of the anxiety is due to raised emotional response, then relaxation techniques which involves cognition–such as hypnosis or meditation–are more likely to help reduce symptoms. If, however, the anxiety manifests as somatic arousal–like shallow breathing, sweating, shaking and reflexive swallowing–physiological techniques such as progressive muscle relaxation may be a better solution.[26]

Cue-controlled Relaxation

Cue-controlled relaxation is a counselling tool and technique which uses a combination of deep breathing and repetition of the word 'relax'. Using this method, the individual learns to relax their muscles whenever they want by combining a verbal suggestion with abdominal breathing. This exercise involves focus on breathing whilst repeating the instruction to relax. As the patient gets comfortable with the method, it can be used to mitigate anxiety response in stressful situations.

Expressive Art Therapies

Expressive art therapy is the practice of using imagery, storytelling, dance, movement, music, drama, poetry, and the visual arts in an integrated way to foster

[26] Ansgar Conrad and Walton R. Roth, 'Muscle relaxation therapy for anxiety disorders: It works but how', *Journal of Anxiety Disorders* 21 (2007), 243-264.

human growth, healing and development. For example, Music Therapy and Guided Imagery are often paired with Yoga or other meditational practices.

Music Therapy

Music Therapy is where music is used to address physical, emotional, cognitive and social needs of an individual. It is suggested as particularly beneficial to musicians since they are more sensitive to aural stimuli, and benefits accruing from this method of stress relief also include increases in musicality and confidence as well as decreased stress and improved focus of attention. The music therapy model proposed and tested by Louise Montello, appears to have promise in the management of MPA for music professionals although it may not be suitable for younger, less experienced musicians as the expectation to improvise may itself cause additional anxiety.[27]

Mental Imagery

Imagery Therapy is psychotherapeutic method employing the individual's internal imagery to uncover and resolve emotional conflicts.[28] The therapist guides the individual through a series of fantasies, meditations, dreams and scenarios through

[27] Louise Montello, Edgar E. Coons and Jay Kantor, 'The Use of Group Music Therapy as a Treatment for Musical Performance Stress', *Journal of Medical Problems of Performing Artists* (1990), 49-57; Dianna T. Kenny, 'Treatment Review of Music Performance Anxiety: What Works?', (unpublished, 2005), 1-21 <http://www.researchgate.net/...Music_performance_anxiety...treatment/.../5046.pdf> *[Accessed 3 March 2013]*; Louise Montello, *Essential Musical Intelligence: Using Music as Your Path to Healing, Creativity, and Radiant Wholeness* (Wheaton USA: Quest Books, 2002).

[28] Melanie J. Gregg and Terry Clark, 'Theoretical and Practical applications of mental imagery', *International Symposium on Performance Science* (2007), 295-300; Christopher Connolly and Aaron Williamon, ' Mental Skills Training', in Aaron Williamon (ed.), *Musical Excellence Strategies and techniques to enhance performance* (2004), 221-245.

which the emotional disturbance is addressed. It may be paired with exposure therapy where frequent performing is recommended to lessen the possibility of inflicting further trauma on the individual. Nevertheless, in light of findings from this current study in relation to the possible impact of hormonal contraceptives on memory and the ability of females to exorcise fear, the use of exposure therapy and others involving desensitisation and memory in female subjects may need to be reviewed. Other imagery therapy such as visuo-motor behaviour rehearsal, is an imagery rehearsal procedure combining relaxation and imagery. Developed for sports, the method first introduces relaxation, then the practice of imagery–which can be a visualisation of the specific performance situation or a particular skill. This helps to strengthen the individual's psychological or motor skills within the context of the stressful scenario. This multisensory method seeks to experience the event to the maximum capabilities of the psyche. The benefits of this training method include increased ability to relax and concentrate. One such example of this training method which has been devised for musicians is the previously mentioned virtual concert hall at the Royal College in London.[29] Imagery has been a very successful tool for musicians and it has been effective when combined with traditional teaching. However learning styles and personality types should be considered. Some individuals may have greater imagery ability. Ability is defined by vividness and controllability. When used in conjunction with music therapy, imagery exercises have shown to diminish stress.

[29] Dalya Alberge, 'Concert hall simulator helps musicians prepare to perform' *The Guardian* 22 March 2015 < www.theguardian.com › Arts › Music> [Accessed 20 June 2016].

Biofeedback

Electromyographic Biofeedback offers a means by which to measure the subject's quantifiable bodily functions–such as blood pressure, heart rate, skin temperature, sweat gland activity and muscle tension–by means of strategically placed sensors and instant on-screen readings. Originated by experimental psychologist Neal Miller[30] in the early 1960s, biofeedback allows subjects to identify what triggering thoughts or emotions influence their personal physical responses. Biofeedback makes the user aware of the misuse of muscles, which is a prerequisite to creating new habits and is traditionally used in conjunction with progressive muscle relaxation and cue-controlled relaxation, mentioned earlier which is a behaviour rehearsal method where certain words are employed to prompt the physical act of tension release. Biofeedback has also been combined in studies with Emotional Management Techniques.[31]

Hypnotherapy

Hypnotism is a state of physical relaxation accompanied and induced by mental concentration. Hypnosis is described as a procedure used to encourage and evaluate

[30] Neal Elgar Miller died in 2002 and was an American experimental psychologist. Neal Miller's research contributions mainly concerned reward and learning mechanisms: underlying thought processes and behaviours relevant to problem solving in psychotherapy and everyday life, as mediated by the nervous system, and involved in learning control over voluntary (conscious) skeletal muscle and autonomic (normally unconscious) internal-organ response systems for minimizing stress, treating disease, and promoting health; Edgar E. Coons and Sarah F. Leibowitz, 'Neal E. Miller and His Research', *Biofeedback* (2010), 101-107.

[31] Myron R. Thurber et al., 'Effects of Heart Rate Variability Coherence Biofeedback Training and Emotional Management Techniques to Decrease Music Performance Anxiety', *Journal of Biofeedback* 38 (2010), 28-39; See also Patrik N. Juslin et al., ' Feedback learning of musical expressivity' in Aaron Williamon (ed.), *Musical Excellence* (2004), 247-270; See also John H. Gruzelier and Tobias Egner, 'Physiological self-regulation: Biofeedback and Neurofeedback' in Aaron Williamon (ed.), *Musical Excellence* (2004), 197-219.

responses to suggestions for changes in subjective experience, alterations in perception, sensation, emotion, thought or behaviour. There is little research into the use of hypnosis to treat music performance anxiety, although studies in related performance areas noted increased ability to concentrate, heightened self-confidence and the dismissal of fear or nervousness.[32] Hypnotherapy also provides a more private therapeutic option. It can be recorded on compact disc and listened to before sleep, somewhat like meditation and mindfulness options. Hypnotherapy, it is claimed, has the ability to reframe the initial sensitising event that precipitated the anxiety, especially if the negative experience occurred as a result of some unresolved childhood trauma. This treatment method is referred to as regression hypnosis.

