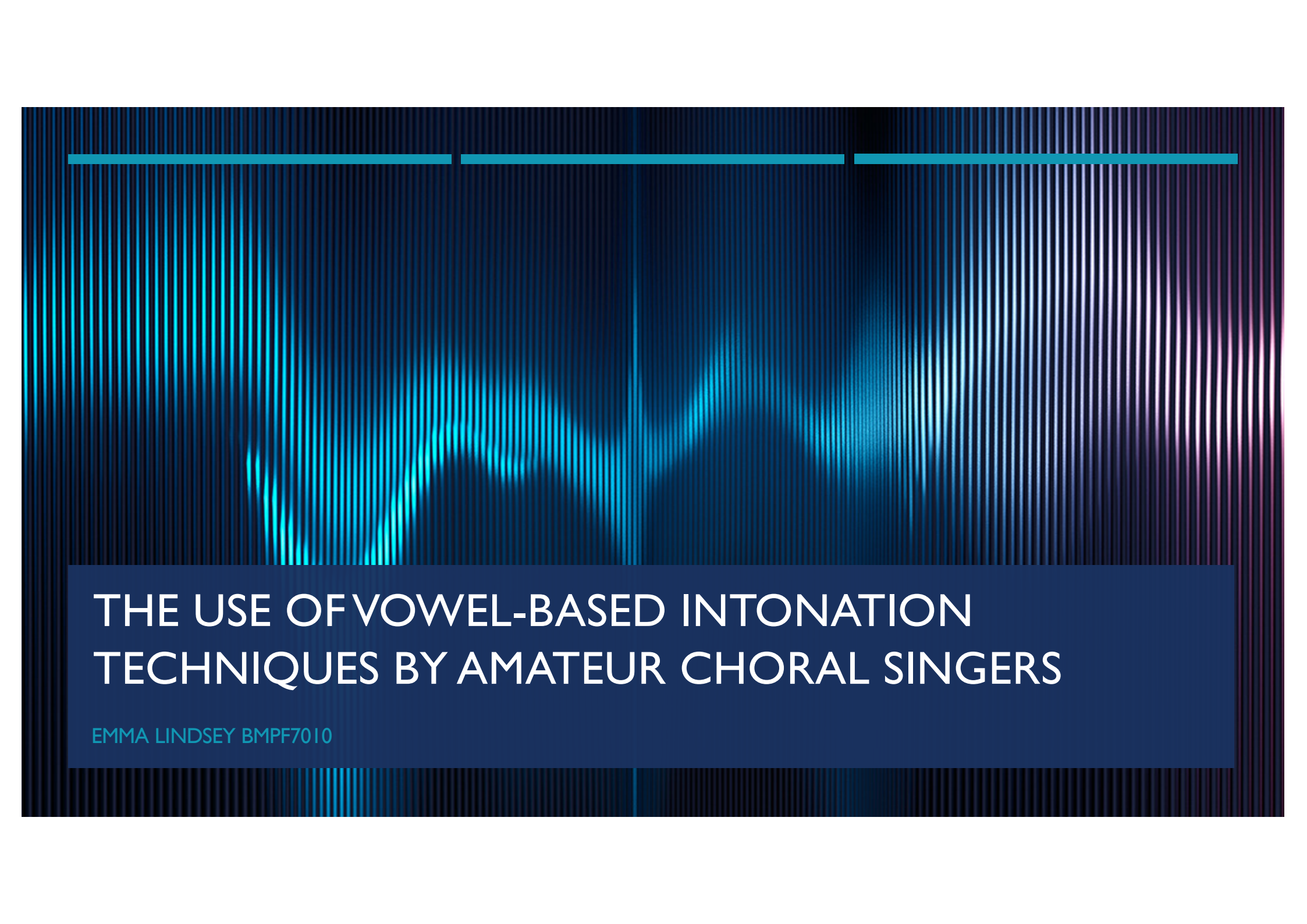




THE USE OF VOWEL-BASED INTONATION TECHNIQUES BY AMATEUR CHORAL SINGERS

EMMA LINDSEY BMPF7010

CONTENTS



Introductory Overview

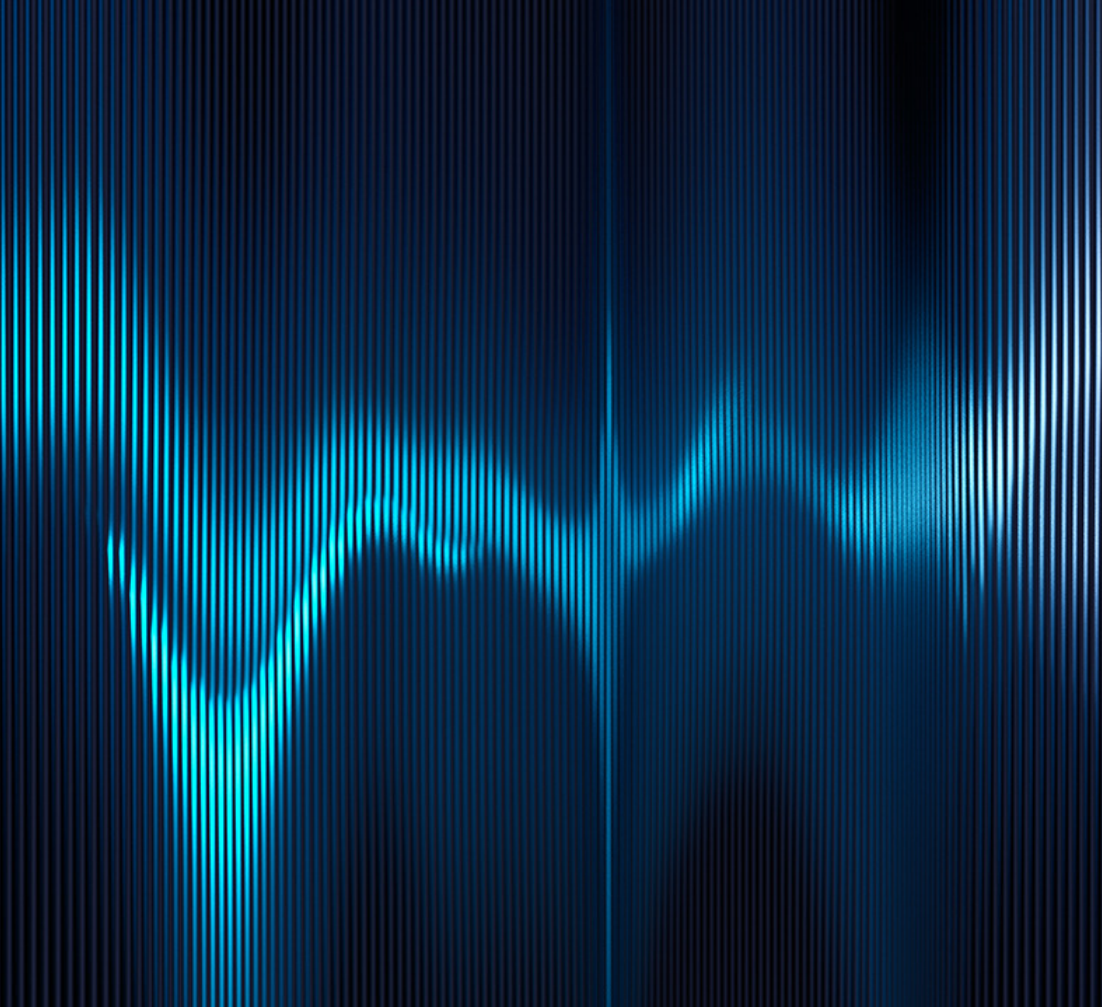


Methods and Findings

- 1 Vowel pairing tests with amateur choral singers
- 2 Interviews with amateur choral singers
- 3 Literature review on aural imagery



Conclusion



INTRODUCTORY OVERVIEW

CONTEXT

My Role:

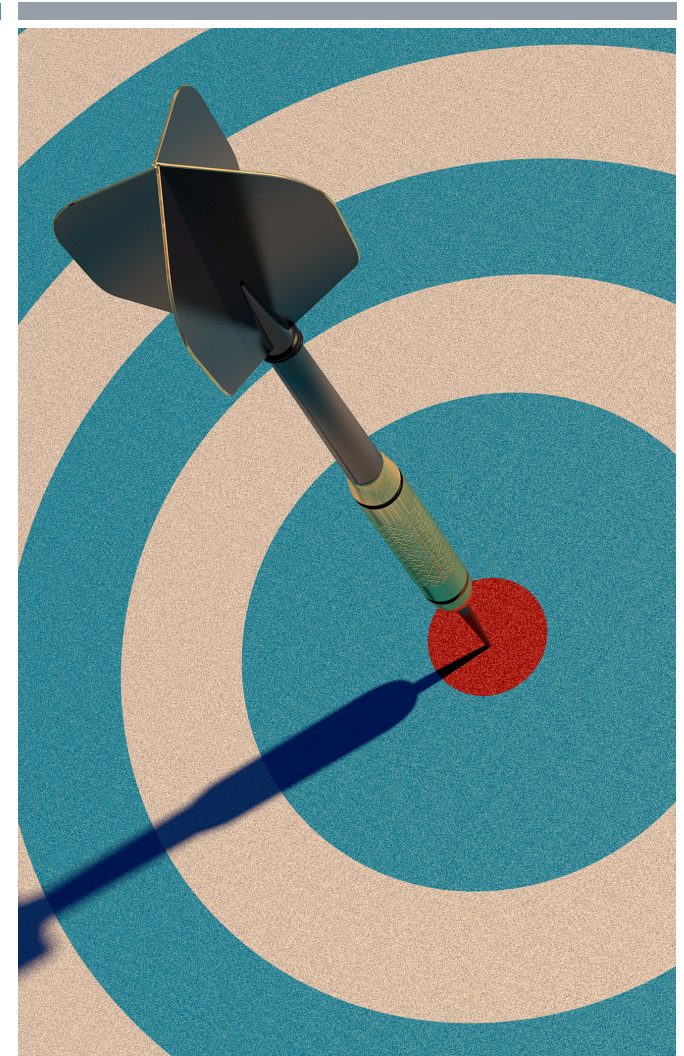
Choral Director

- Upper voice choir of amateur singers
- Looking to specialise in competitive singing



JUSTIFICATION

- Intonation: how precisely a pitch matches the intended target note (Swannell, 1992)
- Intonation is a priority during choral rehearsals (Ganshow, 2014)
- Intonation is a key factor that adjudicators listen for in competitions (Hensley, 2021)
- Vowels are one consideration for determining the quality of intonation. (Sundberg, 1987, p. 143; Howard, 2023)
 - Auditory pitch (Ternström and Sundberg, 1988; Nix, 2012)
 - Intrinsic pitch of vowels (Ternström, Sundberg and Colldén, 1988)
- Subtle techniques which require skilful listening (Howard, 2023)



RESEARCH QUESTIONS

1 How does a change in vowel impact the fundamental frequency of amateur choral singers?

2 Is this change aurally significant enough for choral competition adjudicators to notice?

3 How can I develop the listening skills of amateur choral singers to make vowel-based techniques relevant in improving intonation?

