The Benefits of Singing in a Choir

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Zatorre & Salimpoor (2013)

Loui (2013)
What are the benefits of singing? Some examples

- **Physical benefits**
  - Respiratory (aerobic)
  - Cardiac
  - Immune
  - Neurological
    - Development
    - Integration

- **Psychological benefits**
  - Intra-personal communication
  - Catharsis
  - Inter-personal communication

- **Musical benefits**
  - Understanding of music, e.g., structure, phrasing
  - The development of musical memory
  - Increased expertise in vocal tone colouring, pitch, rhythm and loudness
  - Creation of a musical repertoire

- **Educational benefits**
  - Increasing knowledge, understanding and skills about the world around us
  - Impact on other aspects of intellectual development, such as literacy

- **Social benefits**
  - Group membership
  - Communication
  - Sense of community
  - Social integration
Neuropsychobiological aspects:
Brain Architecture and Singing
The brain has an integrated neurological modularity

For example – these parts of the brain are involved in the analyses of human voices.

A: Overt singing only

B: Imagined singing only

C: Imagined more than overt singing

(Kleber & Zarate, 2014 
Singing students & professionals)
A modular model of music processing in singing

(Welch, 2005; Welch & Preti 2015; adapted from Peretz & Coltheart, 2003)
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An integrated neurological modularity: music and dance

Singing (Kleber et al, 2007)

Improvisation during jazz (Limb & Braun, 2008)

Dance (tango) (Brown et al, 2006)
Recent advances in neuroimaging from the Human Connectome Project (2013)

Sotiropoulos et al, 2013
connectivity examples
Arcuate Fasciculus (AF) volume in Singers (n = 11), Instrumentalists (n = 11), and Non-Musicians (n = 11) p<.05 (Bonf.)


AF region is implicated in normal short-term memory use for language and also RH vocal pitch processing (singing in tune vs ‘tone deafness’)

Images of the arcuate fasciculus, an auditory-motor tract, in each hemisphere of (left) a healthy musician and (right) a healthy non-musician, both in their 60s, demonstrating brain-enhancing benefits of lifelong music making

(Ford Thompson & Schlaug, 2015, p37 Scientific American Mind)
The sequence above shows how, over time, melodic intonation therapy (MIT) built up connections between the hearing and speaking regions in a healthy right brain.

The patient had suffered a massive stroke at age 11 that had destroyed her speech pathways in the left hemisphere.

‘Over time, with therapy, she learned to draw on undamaged brain regions that moderate the rhythmic and tonal aspects of language, bypassing the speech pathways on the left side of her brain that were destroyed. In other words, she found her way back to language through music.’

(Ford Thompson & Schlaug, 2015, p36/p38 Scientific American Mind)
• ‘When she began therapy in 2008, she could not string together more than two or three words, and her speech was often ungrammatical, leaving her frustrated whenever she tried to communicate.

• Her treatment plan was intensive—an hour and a half a day for up to five days a week, with 75 sessions in all.

• By the end of the 15-week treatment period, she could speak in sentences of five to eight words, sometimes more.

• Over the next several years she treated herself at home using the techniques she learned during the sessions.

• Today, eight years after her stroke, she spends some of her time as a motivational speaker, giving hope and support to fellow stroke survivors.’
Example of social processes and musical learning

Children
Age 6 at start
2 groups
(I) Studying a keyboard instrument (n=15)
   Weekly 30 minute lessons x 15 months
(C) Controls (n=16)
   Weekly 40 minute music class
Evidence of longitudinal brain changes in three regional areas in keyboard group

Hyde et al (2009)
Impact of singing lessons on brain function after one year?

Activity changes brain function

Prior to singing lessons

Mithen & Parsons (2008)

After one year of singing lessons

Mithen & Parsons (2008)
Singing development
Musical development begins pre-birth

**Acoustic links**
Prosodic and melodic features of mother’s voice (speaking & singing) are perceived *in utero*

**Hormonal links**
Mother’s emotional state when vocalising (speaking & singing) is ‘encoded’ hormonally in the filtered interfacing of the mother’s and foetus’ bloodstreams

*(Welch, 2005)*
Foetal experiences of maternal voice
Linguistic topology

Rhythmic surface

Pitch contour

key stability

General tendency in Western cultures for bias within children’s song learning (literature survey)

(Welch, 1994)
### Examples of children’s singing aged 9y+ (f)

#### Song 1

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**Welch (1998) A revised model of vocal pitch-matching development (VPMD)*