Relaxation Training

Relaxation therapies focus on reducing muscle tension and the somatic symptoms of anxiety. Therapists reduce subjective anxiety by targeting many physiological symptoms–like respiration rate and muscle tension, heart rate, blood pressure–and this involves distinguishing a state of tension from a state of relaxation, detecting the early signs of tension and changing behaviour before a spiral of tension develop, and finally learning to relax and conduct all activities with less tension.

[32] Gerard E. Boutin and Donald J. Tosti, 'Modification of Irrational Ideas and Test Anxiety through Rational Stage Directed Hypnotherapy [RSDH]', *Journal of Clinical Psychology* 39 (1983), 382- 391.

Yoga, Tai Chi

Performers are keenly aware of pain related to undesirable tension or somatic symptoms of heightened arousal. Training in the practices of yoga or tai chi incorporate breathing and meditation with physical movements known to alleviate stress, mood disturbance, anxiety, and musculoskeletal pain. The emphasis on physical balance and stretching is particularly useful for singers.[33]

Exercise

When it comes to the benefits that are derived from exercise, even that which is not in itself designed to be of particular benefit to performers, it must be said that the benefits of practising any type of regular exercise are enormous. During exercise, the brain uses up a lot of fuel in the form of glucose and other carbohydrates. Research suggests that the brain is using this energy to make more of the neurochemicals that it needs to stay healthy, major depressive disorder is often characterised by depleted glutamate and the neurochemical GABA, which is the brain's 'calm down' chemical. Exercise activates the metabolic pathway that replenishes these neurotransmitters, which return to normal when mental health is restored. Aside from a fitness and cardiovascular standpoint, there are therefore considerable benefits towards reducing stress and promoting wellbeing which are accrued through regular exercise.[34]

[33] Carmelle Moore, 'Reflections on Clinical applications of yoga in voice therapy with MTD', *Logopedics Phoniatrics Vocology* 37 (2012), 144-150; Judith E. Carman, 'Yoga for Singers' in Anthony F. Jahn (ed.), *The Singers Guide to Complete Health* (2013), 321-333.
[34] Richard J. Maddock et al., 'Acute Modulation of Cortical Glutamate and GABA Content by Physical Activity', *The Journal of Neuroscience* (2016), 2449-2457.

Alexander Technique

Alexander Technique is a method of kinaesthetic education developed by F. M. Alexander,[35] where a new postural model is encouraged.[36] In association with verbal instruction, habits of held tension are challenged with intentional action or inhibition. It promotes body awareness and teaches relaxation exercises. The exercises consist of simple formulas repeated silently, focusing on the physical sensations associated with relaxing different parts of the body.[37] The method emphasises economy of effort and the balanced management of tension. Alexander technique training for singing has been found to significantly improve singing quality, especially pertaining to adjustments concerning the correct positioning of the head in relation to the rest of the body. Improvements in breath control and relaxation were also noted to have resulted for individuals who practised this technique to improve and correct postural issues.[38]

Feldenkrais Method

The Feldenkrais Method is a somatic educational system designed by Moshé Feldenkrais.[39] Lessons can be hands-on in the form of tactile, kinesthetic

[35] F. M. Alexander died in London in 1955. Born in Tasmania in 1869, he was an actor and suffered periodic loss of voice when under stress. His technique involves conditioning the association of a new postural model in response to verbal instructions.
[36] Pedro De Alcantara, *Indirect Procedures: A Musician's Guide to Alexander Technique* (Oxford: Clarendon Press, 1997).
[37] Barbara Hudson, 'The Effects of The Alexander Technique on the Respiratory System of the Singer/Actor Part II: Implications for Training Respiration in Singer/Actors Based on Concepts of the Alexander Technique', *Journal of Singing* 59 (2002), 105-110.
[38] Elizabeth Valentine, 'Alexander Technique' in Aaron Williamon (ed.), *Musical Excellence* (2004), 179-195.
[39] Moshé Feldenkrais died in 1984 and was an Israeli physicist and the founder of the Feldenkrais Method, which is claimed to improve human functioning by increasing self-awareness through

communication between practitioner and student or involve verbally directed movement sequences given primarily in a group setting, although they can also be given to individuals. Feldenkrais aims to improve people's quality of movement, their overall physical function, and their general wellbeing by increasing awareness of themselves and by expanding their movement repertoire. Education about the reduction of pain and the elimination of biomechanically unsound movement habits are often an important part of this process.[40]

Deconstruction and Narrative Thinking

Professional musicians develop many strategies and systems for memorising new music for performance, for example, by rote, mnemonics, visualisation, ear, imagination, conceptualisation and analysis.[41] Recall may originate from 'landmarks' or expressive features in the music, musical cues, and/or certain performance cues (which may involve conveying a particular emotion) or involve basic technique or attention to sensorimotor adjustments which are ingrained to memory during personal practice or shared rehearsal.[42] Deconstruction involves breaking down the structure of the musical writing and focusing attention using deliberate practice to make mental notes involving the components of the score,

movement; Samuel Nelson and Elizabeth Blades-Zeller, *Singing with your Whole Self: The Feldenkrais Method and Voice* (Lanham, MD: Scarecrow Press, 2001).

[40] Samuel Nelson and Elizabeth Blades-Zeller, 'Pelvic Centering for Balance and Power Using the Feldenkrais Method', *Journal of Singing* 62 (2005), 153-157; Samuel Nelson and Elizabeth Blades-Zeller, 'Singing with Your Whole Self: The Feldenkrais Method and Voice', *Journal of Singing* 62 (2005), 145-157.

[41] Jane Ginsborg, 'Strategies for memorizing music' in Aaron Williamon (ed.), *Musical Excellence* (2004), 127; Jane Ginsborg, 'Singing by Heart: Memorization Strategies for the Words and Music of Songs', in Jane W. Davidson (ed.), *The Music Practitioner: Research for the Music Performer, Teacher and Listener* (Aldershot: Ashgate Publishing Limited, 2004), 150-152.