INTENDED IMPACT



Understand the practical application of the concept of *intrinsic pitch of vowels* within amateur choirs



Understand how to develop amateur choral singers to better use these techniques



Investigate the concept of hearing music in the mind and ways to improve these skills



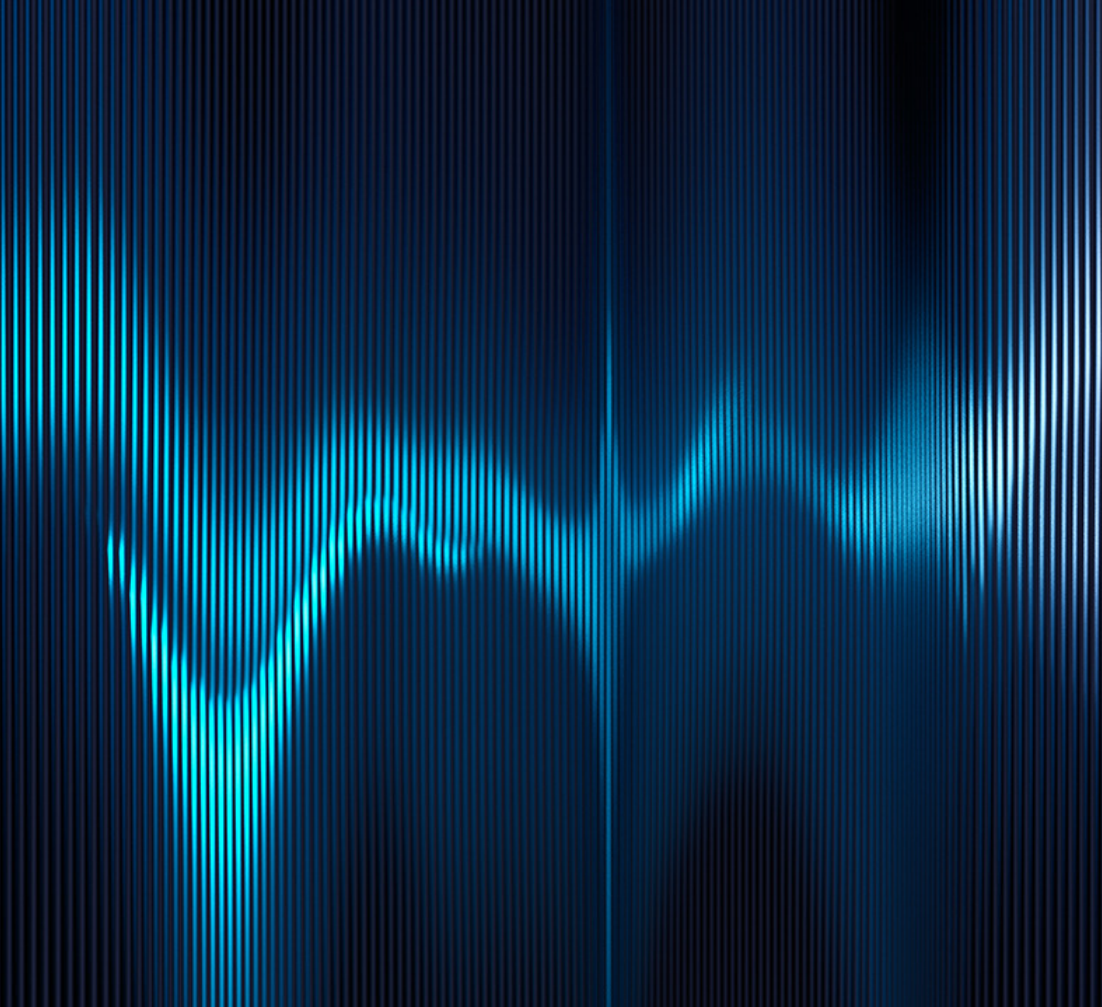
Create an artefact to support the development of choral singers, complementing the artefact from Module 5



Helping other choirs striving for detailed excellence and a competitive edge



Identify gaps in existing literature



METHODS AND FINDINGS

METHODOLOGY



Study is guided by social constructivism



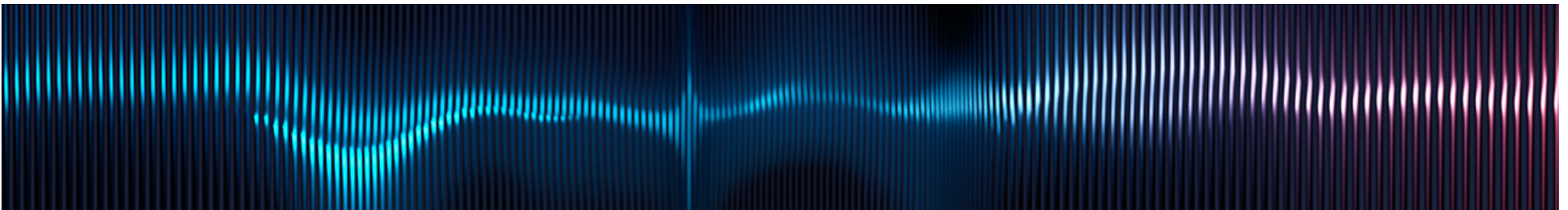
Makes use of quantitative and qualitative data under a grounded theory methodology

- 1: Vowel pairing tests with amateur choral singers
- 2: Interviews with amateur choral singers
- 3: Literature review on aural imagery

ETHICS AND INSIDE RESEARCH

- University of Wales Trinity St David gave ethical approval:
 - All participants received information about the project and their role and the collection and handling of data.
 - All participants signed consent forms.
 - Ensured confidentiality to prevent reputational harm.
 - Participants were given unique identifiers and their data was anonymised.
- Considered inside research challenges as all participants were members of my choir:
 - Did not share findings with anyone.
 - Participants were volunteers and they were reassured that they could withdraw their participation, and that there would be no impact on their membership.