1. "Pre-singer" does not sing but chants the song text.
2. "Inconsistent Speaking Range Singer" sometimes chants, sometimes sustains tones and exhibits some sensitivity to pitch, but remains in the speaking voice range (usually a3 to c4).
3. "Speaking Range Singer" sustains tones and exhibits some sensitivity to pitch but remains in the speaking voice range (usually a3 to c4).
4. "Inconsistent Limited Range singer" waives between speaking and singing voices and uses a limited range when in singing voice (usually up to f4).
5. "Limited Range Singer" exhibits consistent use of initial singing range (usually d4 to f4).
6. "Inconsistent Initial Range Singer" sometimes only exhibits use of limited singing range, but other times exhibits use of initial singing range (usually d4 to a4).
7. "Initial Range Singer" exhibits consistent use of initial singing range (usually d4 to a4).
8. "Inconsistent Singer" sometimes only exhibits use of initial singing range, but other times exhibits use of extended singing range (sings beyond the register lift: bb4 and above).

1. The words of the song appear to be the initial centre of interest rather than the melody, singing is often described as 'chant-like', employing a restricted pitch range and melodic phrases. In infant vocal pitch exploration, descending patterns predominate.
2. There is a growing awareness that vocal pitch can be a conscious process and that changes in vocal pitch are controllable. Sung melodic outline begins to follow the general (macro) contours of the target melody or key constituent phrases. Tonality is essentially phrase based. Self-invented and 'schematic' songs 'borrow' elements from the child's musical culture. Vocal pitch range used in 'song' singing expands.
3. Melodic shape and intervals are mostly accurate, but some changes in tonality may occur, perhaps linked to inappropriate register usage. Overall, however, the number of different reference pitches is much reduced.
4. No significant melodic or pitch errors in relation to relatively simple songs from the singer's musical culture.
Overall, approximately 2 years advantage in singing development for Sing Up participants (Welch et al, in press)
Longitudinal changes in the vocal pitching behaviour of a female chorister over a five-year period (song phrase above)

(Howard & Welch, in press)
Spectral changes (vocal timbre) in singing for the same female chorister over 4 years

(The truth of God the God of love,

(Howard & Welch, in press)
General singing ability in the adult population?

• The majority of adult individuals can carry a tune
  (Dalla Bella, Giguère, & Peretz, 2007; Pfordresher & Brown, 2007; Pfordresher, et al., 2010)

• 10-20% of the general population is inaccurate when singing a melody from memory, or in pitch-matching tasks
  (Dalla Bella & Berkowska, 2009; Dalla Bella, Giguère, & Peretz, 2007; Pfordresher & Brown)

• Occasional singers tended to sing at a faster tempo and with more pitch and time errors relative to professional singers....but....when asked to sing more slowly, they are as accurate as professional singers
  (Dalla Bella, Giguère, & Peretz, 2007; Larrouy-Maestri & Morsomme, 2014)
Singing and emotion
Neuropsychobiological design and music: the ‘bodymind’ (Pert, 1986; Thurman & Welch, 2000; Welch, 2005; Welch & Preti, 2015)

Music is an ‘emotional’ experience

Image by Tsiaras (2005)
Emotion and listening to music

• Intense pleasure when listening to music – experiencing an abstract sequence of sound unfolding over time – is associated with dopamine activity (in the mesolimbic reward system) [combined fMRI and PET study].

• The pleasure sequence of dopamine release over time embraces both anticipation and resolution.

• Also increase in heart rate ($p < 0.05$), respiration ($p < 0.001$) and electrodermal response ($p < 0.05$), with decreases in temperature ($p < 0.01$) and blood volume pulse amplitude ($p < 0.001$).

(Stimulating images of brain activity)

Nucleus accumbens – NAcc region – associated with reward

(Salimpoor et al, 2011)
Singing & physiological benefits

Singing in a choir rehearsal = reduction in cortisol (the stress hormone)

Clow (2009)
‘...group singing may lead to increases in positive feelings, decreases in negative feelings as well as to increases in the release of the hormone oxytocin, which has previously been implicated in intimate social bonding’ (Kreutz, 2014: 55)

Self-reported impact of singing compared to chatting in two choral rehearsals (Kreutz, 2014)
Low-stress and high-stress singing have contrasting effects on glucocorticoid response (Fancourt, Aufegger, & Williamon, 2015)

- N=15 professional singers, highly experienced as a group
- Singing with and without audience in a concert venue, two consecutive evenings
- Low-stress performance context = reduction in cortisol and cortisone, i.e., singing in itself is stress-reducing

BUT

- High-stress performance context (with audience) = increase in cortisol and cortisone

ALSO

- Levels of stress hormone impacted on levels of singers’ perceived anxiety
Other physical benefits?
• There is evidence of short-term and long-term health and well-being benefits of group singing – for young and old
• Physical benefits include improved vocal and lung functions, enhanced mobility and strengthening posture
• Psychological benefits include distraction, positive thoughts, feelings and emotions
• Social benefits include sharing positive experiences with other people, opportunities for social interactions and social acceptance