[42] Jane Ginsborg and Rodger Chaffin, 'Performance cues in singing: evidence from practice and recall' in Irène Deliège and Jane W. Davidson (eds.), *Music and the Mind: Essays in honour of John Sloboda* (New York: Oxford University Press, 2011), 339-360.

basic structure, words, melody, rhythms, dynamics, tempo, interpretation, by means of systematic technique which is required in order to assist recall. Narrative thinking engages the brain with storytelling in order to develop a particular frame of mind that leads the performer towards having a flow, connection, tension and progression throughout their performance. Flow implies sequences of events that progress through time.[43] There is sense in their connection with one another. There is cause and effect. Singers, especially, find that melodic writing with text lends itself to this type of performance and memorisation strategy. Finding flow is the goal for many performers and is understood be the antithesis of anxiety in performance.[44]

Quiet time before performing

Pre-performance routines are important. There can be quite a bit of hustle and bustle before a performance. For the singer, last minute rehearsal, costume, wigs or make-up, notes from stage directors, vocal coaches, language coaches and conductors can be very distracting. Individuals take in cues from their environment and from themselves. As arousal increases as the performance approaches, the range of cues which can be attended by the individual reduces. Integrating pre-performance setting cues into performance preparation reduces the demands on the artist's attention on the day or immediately prior to the performance. Finding and keeping a strict adherence to quiet time before a performance can be very helpful in reducing anxiety and initiating attention and cognitive focus.

[43] Joann Marie Kirchner, 'Incorporating flow into practice and performance', *Work* 40 (2011), 289-296.
[44] Mihaly Csikszentmihalyi, *Finding Flow: The Psychology of engagement with everyday life* (New York: BasicBooks, 1997); Mihaly Csikszentmihalyi, *Flow: The Psychology of Optimal Experience* (New York: Harper and Row, 1990).

Goal Setting

Goal setting theory advances the idea that setting specific challenging goals enhances performance. There are two key factors: the nature of the goal chosen and the individuals' self-efficacy that the goal can be attained. Goal orientation has a significant impact on goal attainment. Individuals who focus on task mastery view errors as necessary towards learning. Those with a performance goal orientation choose tasks which make them look good and will avoid tasks they believe they cannot perform well. Goal setting and goal attainment have an impact on subjective well-being. Striving to achieve learning goals results in superior performance. Attainment only enhances well-being if the goal was perceived as difficult to attain.[45]

Practice

Individual personal practice and the establishment of good practice habits, including rest breaks, is highly recommended for all elite musicians and singers.[46] The physical health and fitness of the individual is of concern. Performance-related musculoskeletal disorders can occur. Practising for too long, practising when tired, or returning to practice too soon after an injury or during particularly heavy

[45] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (2011), 209-210.
[46] Kate F. Hays, 'The Enhancement of Performance Excellence Among Performing Artists', *Journal of Applied Sports Psychology* 14 (2010), 299-312; Aaron Williamon, 'A Guide to enhancing Musical Performance' in Aaron Williamon (ed.), *Musical Excellence: Strategies and techniques to enhance performance* (2004), 3-18; Sophie L. Hoffman and Stephanie J. Hanrahan, 'Mental Skills for Musicians: Managing Music Performance Anxiety and Enhancing Performance', *Sport, Exercise, and Performance Psychology* (2011),1-12.

workloads, for example can cause further pain or injury. There is a self-evident link between inadequate practice and music performance anxiety.

Mental Practice

Mental practice is a therapy relative to guided imagery but is more self-directed. It is a specialised form of imagery involving greater attention to detail, such as mentally simulating the physical execution of a complex task. It is a useful adjunct but never a substitute for motor practice. Mental practice for singers can be useful when saving the voice is important. It may not always be possible to practise in the venue where the performance is taking place: there may be the lack of a suitable rehearsal space. This type of preparation for performance can itself be calming. Research in musical mental practice finds that combinations of physical and mental practice appear to yield the best performance results.[47]

Exposure and Systematic Desensitisation

Exposure therapy is a behavioural therapy which involves experiencing the feared context without any danger in order to overcome the anxiety and is similar to systematic desensitisation, a treatment for phobias, in which the patient is exposed to progressively more anxiety-provoking stimuli while being coached in maintaining a

[47] Jane Ginsborg, 'Strategies for Memorizing Music' in Aaron Williamon (ed.), *Musical Excellence* (2004), 123-141; M. Brouziyne and C. Molinaro, 'Mental Imagery combined with Physical Practice of Approach shots for Golf Beginners', *Journal of Perceptual and Motor skills* 101 (2005), 203-211; Jeanette Ignacio et al., 'Development, implementation, and evaluation of a mental rehearsal strategy to improve clinical performance and reduce stress: A mixed methods study', *Journal of Nurse Education Today* 37 (2016), 27-32; Dora Ohrenstein, 'Insights Into Training Aural and Kinesthetic Awareness', *Journal of Singing* 60 (2003), 29-35.

state of relaxation, and counterconditioning which involves the negative response to stimulus being replaced with a positive one. The previously mentioned virtual concert hall explores this method using the virtual audience in various modes from positive to negative.

Drug Treatments for Anxiety

Ethical standards for research are now more rigorous than they were thirty to forty years ago when the major drug studies were carried out in relation to performance anxiety. It is therefore unlikely that there would be any new investigations about the use of these very commonly prescribed drugs and the effects on musicians during performance. What is important to remember is that music performance is a psychomotor task.[48] Drug use can inhibit the execution of complex skills.[49]

Beta-Blockers

Beta-blockers are tranquilisers which are commonly used in the medicinal treatment of adverse physiological symptoms of performance anxiety. These symptoms include palpitations, hyperventilation, tremor and nausea, dread, irritability, lack of concentration, panic, and depersonalisation (feelings of being separated from reality). These symptoms can be treated with a synthetic medication that competes with beta-adrenergic stimulants like adrenalin. Beta-adrenoceptor-blocking drugs have shown more success in counteracting anxiety in those who are not experiencing

[48] Bruce R. Lydiard, 'The role of drug therapy in social phobia', *Journal of Affective Disorders* 50 (1998), S35-S39.
[49] Robert West, 'Drugs and Musical Performance' in Aaron Williamon (ed.), *Musical Excellence* (2004), 271.