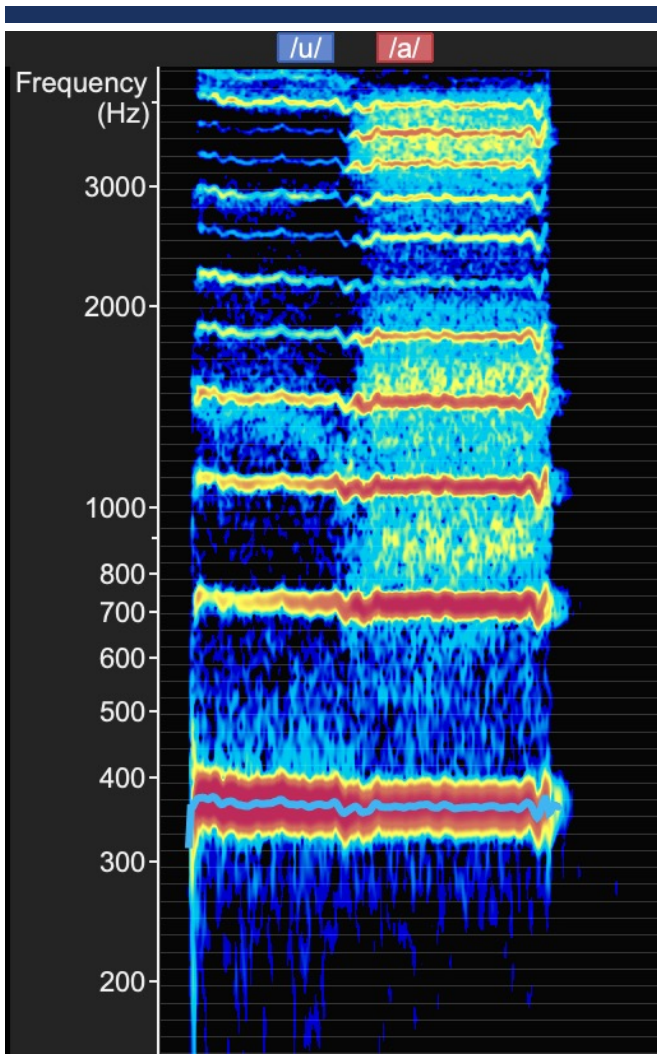
I: VOWEL PAIRING TESTS WITH AMATEUR CHORAL SINGERS



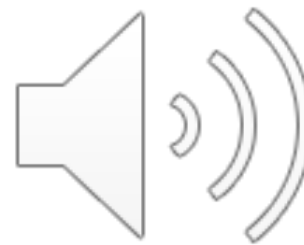
METHOD



- Quantitative approach: examined how well amateur choral singers are able to sustain the fundamental frequency while changing vowels and how perceptible these changes are to both musicians and non-musicians.
- Based on part of the study by Ternström, Sundberg and Colldén (1988)
- Eight members of my choir volunteered to take part and were recorded on VoceVista:
 - Listened to spoken vowel demonstration of two vowel sounds.
 - Sang the first vowel sound at a comfortable pitch of their choice and tried to maintain the pitch while moving to the second vowel.
 - Asked to not leave a gap between the vowels, to pre-imagine the pitch they were going to sing and to sing with a straight tone.
 - First round: nine pairs of vowels
 - Break of 45 minutes
 - Second round: the same pairs but in reverse order



EXAMPLE OF A VOWEL PAIR RECORDING



S4: /u/ to /a/ (Source:VoceVista)

FINDINGS

	First round								
	ɔa	uɔ	ua	ie	ɛa	ai	ie	ɔɪ	au
S1	0.30%	-2.06%	-2.06%	-1.50%	-0.71%	-0.11%	-0.89%	13.38%	13.65%
S2	0.39%	-0.12%	0.27%	1.01%	0.69%	0.87%	-0.95%	0.04%	0.74%
S3	0.16%	-0.65%	-1.32%	-0.05%	-0.07%	0.61%	-0.75%	10.88%	12.20%
S4	0.03%	-0.56%	-0.77%	-1.19%	-0.25%	-0.19%	-0.77%	0.59%	-0.92%
S5	-1.03%	1.67%	0.68%	-1.40%	0.70%	1.39%	-0.53%	0.35%	1.45%
S6	0.68%	-0.28%	-2.58%	-0.71%	-0.24%	-1.17%	1.80%	0.24%	0.60%
S7	-0.74%	-0.74%	0.16%	-0.51%	0.85%	1.64%	-0.27%	0.82%	0.88%
S8	-1.00%	-3.46%	-2.70%	-3.35%	-0.73%	4.13%	-0.12%	2.46%	13.03%
	Second round								
	aɔ	ɔu	au	ɛi	aɛ	ia	ei	ɪɔ	ʊa
S1	-0.03%	-0.81%	0.19%	0.10%	1.29%	-0.32%	0.16%	-0.09%	-10.35%
S2	-0.31%	-0.94%	0.50%	0.25%	1.45%	0.51%	1.63%	-1.19%	-0.54%
S3	0.07%	0.83%	0.50%	0.55%	0.31%	-0.93%	0.98%	-10.47%	-13.10%
S4	0.47%	-1.07%	-0.01%	0.09%	-0.33%	-0.05%	0.24%	-0.12%	0.18%
S5	-1.27%	0.53%	1.31%	0.21%	0.24%	-0.16%	0.05%	-0.81%	-1.69%
S6	0.22%	3.85%	1.21%	-0.04%	-0.64%	-1.12%	1.03%	-12.67%	-1.56%
S7	0.52%	0.59%	1.09%	2.07%	1.45%	-2.81%	0.78%	0.12%	-0.07%
S8	-0.05%	1.47%	2.05%	2.30%	1.74%	-0.23%	2.20%	-13.79%	-2.19%