(Kreutz & Clift, 2015)
Singing and performance: 
Solo *versus* Group
Performance anxiety in relation to context

• Solo performance produced higher levels of performance anxiety (both classical and other-than-classical musicians)

• Anxiety levels increased as the performance event approached, reaching a peak immediately before performing and decreasing during the actual solo or group performance

(Papageorgi, Creech & Welch, 2011)
The presence of anxiety in solo and group performances

% of participants feeling distressed 1 hour, immediately before and during performances (summary of three conditions)

<table>
<thead>
<tr>
<th>Distress level</th>
<th>Solo performance</th>
<th>Group performance</th>
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<tbody>
<tr>
<td>LOW</td>
<td>39.8%</td>
<td>75.1%</td>
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<tr>
<td>MODERATE</td>
<td>14%</td>
<td>10.1%</td>
</tr>
<tr>
<td>HIGH</td>
<td>46.2%</td>
<td>9.8%</td>
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- **Solo** performances tended to evoke high levels of distress
- **Group** performances induced low levels of stress

(Papageorgi, Creech & Welch, 2011)
Social benefits?
The musical brain is a social brain
Neurological differences in singing alone or with others

Professor Larry Parsons with Jarvis Cocker

www.pbs.org/musicinstinct
Social benefits of singing?

Welch et al, 2014

National Singing Programme Research – Pupil questionnaire (Sept '08)

I am a  ☐  girl  ☐  boy

My first name starts with the letter: ____________

My last name starts with the letter: ____________

My date of birth is: the _____ of month ____ of year _________

1  I sing at school

2  Singing at school will make me a better singer

3  I think that we should sing more at school

4  I feel good about myself

5  I have sung in a performance at school

6  The boys in my class are better singers than the girls

7  I like the songs that I sing at school

8  The songs we sing at school are boring

9  The songs that I sing outside school are very different to the songs that I sing in school

Social inclusion questions x 15

Attitudes to singing questions x 45
Singing development, self concept and social inclusion

Correlation between sense of being social included and singing ability is similar for both groups ($n = 6,087$) ($p < .0001$)

But

Sing Up participants > Non-Sing Up participants

(Welch, Himonides, Saunders, Papageorgi & Rinta, 2014)
Similar data found in Italy: **Progetto Musica Regione Emilia-Romagna**

**Musica ed inclusione sociale**

dati del questionario - bambini n=190 (bambina = 112; bambino = 78)

![Graph showing data comparison between Project schools and Non-project schools for inclusione sociale. The graph shows a statistically significant difference with t(188), p<.0001.]

(Welch, Preti, Himonides & Toni, 2010)
Sing Up’s Chorister Outreach Programme

- Primary school children who experienced the Chorister Outreach Programme \( (n=943) \) had:
  - the highest positive mean attitudes to singing;
  - the strongest reported engagement with singing; and
  - the highest average social inclusion score

(Saunders et al, 2012)
Singing (dis)ability?
Singing and hearing – and our bodymind response

The Deaf Show Choir
performing as ‘Haverbrook School for the Deaf’
in ‘Glee’
N=34, aged 5-7 years, 20-week singing programme, including visual stimuli and feedback

Singing accuracy of pitch and vocal production score (blind scoring at the IoE by trained listeners)

- HI group far poorer than the NH group from the outset
- Improvements observed for HI group across sessions

(Welch, Vickers et al, in press)
Changes in singing range in semitones

Changes in pitch discrimination scores

(Welch, Vickers et al, in press)
Conclusions
Social benefits of music (and other arts)?

- Artistic behaviour involves many different parts of the brain acting simultaneously
- Successful involvement in arts will embrace integrated neural functioning and potential near and far transfer, including sense of social inclusion
- Benefits are possible across the lifespan (e.g., 570,000+ children, young people and adults attended music activities in 20 European concert halls in 2011 – Welch et al, 2012)
Key concepts

- Basic neuropsychobiological design and maturational development are mediated by socio-cultural imperatives (Altenmuller, 2004; McPherson, 2006; Welch, 2006)
- Particular musical behaviours become more or less developed (Welch, 2000; cf. Sternberg et al, 2000; Eraut, 2004)
- Learning happens within a social process (Engeström, 2001; Welch, 2007)
- Singing development is possible across the lifespan
- Negative experience can hinder or halt singing development – and impact negatively on singer identity
The Benefits of Singing in a Choir?

• Singing with other people brings a wide range of benefits, especially...
  – Physical
  – Psychological (including emotional)
  – Social

• This is in line with the kinds of the benefits that accrue from other successful group music making

• BUT is likely to be more marked for singing because the human voice is an integral part of our identity, of who we are...
Acknowledgements

Research is a collaborative activity

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