more cognitive or psychological symptoms, such as low self-esteem, social phobia, or general anxiety. Because of the sedative nature of these drugs, their usage does not come without concern regarding the deterioration of performance due to lethargy. These drugs are recommended in low doses. Higher doses have resulted in decline in performance, particularly rhythmic accuracy and dynamic intensity, and can contribute to an abnormally slow heart rate (arrhythmia), hypotension, cold extremities, gastrointestinal upset, hallucinations, sleep disturbance and muscle fatigue. The use of these drugs has raised concerns that they cause detachment or zombie musicians in performance, where musical sensitivity and expression decline as a result of these medications. General fatigue is of common concern regarding the regular use of beta blockers as is their association with depression. Beta blockers are not popular with singers or wind instrumentalists because they have been shown to increase salivation[50]and they are contraindicated for those who suffer with asthma and bronchitis.[51]

Benzodiazepines

Benzodiazepines are anti-anxiety medications which primarily affect the central location for emotional processing and are used to treat depression, muscle tension and gastrointestinal distress. They are also prescribed in the treatment of epilepsy and alcohol withdrawal, and are used for sedation. Common brands include Valium, Xanax, and lorazepam. The medication communicates with the neural receptors of the brain to increase the activity of the inhibitory neurotransmitter, which prevents

[50] Robert T. Sataloff et al, 'Performance anxiety: What singing teachers should know', *Journal of Singing* 56 (2000), 33-40.
[51] Jacqueline Nubé, 'Beta-Blockers: Effects on performing musicians', *Journal of Medical Problems of Performing Artists* 6 (1991), 61-68.

heightened arousal in some areas of the brain, including the hippocampus, amygdala, cerebellum and cortex. The actions of the drug on the cerebellum initiates full-body relaxation. These drugs also cause drowsiness and loss of co-ordination and there is a risk of dependency from regular use.

Anti-depressants- MAOI, SSRIs, Tricyclics

(MAOI) Monoamine Oxidase Inhibitors

Monoamine oxidase inhibitors are a class of antidepressants which were developed in the 1950s. They are effective in treating depression, panic disorder and other anxiety disorders. Although they are generally as effective as selective serotonin reuptake inhibitors (SSRI) and tricyclic antidepressants (TCAs), they are used less frequently because of necessary dietary precautions and risks of adverse reactions when mixed with certain drugs. For example, food or drinks that contain tyramine (including alcoholic drinks) can cause a very large, sudden increase in blood pressure (hypertensive crisis). Tyramine is found in cheese, liver, yoghurt, Marmite, Oxo, Bovril, brewer's yeast, flavoured textured vegetable protein, broad bean pods (the beans inside can be eaten), protein which has been allowed to age or ferment (for example, hung game, pickled herrings or dry sausage such as salami or pepperoni), fermented soya bean extract and large amounts of chocolate. Tyramine is also found in alcoholic drinks, including beer, lager or wine (especially red wine) and in non-alcoholic beer. Some medicines that are used for coughs and colds can also cause the same reaction, leading to hypertensive crisis, or can result in making the patient very excitable or, conversely, depressed.

(SSRIs) Selective Serotonin Reuptake Inhibitors

Selective serotonin reuptake inhibitors are a widely-used type of antidepressant medication. They are mainly prescribed to treat depression, particularly persistent or severe cases, and are often used in combination with a talking therapy such as cognitive behavioural therapy (CBT). SSRIs are usually the first choice medication for depression because they generally have fewer side effects than most other types of antidepressant. As well as treating depression, SSRIs can be used to treat a number of other mental health conditions, including: generalised anxiety disorder (GAD), obsessive compulsive disorder (OCD), panic disorder, severe phobias such as agoraphobia and social phobia, bulimia, and post-traumatic stress disorder (PTSD). SSRIs can sometimes be used to treat other conditions, such as premature ejaculation, premenstrual syndrome (PMS), fibromyalgia and irritable bowel syndrome (IBS). Occasionally, they may also be prescribed to treat pain. It is thought that SSRIs work by increasing serotonin levels in the brain. Serotonin is a neurotransmitter (a messenger chemical that carries signals between nerve cells in the brain). It is thought to have a good influence on mood, emotion and sleep. After carrying a message, serotonin is usually reabsorbed by the nerve cells, a process known as reuptake. SSRIs work by inhibiting reuptake, meaning more serotonin is available to pass further messages between nearby nerve cells. A rise in serotonin levels can improve symptoms and make people more responsive to other types of treatment, such as CBT.

Tricyclics

Tricyclic and tetracyclic antidepressants, also called cyclic antidepressants, were among the earliest antidepressants developed. They are effective, but they have generally been replaced by antidepressants that cause fewer side effects. Tricyclic and tetracyclic antidepressants ease depression by affecting naturally occurring chemical messengers (neurotransmitters), which are used to communicate between brain cells. Cyclic antidepressants block the absorption (reuptake) of the neurotransmitters serotonin and norepinephrine, making more of these chemicals available in the brain. This seems to help brain cells send and receive messages, which in turn boosts mood. Most antidepressants work by changing the levels of one or more neurotransmitters. Cyclic antidepressants also affect other chemical messengers, which can lead to a number of side effects. These antidepressants are used to treat depression, but may be prescribed for anxiety disorders or nerve-related (neuropathic) pain. Side effects of cyclic antidepressants vary according to the medication. The most common side effects of cyclic antidepressants include: dry mouth, blurred vision, constipation, urinary retention, drowsiness, increased appetite leading to weight gain, drop in blood pressure when moving from sitting to standing, which can cause light-headedness and increased sweating. Other side effects may include: disorientation or confusion, particularly in older people when the dosage is too high, tremor, increased or irregular heart rate, and low sex drive.

Alcohol

Many performers and singers self-medicate with alcohol to alleviate the somatic symptoms of nervousness. However, there are many studies on the impairing effects of alcohol and other ‘recreational’ substances which attest to the inhibiting effects on cognitive function, making it unlikely that there are any benefits to either health or music performance from the frequent use of these substances.

Nicotine

In low doses, nicotine stimulates the release of beta-endorphins which are associated with calm and wellbeing. At high doses, nicotine prompts the release of noradrenaline, adrenaline, and dopamine which enhance both alertness and relaxation. Nicotine can enhance memory but the effects are short lived; withdrawal causes difficulty with concentration and is accompanied by deficits in task performance. It is highly addictive and carcinogenic. For singers, disease which is associated with smoking, especially that involving the throat and lungs, makes ingesting this substance counter-intuitive.