Percentage difference between the mean fundamental frequencies of each vowel in a pair

FINDINGS (CONTINUED)

	N	Minimum	Maximum	Mean	Std. Deviation
ɪɔ	8	-13.79%	0.12%	-4.8765%	6.23399%
ʊa	8	-13.10%	0.18%	-3.6630%	5.09416%
ua	8	-2.70%	0.68%	-1.0405%	1.33229%
ie	8	-3.35%	1.01%	-0.9636%	1.26414%
uɔ	8	-3.46%	1.67%	-0.7751%	1.48970%
ia	8	-2.81%	0.51%	-0.6364%	1.01293%
ie	8	-0.95%	1.80%	-0.3091%	0.90290%
ɔa	8	-1.03%	0.68%	-0.1505%	0.67118%
aɔ	8	-1.27%	0.52%	-0.0463%	0.56609%
ɛa	8	-0.73%	0.85%	0.0294%	0.63672%
ɔu	8	-1.07%	3.85%	0.5558%	1.62750%
aɛ	8	-0.64%	1.74%	0.6902%	0.90816%
ɛi	8	-0.04%	2.30%	0.6902%	0.93898%
au	8	-0.01%	2.05%	0.8566%	0.68167%
ei	8	0.05%	2.20%	0.8835%	0.75043%
ai	8	-1.17%	4.13%	0.8955%	1.59709%
ɔɪ	8	0.04%	13.38%	3.5939%	5.36120%
aʊ	8	-0.92%	13.65%	5.2027%	6.47036%

Mean and standard deviation for each vowel pairing (Source: IBM SPSS)

AUDIBLE DIFFERENCES

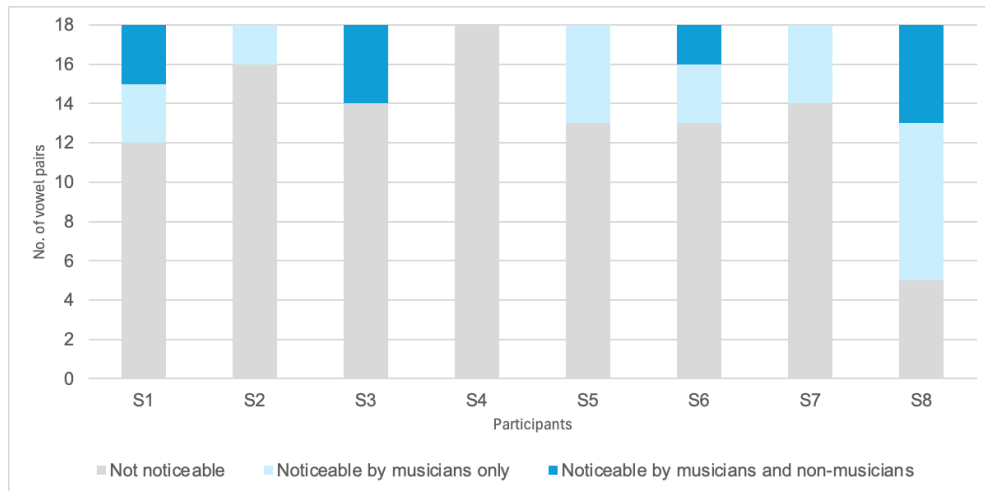
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S5	-1.27%	0.53%	1.31%	0.21%	0.24%	-0.16%	0.05%	-0.81%	-1.69%
S6	0.22%	3.85%	1.21%	-0.04%	-0.64%	-1.12%	1.03%	-12.67%	-1.56%
S7	0.52%	0.59%	1.09%	2.07%	1.45%	-2.81%	0.78%	0.12%	-0.07%
S8	-0.05%	1.47%	2.05%	2.30%	1.74%	-0.23%	2.20%	-13.79%	-2.19%
	Exceeded DLF for musicians					Exceeded DLF for non-musicians			

Difference Limen for Frequency (DLF)

Musicians: 1.35%
Non-musicians: 3.19%
(Nikjeh, Lister and Frisch 2008)

Percentage difference between the mean fundamental frequencies of each vowel in a pair categorised by DLFs

AUDIBLE DIFFERENCES (CONTINUED)



Audible differences for each participant

		Choral experience (years)	Noticeable tokens
Choral experience (years)	Pearson Correlation	1	0.444
	Sig. (2-tailed)		0.270
	N	8	8
Noticeable tokens	Pearson Correlation	0.444	1
	Sig. (2-tailed)	0.270	
	N	8	8