Caffeine

Caffeine is a psycho-stimulant chemical found in coffee, tea, soft drinks and energy drinks. Caffeine is reported to have a positive impact on mood and cognitive function, particularly for longer, more difficult, tasks involving low arousal, on selective attention, and on immediate and working memory. At high doses, however, caffeine may increase arousal and anxiety. Tolerance develops with habitual use and

withdrawal can cause fatigue. Caffeine is not recommended for those with hypertension or arrhythmia and may interfere with the effectiveness of anxiety medications. Performers must consider the anxiety-amplifying effects of caffeine prior to performance.

Cannabis

Observational studies show that cannabis derived substances affect mood and emotional reactivity, which are dose dependant. Cannabis and its derivatives are neurochemicals which mediate anxiety and fear learning in both animal and human studies. For this reason, there have been further, more recent studies regarding cannabidiol (CBD), a non-psychotropic constituent of cannabis, and its therapeutic effects–including anti-convulsive, anti-anxiety, anti-psychotic, anti-nausea, and anti-rheumatoid arthritis properties. The need to find effective therapies for social anxiety disorder (SAD), given the high prevalence of the condition, has prompted this research.[52] However, further long-term studies need to be undertaken to confirm the therapeutic benefits for use in humans. A chapter on drugs which expands on the effects of illicit drugs such as Cocaine, Ecstasy, Hallucinogens and Opiates is available for review from Robert West, 'Drugs and Musical Performance' in Aaron Williamon (ed.), *Musical Excellence: Strategies and techniques to enhance performance* (2004).[53]

[52] J. A. S. Crippa, 'Neural basis of anxiolytic effects of cannabidiol (CBD) in generalized social anxiety disorder: A Preliminary Report', *Journal of Psychopharmacology* 25 (2011), 121-130.
[53] Robert West, 'Drugs and musical performance', in Aaron Williamon (ed.), *Musical Excellence* (2004), 280-284.

Oxytocin and Social Support

For many years there has been increased interest in the biological influences of stress. Wallace Rubin investigated the allergic, dietary, chemical, stress, and hormonal influences in voice abnormalities in vocalists in the late 1980s.[54] More recently, behavioural neuroscientists have investigated the benefits of oxytocin[55] because of it and vasopressin's [56] central role in learning, stress and social behaviour. Only in the past decade has oxytocin moved into the world of clinical science. At the end of 2014, a search of 'oxytocin and intranasal' would have revealed ninety-nine trials listed in ClinicalTrials.gov.[57] Oxytocin seems to enhance the buffering support of social support on stress responsiveness.[58] It remains very early stages in the clinical applications of this research. But the initial benefits of this treatment seem promising and are currently being extensively investigated.[59]

Complementary and Alternative Medicine (CAM)

Complementary alternative medicines are therapies used along with, or in addition to, conventional medicine.[60] Some CAM herbal preparations are beneficial; others

[54] Wallace Rubin, 'Allergic, Dietary, Chemical, Stress, and Hormonal Influences in voice Abnormalities', *Journal of Voice* 1 (1988), 378-385.
[55] Oxytocin is a hormone, neuropeptide. See Glossary.
[56] Vasopressin, also known as antidiuretic hormone (ADH), is a neurohypophysial hormone. See Glossary.
[57] Thomas R. Insel, 'Translating Oxytocin Neuroscience to the Clinic: A National Institute of Mental Health Perspective', *Journal of Biological Psychiatry* 79 (2016), 153-154.
[58] Markus Heinrichs et al., 'Social Support and Oxytocin Interact to Suppress Cortisol and Subjective Responses to Psychosocial Stress', *Journal of Biological Psychiatry* 54 (2003), 1389-1398.
[59] Larry J. Young and Loretta M. Flanagan-Cato, 'Editorial comment: Oxytocin, vasopressin and social behavior', *Journal of Hormones and Behavior* 61 (2012), 227-229.
[60] Joel S. Edman, Lauren B. Knodrad and Birgit Rakel, 'The Use of Nutrition and Integrative Medicine or Complementary and Alternative Medicine (CAM) for Singers, Part 1', *Journal of Singing* 68 (2011), 165-173; Joel S. Edman, Lauren B. Knodrad and Birgit Rakel, 'The Use of Nutrition and Integrative Medicine or Complementary and Alternative Medicine (CAM) for Singers, Part 2', *Journal of Singing* 68 (2012), 291-297.

have no proven efficacy. Some are potentially harmful. Singers frequently seek treatment from providers or with modalities considered alternative to traditional medical care.[61] Frequently, singers will self-medicate or take advice from people not well versed in the needs of a professional voice user. They may not share this information with their physician when seeking traditional medical care. Some treatments sought by singers have not been approved or tested as fit for purpose by the clinical community.[62]

Kava

Kava is also known as Kava-Kava and is derived from the plant *piper methysticum*, a plant native to the South Pacific Islands. It is used to treat restlessness and reduce stress and anxiety. Studies support the use of Kava for short-term use (one to eight weeks) for anxiety disorders. However, Kava can cause unpredictable, severe liver damage.[63]

St John's Wort

St John's wort or *hypericum perforatum*, is used as an antidepressant in the treatment of seasonal affective disorder (SAD). However, there are some adverse reactions

[61]Joseph R. Anticaglia, Robert T. Sataloff and Mary Hawkshaw, 'What Singing Teachers Should Know About Complementary, Alternative, and Integrated Medicine', *Journal of Singing* 62 (2005), 45-52.
[62] Jason B. Surow and Jeanette Lovetri, '"Alternative Medical Therapy" Use Among Singers: Prevalence and Implications for the Medical Care of the Singer', *Journal of Voice* 14 (2000), 398-409.
[63] Joseph R. Anticaglia, Robert T. Sataloff and Mary Hawkshaw, 'What Singing Teachers Should Know About Complementary, Alternative, and Integrated Medicine', *Journal of Singing* 62 (2005), 46.

which include dry mouth, insomnia, anxiety, gastro-intestinal upset, vivid dreams, fatigue, photosensitivity (hypersensitivity to light) headache and intermittent menstrual bleeding. This herb should be used cautiously with other anti-depressants as it may cause hypertensive crisis.[64]

Lysine

Lysine is an amino acid which acts as a partial serotonin receptor antagonist, decreasing brain-gut response to stress as well as decreasing blood cortisol levels. Good sources of lysine are high-protein foods such as eggs, meat–specifically red meat, lamb, pork, and poultry, soy, beans and peas, cheese, particularly Parmesan, and certain fish, such as cod and sardines.[65]

Magnesium

Magnesium in the body occurs as a positively charged ion that is involved in many important molecular functions and has been linked to anxiety-related disorders. Magnesium is the eleventh most abundant element by mass in the human body, and the ions are essential to all cells. It is postulated that magnesium could have synergistic effects when combined with other herbs. On its own, it had results which were no better than placebo.[66]

[64] Ibid., 49.
[65] Lysine is an amino acid that is used in the biosynthesis of proteins. As an essential amino acid, lysine is not synthesized in animals, hence it must be ingested as lysine or lysine-containing proteins. Lysine is metabolized in mammals. Allysine is a derivative of lysine, used in the production of elastin and collagen. It is produced by the actions of the enzyme lysyl oxidase on lysine in the extracellular matrix and is essential in the crosslink formation that stabilizes both collagen and elastin.
[66] Dianna T. Kenny, *The Psychology of Music Performance Anxiety* (2011), 226.

Acupuncture and Massage

Acupuncture is an ancient form of treatment which originated in China and consists of modulating the flow of energy through the body using small needles inserted at specific points. Acupuncture belongs to traditional Chinese medicine (TCM) and is only one of a series of branches. These include acupressure, herbal medications, diet and nutrition, tuina (Medical Massage), meditation (Qi Gong), and Tai chi. A great deal of scientific research has been done on acupuncture. Clinical observations have identified meridian points that form a network interconnecting all parts of the body. The effects of acupuncture are real and take place independently of the patient's awareness or will. Integrative medicine suggests that acupuncture is an important treatment modality which can assist other therapies to be more affective.[67] Massage therapy is the scientific manipulation of the soft tissues of the body for the purpose of normalising those tissues and consists of manual techniques that include applying fixed or movable pressure, holding, and/or causing movement of or to the body. Generally, massage is known to affect the circulation of blood and the flow of blood and lymph, reduce muscular tension or flaccidity, affect the nervous system through stimulation or sedation, and enhance tissue healing. These effects provide a number of benefits: reduction of muscle tension and stiffness; relief of muscle spasms; greater flexibility and range of motion; increase in the ease and efficiency of movement; relief of stress and aiding of relaxation; promotion of deeper and easier breathing; improvement of the circulation of blood and movement of lymph; relief of tension-related conditions, such as headaches and eyestrain; promotion of faster

[67] Anthony F. Jahn and Gertrude Kubiena, ' Acupuncture for the Vocal Performer' in Anthony F. Jahn (ed.), *The Singers Guide to Complete Health* (2013), 335-341; Further information in relation to acupuncture is available on the American integrated health website <https://nccih.nih.gov/health/acupuncture/introduction >

healing of soft tissue injuries; such as pulled muscles and sprained ligaments; and reduction in pain and swelling related to such injuries; reduction in the formation of excessive scar tissue following soft tissue injuries; enhancement in the health and nourishment of skin; improvement in posture through changing tension patterns that affect posture; reduction in stress and an excellent stress management tool; creation of a feeling of well-being; reduction in levels of anxiety; increase in awareness of the mind-body connection; and promotion of a relaxed state of mental awareness. Massage therapy also has a number of documented clinical benefits. For example, massage can reduce anxiety, improve pulmonary function in young asthma patients, reduce psycho-emotional distress in persons suffering from chronic inflammatory bowel disease, increase weight and improve motor development in premature infants, and may enhance immune system functioning. Some medical conditions that massage therapy can help are: allergies, anxiety and stress, arthritis, asthma and bronchitis, carpal tunnel syndrome and other repetitive motion injuries, chronic and temporary pain, circulatory problems, depression, digestive disorders, tension headache, insomnia, myofascial pain, sports injuries, and temporomandibular joint dysfunction. In many instances, acupuncture and message therapy are used in combined treatments.

Emotional Tapping/Emotional Freedom Techniques (EFT)

As previously mentioned, singers are known to be very open to a large variety of alternative treatments–some of which have very few scientifically-proven benefits. Emotional freedom technique is a form of counselling intervention that draws on various theories of alternative medicine, including acupuncture, neuro-linguistic

programming,[68] energy medicine,[69] and thought field therapy (TFT).[70] Emotional freedom and similar techniques are often discussed under the umbrella term 'energy psychology'.[71] Advocates claim that the technique may be used to treat a wide variety of physical and psychological disorders, and as a simple form of self-administered therapy. The foundations of EFT (Emotional Freedom Technique or Emotion Tapping) have been described as 'a hodgepodge of concepts derived from a variety of sources'.[72] Emotional tapping/freedom therapy has not garnered significant support in clinical psychology. This therapy should not be confused with Emotion Focused Therapy (EFT) which was referred to earlier in this resource.[73]

[68] Neuro-linguistic programming (NLP) is an approach to communication, personal development, and psychotherapy created by Richard Bandler and John Grinder in California, United States, in the 1970s. NLP has since been largely discredited scientifically but continues to be marketed by some seminar runners and some hypnotherapists.

[69] While early reviews of the scientific literature on energy medicine or energy healing recommended further research, more recent reviews have concluded that there is no evidence supporting clinical efficiency. The theoretical basis of healing has been criticised as implausible, research and reviews supportive of energy medicine have been faulted for containing methodological flaws and selection bias, and positive therapeutic results have been dismissed as resulting from known psychological mechanisms.

[70] Thought Field Therapy (TFT) is a fringe psychological treatment developed by an American psychologist, Roger Callahan. Its advocates say that it can heal a variety of mental and physical ailments through specialised 'tapping' with the fingers at meridian points on the upper body and hands. The theory behind TFT is a mixture of concepts, foremost is the ancient Chinese philosophy of chi, Callahan also bases his theory upon applied kinesiology and physics. There is no scientific evidence that TFT is effective. According to the American Psychological Association it 'lacks a scientific basis'.

[71] Energy psychology addresses the relationship of energy systems to emotion, cognition, behavior and health. These systems include electrical activity of the nervous system and heart, meridians among others. Although psychological functioning involves thought, emotions, chemistry, neurology, genetics and environmental aspects, at an essential level bioenergy is also involved. Energy psychology is applicable to a wide range of areas including psychotherapy, counselling, education, vocational guidance, physical health, pain management, sports and peak performance.