Pearson correlation of participants' choral experience and noticeable tokens – correlation is significant at 0.05 (Source: IBM SPSS)

INFLUENCE OF SPOKEN DEMONSTRATION VOWELS

		Correlations								
		S1	S2	S3	S4	S5	S6	S7	S8	Spoken
S1	Pearson Correlation	1	0.211	.878**	0.042	0.406	0.126	0.242	.551*	.812**
	Sig. (2-tailed)		0.401	0.000	0.870	0.095	0.619	0.333	0.018	0.000
	N	18	18	18	18	18	18	18	18	18
S2	Pearson Correlation	0.211	1	0.399	0.045	0.275	0.268	0.201	0.465	0.278
	Sig. (2-tailed)	0.401		0.101	0.858	0.270	0.283	0.424	0.052	0.263
	N	18	18	18	18	18	18	18	18	18
S3	Pearson Correlation	.878**	0.399	1	-0.094	.522*	.528*	0.247	.757**	.948**
	Sig. (2-tailed)	0.000	0.101		0.710	0.026	0.024	0.323	0.000	0.000
	N	18	18	18	18	18	18	18	18	18
S4	Pearson Correlation	0.042	0.045	-0.094	1	-0.215	-0.127	0.137	-0.063	0.015
	Sig. (2-tailed)	0.870	0.858	0.710		0.391	0.615	0.588	0.803	0.952
	N	18	18	18	18	18	18	18	18	18
S5	Pearson Correlation	0.406	0.275	.522*	-0.215	1	0.232	0.344	.473*	.470*
	Sig. (2-tailed)	0.095	0.270	0.026	0.391		0.354	0.162	0.047	0.049
	N	18	18	18	18	18	18	18	18	18
S6	Pearson Correlation	0.126	0.268	.528*	-0.127	0.232	1	0.106	.703**	.582*
	Sig. (2-tailed)	0.619	0.283	0.024	0.615	0.354		0.676	0.001	0.011
	N	18	18	18	18	18	18	18	18	18
S7	Pearson Correlation	0.242	0.201	0.247	0.137	0.344	0.106	1	0.363	0.217
	Sig. (2-tailed)	0.333	0.424	0.323	0.588	0.162	0.676		0.139	0.388
	N	18	18	18	18	18	18	18	18	18
S8	Pearson Correlation	.551*	0.465	.757**	-0.063	.473*	.703**	0.363	1	.736**
	Sig. (2-tailed)	0.018	0.052	0.000	0.803	0.047	0.001	0.139		0.000
	N	18	18	18	18	18	18	18	18	18
Spoken	Pearson Correlation	.812**	0.278	.948**	0.015	.470*	.582*	0.217	.736**	1
	Sig. (2-tailed)	0.000	0.263	0.000	0.952	0.049	0.011	0.388	0.000	
	N	18	18	18	18	18	18	18	18	18

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

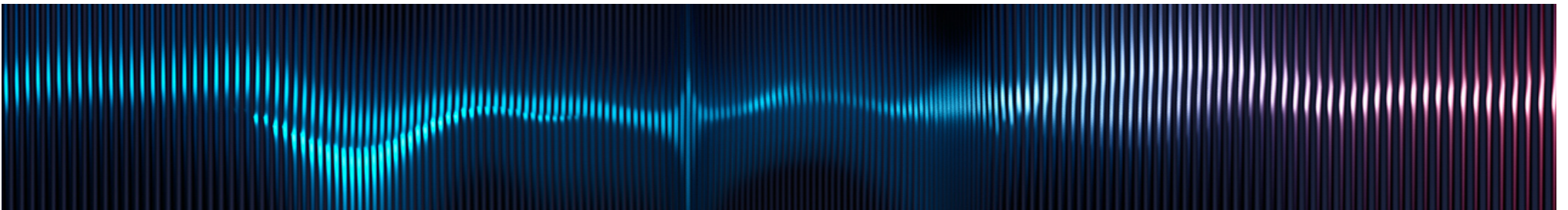
Pearson correlation between the change in fundamental frequency of the spoken vowels and those produced by the participants (Source: IBM SPSS)

IMPACT OF EXPERIENCE

		Paired Differences						Significance		
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			One-Sided p	Two-Sided p	
					Lower					Upper
Pair 1	ɔa - əɔ	0.17283%	0.42517%	0.15032%	-0.18262%	0.52828%	1.150	7	0.144	0.288
Pair 2	ʊɔ - ɔʊ	-0.07088%	1.71100%	0.60493%	-1.50132%	1.35955%	-0.117	7	0.455	0.910
Pair 3	ʊa - aʊ	0.45907%	0.97663%	0.34529%	-0.35741%	1.27556%	1.330	7	0.113	0.225
Pair 4	ie - ei	0.51373%	1.01783%	0.35986%	-0.33719%	1.36466%	1.428	7	0.098	0.196
Pair 5	ɛa - aɛ	-0.40234%	0.45499%	0.16086%	-0.78272%	-0.02195%	-2.501	7	0.020	0.041
Pair 6	ai - ia	0.50051%	1.52917%	0.54064%	-0.77790%	1.77893%	0.926	7	0.193	0.385
Pair 7	ie - ei	-0.12336%	0.96870%	0.34249%	-0.93322%	0.68649%	-0.360	7	0.365	0.729
Pair 8	ɔɪ - ɪɔ	-1.31257%	7.99852%	2.82790%	-7.99950%	5.37436%	-0.464	7	0.328	0.657
Pair 9	aʊ - ʊa	1.72374%	3.92139%	1.38642%	-1.55462%	5.00211%	1.243	7	0.127	0.254