[72] Brandon A. Gaudiano and James D. Herbert, 'Can We Really Tap Our Problems Away? A Critical Analysis of Thought Field Therapy', *Skeptical Inquirer* 24 (2000) <www.csicop.org/si/show/can_we_really_tap_our_problems_away_a.> [Accessed 20 June 2016]

[73] For explanation see emotionally focused therapy (EFT), also known as emotion-focused therapy and process-experiential therapy page 191 above.

Prayer

Many performers rely on their personal faith beliefs in times of difficulty and stress. The positive influence of prayer in surmounting overwhelming emotional reactions to issues of fear is well recorded.[74] Many individuals find comfort in the repetitive nature of prayer and also in the time-space it provides for inner reflection.

Self-help Books

Self-help books can be related to all aspects of personal development and include those devoted to strategies which enhance performance, such as sport psychology, music performance psychology or, more recently, those concerning mindfulness. Several self-help books have been written for professional musicians by other musicians and offer insights into their own stage experiences. In addition to scholarly articles and experimental studies, they provide an accessible starting point for personal research towards locating performance solutions. They offer treatment options for music performance anxiety through self-reflection and journaling, as well as offering practical instruction in the case of mindfulness techniques. One notable recent publication highly recommended for singers is edited by otolaryngologist Anthony F. Jahn, *The Singer's Guide to Complete Health* (Oxford: Oxford University Press, 2013). Dr Jahn has a thirty-year association with the metropolitan opera and practises in New York, with a special focus on professional voice users. This book provides a unique reference for the care of singers and discusses many

[74] E. James Baesler, 'Stirring The Soul: The Influence Of Prayer On Mind And Body', *Quest* 5 (2002) <http://ww2.odu.edu/ao/instadv/quest/Volume5Issue2.html>[Accessed 23 June 2016].

troubling aspects of the career, providing useful chapters on therapies which can assist singers find a work/life balance. A list of other notable self-help books in relation to health for singing, performance anxiety, mindfulness and concerning female hormones is presented in Appendix E.

Appendix E: List of Self-help Books

Balk, H. Wesley, *Performing Power: A New Approach for the Singer-Actor* (Minneapolis: University of Minnesota Press, 2nd edn 1985)

Balk, H. Wesley, *The Complete Singer-Actor: Training for Music Theatre* (Minneapolis: University of Minnesota Press, 1978)

Balk, H. Wesley, *The Radiant Performer: The Spiral Path to Performing Power* (Minneapolis: University of Minnesota Press, 1991)

Boone, Daniel R., *Is your Voice Telling on You? How to find and Use your Natural Voice* (London: Whurr, 1997)

Brouziyne, M. and Molinaro, C., 'Mental Imagery combined with Physical Practice of Approach shots for Golf Beginners', *Journal of Perceptual and Motor skills* 101 (2005), 203-211

Brown, Oren, *Discover Your Voice: How to develop Healthy Voice Habits* (San Diego: Singular, 1996)

Bruser, Madeline, *The Art of Practicing: A Guide to Making Music from the Heart* (New York: Crown Publishing, 1997)

Buswell, David, *Performance Strategies for Musicians* (Hertfordshire: MX Publishing, 2006)

Caldwell, J. Timothy, *Expressive Singing: Dalcroze Eurhythmics for Voice* (Englewood Cliffs New Jersey: Prentice-Hall, 1995)

Caldwell, Robert, *The Performer Prepares* (Dallas Texas: Pst…Inc., 1990)

Cameron, Julia, *The Artist's Way* (New York: Putnam, 1992)

Chapman, Janice L., *Singing and Teaching Singing: A Holistic Approach to the Classical Voice* (San Diego: Plural Publishing, 2nd edn 2012)

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Craig, David, *On Singing Onstage* (New York: Applause Theatre Book Publishers, 1978)

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Csikszentmihalyi, Mihaly, *Finding Flow: The Psychology of engagement with everyday life* (New York: BasicBooks, 1997)

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Davidson, Jane W. (ed.), *The Music Practitioner: Research for the Music Performer, Teacher and Listener* (Aldershot: Ashgate Publishing Limited, 2004)

De Alcantara, Pedro, *Indirect Procedures: A Musician's Guide to Alexander Technique* (Oxford: Clarendon Press, 1997)

Doscher, Barbara, *The Functional Unity of the Singing Voice* (New Jersey: Scarecrow Press, 1988)

Dornemann, Joan, *Complete Preparation: A Guide to Auditioning for Opera* (New York: Excalibur Publishing, 1992)

Emmons, Shirlee and Thomas, Alma, *Power Performance for Singers: Transcending the Barriers* (New York: Oxford University Press, 1998)

Green, Barry and Gallwey, Timothy W., *The Inner Game of Music* (New York: Doubleday, 1986)

Green, Don, *Audition Success: An Olympic Sport Psychologist Teaches Performing Artists How to Win* (New York: ProMind Music, 1998)

Green, Don, *Performance Success: Performing Your Best Under Pressure* (New York: Routledge, 2002)

Greene, Alan, *The New Voice: How to Sing and Speak Properly* (Milwaukee, WI: Hal Leonard, 1975)

Gordon, Stewart, *Mastering the art of performance: A Primer for Musicians* (Oxford: Oxford University Press, 2006)

Gorrie, Jon, *Performing in the Zone: Unleash your true performing potential!* (Lulu.com, 2005)

Havas, Kato, *Stage Fright: Its Causes and Cures with Special Reference to Violin Playing* (London: Bosworth & Co. Ltd., 11th edn 1998)

Jahn, Anthony F., (ed.), *The Singer's Guide to Complete Health* (New York: Oxford University Press, 2013)

Jeffers, Susan, *Feel the Fear and do it Anyway* (New York: Ballantine Books, 1987)

Jordan, James, *The Musicians Soul* (Chicago: G.I.A. Publications, 1999)

Jourdain, Robert, *Music the Brain and Ecstasy* (New York: Avon Books, 1997)

Judy, Stephanie, *Making music for the Joy of It: Enhancing Creativity, Skills, and Musical Confidence* (New York: J. P. Tarcher, 1990)

Kilckstein, Gerald, *The Musician's Way: A Guide to Practice, Performance, and Wellness* (Oxford: Oxford University Press, 2009)

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Lieberman, Julie L., *You are your Instrument: The definitive Musician's Guide to Practice and Performance* (New York: Huiksi Music, 1991)

Linklater, Kirstin, *Freeing the Natural Voice* (New York: Drama Book Publishers, 1976)

Loehr, James E., *Mental Toughness Training for Sports* (Lexington, Massachusetts: The Stephen Greene Press, 1982)

Lundin, Mia, *Female Brain Gone Insane: An Emergency Guide for Women Who Feel like They Are Falling Apart* (Florida: Health Communications Inc., 2009)

Maas, James, *Power Sleep: The Revolutionary Program that Prepares your Mind for Peak Performance* (New York: Villard Books, 1998)

McGrath, Casey, Hendricks, Karin S., and Smith, Tawnya D., *Performance Anxiety Strategies: A Musicians guide to managing stage fright* (Maryland: Rowman and Littlefield, 2017)

Morton, Jennie, *The Authentic Performer: Wearing a Mask and the Effect on Health* (Abington: Compton Publishing, 2015)

Nathan, Amy, *The Young Musician's Survival Guide: Tips from Teens and Pros* (New York: Oxford University Press, 2000)

Nelson, Samuel and Blades-Zeller, Elizabeth, *Singing with your Whole Self: The Feldenkrais Method and Voice* (Lanham, MD: Scarecrow Press, 2001)

O'Brien, Dominic, *Learn to Remember: Practical Exercises and Techniques to Improve Your Memory* (London: Duncan Baird Publishers, 2000)

Rayapati Sangeetha, *Sing into your Sixties…and Beyond! A Manual and Anthology for Group and individual Voice Instruction* (Delaware, OH: Inside View Press, 2012) <www.VoiceInsideView.com>

Robison, Clayne W., *Beautiful Singing: "Mind Warp Moments"* (Provo, UT: Clayne W. Robison, 2001)

Salaman, Esther, *Unlocking your voice: Freedom to sing* (London: Kahn & Averill, 1999)

Schneiderman, Barbara, *Confident Music Performance: The Art of Preparing* (St Louis, Missouri: MMB Music, 1991)

Thompson, Jo, *Find your Voice* (London: Artemis Editions, 2004)

Thurman, Leon and Welch, Graham, *Body Mind and Voice* (Iowa: The Voice Care Network, National Centre for Voice and Speech, 1997)

Vliet lee, Elizabeth, *Women, Weight, and Hormones* (New York: M. Evans and Company, 2001)

Vliet Lee, Elizabeth, *Screaming to be heard: Hormone Connections Women Suspect and Doctors Still Ignore* (Lanham, Maryland: Roman & Littlefield, 2006)

Wall, Joan and Caldwell, Robert, *Excellence in Singing* (5 Vols, Seattle: Caldwell Publishing, 2000)

Whykes, Susan, *Mind over Matter* (Milton Keynes: AuthorHouse, 2007)

Williamon, Aaron, *Musical Excellence: Strategies and techniques to enhance performance* (New York: Oxford University Press, 2004)

Williams, Mark and Penman, *Mindfulness: a practical guide to Finding Peace In A Frantic World* (London: Hachette Digital, 2011)

Wilson, G. D. *Psychology for performing artists* (London, U.K: Whurr, 2nd edn 2002)

Appendix F: List of Useful Contacts

British Association for performing arts medicine BAPAM
<http://www.bapam.org.uk >

Ireland BAPAM <www.portobellophysio.ie/dublin-performing-artists-medical-centre.>

British Laryngological Association <www.**british**laryngological.org>

British Association for Music Therapy BAMT <http://www.bamt.org/site>

British Voice Association <www.britishvoiceassociation.org.uk>

The Laryngological Project <www.lary.org.uk/information/support-for-singers>

Equity <www.equity.org.uk>

U.k. Theatre <www.uktheatre.org >

Panic Attacks:
Patient.co.uk < http://www.patient.co.uk/health/panic-attack-and-panic-disorder>

Eating and Wellness:
<https://www.umsystem.edu/newscentral/mindfuleating/audiovideo-recordings/>

Counselling and Support:
<http://resourceireland.ie >

USA–Integrative Health

The National Centre for Complementary and Integrative Health (NCCIH) is the Federal Government's lead agency for scientific research on complementary and integrative health approaches. 1 of the 27 institutes and centres that make up the National Institutes of Health (NIH) within the U.S. Department of Health and Human Services. Their website provides a large database of information and services.

National Centre for Complementary and Integrative Health (NCCIH)
<https://nccih.nih.gov/health/integrative-health>

Appendix G: DMusPerf Performance Examinations

Imelda Drumm

Mezzo-Soprano

1 October 2010, performance of 'Sheherezade' by Maurice Ravel with the R.T.É National Symphony Orchestra at the National Concert Hall Dublin.

17 October 2011, performance of the role of 'Azucena' in the opera *Il Trovatore* by Giuseppe Verdi with Lyric Opera Ireland at the National Concert Hall in Dublin.

5 March 2012, solo performance in the 2nd Symphony by Gustav Mahler with the RIAM symphony orchestra and choir at the National Concert Hall Dublin.

1 June 2012, recital of 'Frauenliebe und Leben' by Robert Schumann and 'Sea Pictures' by Edward Elgar in the Organ Room of the Royal Irish Academy of Music.

3 October 2012, performance of the role of 'Brangäne' in the opera Tristan und Isolde by Richard Wagner with Wide Open Opera at the Bord Gais Energy Theatre Dublin.

14 November 2012, performance of the role of 'Amneris', in the opera Aida by Giuseppe Verdi with Lyric Opera Ireland at the Gaiety Theatre in Dublin.

Lecture Recital

Lecture Recital was given on the 9 of June 2014 in the Recital Room of the Royal Irish Academy of Music in Dublin.

Title

'When is a Mezzo not a Mezzo? The vocal classification of female singers, exploring the effects of aging on voices as demonstrated by the title role of Bizet's *Carmen*'

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* * Note: Page numbers; for example, 129.e21- 129.e23 represent electronic 'versions' where the number after the 'e' represents the page number location in the electronic version and the number '129' references the location in the Journal. Page numbers; for example, S3-S9 (supplement) pages contained in the electronic editions are location identifiers describing the location and number of pages which appear in supplemental or amended articles in the electronic version of journals.

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Adrian, Stephanie, ‘The impact of Pregnancy on the singing Voice: A Case Study’, *Journal of Singing* 68 (2012), 265-271

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