*Paired samples t-test to compare the performance of the first round of testing with the second round for each vowel pair
(Source: IBM SPSS)*

2: INTERVIEWS WITH AMATEUR CHORAL SINGERS



METHOD

- Qualitative approach: explored the perspectives and experience of the vowel pairing test participants to improve the understanding of the quantitative data.
- Phenomenological study
- Semi-structured interviews covering their backgrounds and their understandings of intonation and vowels
- Conducted over Zoom, transcribed and checked for accuracy by the participants
- Coding: *in vivo*, initial and structural coding

THEMES AND SUB-THEMES



CONTEXTS OF LEARNING: PARTICIPANT QUOTES



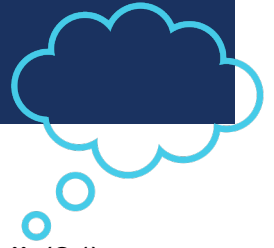
Background

- Varied levels of music training – S8, S3, S7 and S2 receiving the most formal training and S4 being the most advanced from a self-taught perspective. S6 had the least experience, followed by S1. S5 occupies an intermediate position with some formal training and some performance experience.
- Neurodiversity: No formal diagnoses, but four participants suspected they were neurodiverse (S2, S3, S5 and S8)

Cognitive processes

- “segment her mind into doing different things” and a fascination with pattern-matching(S2)
- “found it easier to learn by doing” (S5)
- S2, S3 and S5 all spoke about finding it challenging to focus
- Confidence levels affecting singing (S2, S3 and S4)

CONTEXTS OF LEARNING: PARTICIPANT QUOTES



Individual vs choir

- “I think I have more experience to know how I think it should sound and therefore I don’t tend to listen” (S4)
- Influenced by singers “doing a good job” (S7)
- Under direction (S7, S4, S1, S8)

Motivation for improvement

- “it’s not really something that I take too much notice of” (S1)
- “we all just want to sing for pleasure and it just sort of comes out of your mouth ... And I think it is really good to dissect it a bit because ... that’s what makes us a better choir.” (S8)
- “how far I could go” (S2), “wanting to ... stretch my brain” (S7) and “I don’t think we can ever stop” (S4)

TECHNICAL AREAS OF DEVELOPMENT: PARTICIPANT QUOTES



Aural skills

- S2, S3 and S8 had had formal training to grade 8 – S3 “struggled”, “S7” okay, S2 “straightforward”
- “Learn things a lot by ear” (S4)
- “Did that sound about right?” (S2)
- Listening was a key skill for many participants for identifying and correcting intonation issues – using an external reference, but also S3 and S8 spoke of hearing sounds in their heads and S7: “just really think[s] about it”

Vowels

- “shapes on the inside of your mouth” (S2)
- “Julie Andrews” (S6) or “sing it in a more posh way” (S8)
- S4 consciously used vowel modification “literally all the time” and S5 said “the more you open, the easier it becomes for you to reach a specific note”
- “figure out what the best way to sing something would be” (S4)

Intonation

- “we weren’t singing what was written” (S3) versus “a little smidge out” (S7)
- “it is the end of the day for me, because I always thought I was a strong singer” (S5)

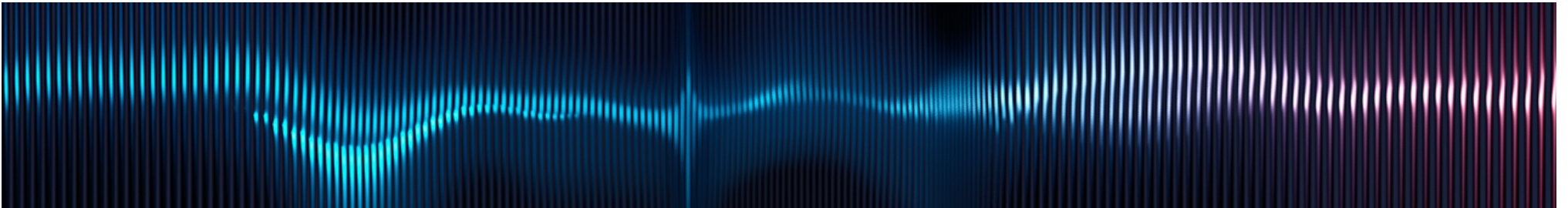
DISCUSSION IN
RELATION TO
THE VOWEL
PAIRING TEST
RESULTS

1 A strong desire to improve

2 Vocal technique

3 Musicianship

3: LITERATURE REVIEW ON AURAL IMAGERY



METHOD

Narrative literature review focused on peer-reviewed sources with a small amount of grey literature

Searched 'audiation', 'aural imagery' and 'inner hearing' on multiple databases

Citation mining

Created educational resource using a pragmatic approach

AURAL IMAGERY



Hearing and processing music in the mind when no music is present.



Synonyms include aural perception, musical perception, subvocalization, inner hearing and audiation.



Audiation has gathered widespread use (Gerhardstein, 2002).



Cognitively there appears to be a similar process occurring when we imagine music and when we hear it. (Halpern, 2001)

MOVABLE-DO

- Method for teaching sight-singing
- Evidence that the development of aural skills is linked to sightreading (Grutzmacher, 1987; Kopiez and In Lee, 2008)
- Hand signs by John Curwen
- Other factors contributing to success
- Reference guide resources

(Curwen, 1884, p. viii)

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NOTE.—The diagrams show the hand as seen by pupils sitting in front of the teacher. The teacher makes his signs in front of his ribs, chest, face and head, rising a little as the tones

SECOND STEP.



TE.

The **PIERCING** or sensitive tone, — the **Major LEADING TONE**, making with *Ray* and *Fah* the weak Chord T.

THIRD STEP.



LAH.

The **SAD** or weeping tone, — the **Major SUBMEDIANT**, making with *Doh* and *Me* the Chord L.

HARMONIC CONTEXT

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- Evidence that a harmonic context can improve the perception of pitch (Graves and Oxenham, 2017, p. 1).
- Tonic-dominant relationship
- Reference guide resources

(Malmark Chimes Source: malmark.com)



CHORAL SPACING

- Balancing a singer's ability to hear their own voice with the ability to hear the choir.
- Spread spacing is preferred with a preference for circumambient spacing to hear own voice. (Daugherty, 2003)
- 55% preferred spread spacing to hear the choir. (Daugherty, 2003)
- Higher risers for hearing own voice. Lower risers for hearing the choir. (Daugherty, Manternach and Brunkan, 2013)
- Sopranos prefer a higher self-to-other ratio than basses (Ternström, 1999)

(Daugherty, 2003, p. 51)

Close chamber choir spacing:



Lateral chamber choir spacing:



Circumambient chamber choir spacing:



CONCLUSION

CONCLUSION

- Answering the research questions:
 - How does a change in vowel impact the fundamental frequency of amateur choral singers?
 - Is this change aurally significant enough for choral competition adjudicators to notice?
 - How can I develop the listening skills of amateur choral singers to make vowel-based techniques relevant in improving intonation?
- Limitations
 - Spoken vowel demonstrations
 - Small-scale study limits generalizability
 - Not relevant to all amateur choirs
- Future directions
- Personal reflection



THANK YOU FOR LISTENING!

REFERENCES

- Curwen, J. (1884) *The Standard Course of Lessons and Exercises of the Tonic Sol-fa Method of Teaching Music*. 7th edn. London: Tonic Sol-fa Agency.
- Daugherty, J.F. (2003) 'Choir Spacing and Formation: Choral Sound Preferences in Random, Synergistic, and Gender-Specific Chamber Choir Placements', *International Journal of Research in Choral Singing*, 1(1), pp. 48–59.
- Daugherty, J.F., Manternach, J.N. and Brunkan, M.C. (2013) 'Acoustic and perceptual measures of SATB choir performances on two types of portable choral riser units in three singer-spacing conditions', *International Journal of Music Education*, 31(3), pp. 359–375.
- Ganschow, C.M. (2014) 'Secondary School Choral Conductors' Self-Reported Beliefs and Behaviors Related to Fundamental Choral Elements and Rehearsal Approaches', *Journal of Music Teacher Education*, 23(2), pp. 52–63.
- Gerhardstein, R. (2002) 'The historical roots and development of audition', in B. Hanley and T. Goolsby (eds) *Musical Understanding: Perspectives in Theory and Practice*. Canadian Music Educators' Association, pp. 103–118.
- Graves, J.E. and Oxenham, A.J. (2017) 'Familiar Tonal Context Improves Accuracy of Pitch Interval Perception', *Frontiers in Psychology*, 8(OCT).
- Grutzmacher, P.A. (1987) 'The Effect of Tonal Pattern Training on the Aural Perception, Reading Recognition, and Melodic Sight-Reading Achievement of First-Year Instrumental Music Students', *Journal of Research in Music Education*, 35(3), p. 171.

REFERENCES (CONTINUED)

- Halpern, A. (2001) 'Cerebral substrates of musical imagery', *Annals of the New York Academy of Sciences*, 930, pp. 179-192.
- Hensley, D. (2021) 'How Will Your Choir be Judged?', *The Choral Journal*, 62(2), pp. 30-41.
- Howard, D.M. (2023) 'Influence of vowels on note pitching in a cappella vocal quartet performance', *Journal of Voice* [Preprint].
- Kopiez, R. and In Lee, J. (2008) 'Towards a general model of skills involved in sight reading music', *Music Education Research*, 10(1), pp. 41-62.
- Nikjeh, D.A., Lister, J.J. and Frisch, S.A. (2008) 'Hearing of note: An electrophysiologic and psychoacoustic comparison of pitch discrimination between vocal and instrumental musicians', *Psychophysiology*, 45(6), pp. 994-1007.
- Nix, J. (2012) 'Vowel and consonant modification for choirs', in D.R. Karna (ed.) *The use of the international phonetic alphabet in the choral rehearsal*. Scarecrow Press, pp. 10-26.
- Swannell, J. (1992) *The Oxford Modern English Dictionary*. New York: Oxford University Press.
- Sundberg, J. (1987) *The Science of the Singing Voice*. Northern Illinois University Press.
- Ternström, S. (1999) 'Preferred self-to-other ratios in choir singing', *The Journal of the Acoustical Society of America*, 105(6), pp. 3563-3574.
- Ternström, S. and Sundberg, J. (1988) 'Intonation precision of choir singers', *The Journal of the Acoustical Society of America*, 84(1), pp. 59-69.

REFERENCES (CONTINUED)

- Ternström, S., Sundberg, J. and Colldén, A. (1988) 'Articulatory Fo perturbations and auditory feedback', *Journal of Speech and Hearing Research*, 31(2).