Benefits of group singing for ageing well

An investigation of whether group singing achieves unique socio-emotional benefits when compared to other social leisure groups

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Abstract

Evolutionary theories propose that human musicality provides shared and positive emotional experiences, increasing social cohesion and facilitating pro-social behaviours. While there is much interest in how group singing may influence socio-emotional wellbeing, previous research may have inadvertently exaggerated the effects of choir participation through (1) methodological choices that failed to consider the role of preference and choice as contributors to wellbeing, (2) controls that failed to incorporate some of the non-specific characteristics of the choir experience, and (3) limited variation in testing timeframes. The research reported here explored the implications of these theories through changes in emotional, social and mental wellbeing, considered within the context of ageing well. Untrained, no-audition community choirs, focused on enjoyment and inclusion rather than technical ability, were compared to exercise groups and more sedentary social activities using various timeframes and a mixed methods approach. Comparing to group activities which shared key non-specific characteristics allowed isolation of any unique effects of group singing, while conducting the research in a natural environment controlled for effects of agency, choice and preference. In the first study (N=79), immediate (post-activity) benefits in positive affect, group cohesion and energy were observed for choirs, exercise groups, and more sedentary discussion groups. The second study (N=65) revealed long-term benefits in emotional wellbeing (+7months from baseline) and a temporary reduction in mental wellbeing (+3 months from baseline) for both choir and exercise groups. Similar benefits were described, including social connection, confidence, mental and emotional states, but motivation for participation differed. Mechanisms underlying benefits were investigated in the third study (N=190), with movement and social opportunities shown to facilitate greater wellbeing changes than music engagement, and individual differences in motivation and experiences of flow also facilitating improvements, with exercise groups reporting broader wellbeing benefits through a wider range of mediators. These findings point to important wellbeing benefits for choir participation when motivation and preference are considered; however, these benefits do not appear to be heightened when compared to other kinds of engaging social groups or mediated by unique mechanisms. Both activity elements and individual motivation were found to facilitate improved wellbeing, and these effects were shared across differing social group types. An ecological model of person-activity fit is therefore recommended when matching an individual to a social group. Implications for social prescribing and community programs are discussed.

Declaration of authorship

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes four original papers published in peer reviewed journals. The core theme of the thesis is exploring the utility of group singing pertaining to socio-emotional wellbeing. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the student, working within the School of Psychological Sciences under the principal supervision of Adjunct Associate Professor Nikki Rickard.

The inclusion of co-authors reflects the fact that the work came from active collaboration between researchers and acknowledges input into team-based research. In all instances I am listed as the primary author who had primary duties pertaining to scoping the research, recruitment, developing materials, conducting the research, analyzing the data and writing up the findings. My supervisor is listed as second author in all instances excepting the fourth paper, as noted below, which was co-authored by myself, my primary supervisor and my two co-supervisors. My primary supervisor provided valuable guidance and input in all aspects of the research reported here and its publication.

In the case of *chapters 2, 5, 6 and 7* my contribution to the work involved the following:

Thesis Chapter	Publication Title	Status	Nature and % of student contribution	Co-author name(s) Nature and % of Co-author's contribution*
2	Wellbeing in the classroom: How an evolutionary perspective on human musicality can inform music education	Published	70%. Concept and writing first draft	Nikki Rickard – 30%. Draft revision and journal placement
5	A comparison of the effects of short-term singing, exercise, and discussion group activities on the emotional state and social connectedness of older Australians	Published	70%. Concept and collecting data and writing first draft.	Nikki Rickard – 30%. Assistance with data analysis and draft revision
6	The benefits of participation in a choir and an exercise group on older adults' wellbeing in a naturalistic setting	Published	70%. Concept and collecting data and writing first draft.	Nikki Rickard – 30%. Assistance with data analysis and draft revision

7	Socio-emotional benefits associated with choir participation for older adults related to both activity characteristics and motivation factors	Under review	70%. Concept and collecting data and writing first draft.	Nikki Rickard, Dianne Vella-Brodrick, Jane Davidson – 30%. Assistance with data analysis and draft revision.

I have incorporated submitted or published papers into the body of the thesis text including renumbering pages and listing references at the end of the document in order to generate a consistent presentation within the thesis. Due to the nature of thesis by publication, please note that some repetition is unavoidable, although I have attempted to minimise while still maintaining a coherent document.

Student signature: **Date:** 21 April 2021

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the student's and co-authors' contributions to this work. In instances where I am not the responsible author I have consulted with the responsible author to agree on the respective contributions of the authors.

Main Supervisor signature: **Date:** 21/4/2021

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As this research was formed and reformed, took shape and fell apart and took shape again, many people had a hand in supporting me and the ideas that have grown into this body of work.

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Many thanks are due to Stuart Lee and Janette Tamplin, who provided input and oversight across the course of this PhD as reviewers in each of my three milestone events. Your support and enthusiasm, in addition to your willingness to go the distance across the many years that this process encompassed, is much appreciated.

On the home front, nobody felt more pain arising from my lack of free time as well as those occasional days of discouragement than my family. To Matthew, who has been supportive in every way possible, I thank you for your love, encouragement, problem-solving skills and for keeping my laptop running. To Mix and Evan, thank you for your patience for a mom who often had her mind ruminating on things other than what was immediately at hand; perhaps I will be better at finishing my sentences now.

There are many people to thank for supporting the completion of the research reported here. First and foremost are those who actively participated in the studies. For the research reported in chapters 5 and 6, many community organisations welcomed me back over and again for various forms of data collection. These include the wonderful people at:

U3A Nunawading
U3A Manningham
Box Hill Community Arts Centre Choir
Open Door Singers Diamond Valley
Open Door Singers Docklands

All the activity leaders were supportive, helpful, curious and interested. In the process I was also invited to sing, stretch, exercise and discuss current events, which was delightful.

The participants in the study reported in Chapter 7 were enthusiastic both about participating and also about sharing the research within their networks. So many diligently filled the daily diary questionnaire, for which I am forever grateful.

I also wish to acknowledge the helpful assistance from Catherine Martin through the Monash Statistical Consulting Service in determining the appropriate statistical analysis to use in the data collected from the observation methodology reported in chapter 5.

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I appreciated the assistance from lab mates Abdullah Arjmand and Elizabeth Seabrook in conducting the observation methodology reported in chapter 5.

Amanda Nagulendran entered the data for the psychometric questionnaires reported in Chapter 6.

This research was supported by an Australian Government Research Training Program (RTP) Scholarship.

I have great appreciation for annual study leave provided by my employers, Good Shepherd Australia New Zealand, which allowed me to spend extended focused time on working through the data, writing the papers, and most recently pulling together the thesis.

The timing of publication for this thesis, exploring how leisure group activities improve wellbeing, at a time when COVID-19 is keeping so many of us apart, is not lost on me. We have all learned just how much is lost when we are unable to come together, and it is my hope that we will soon be able to return to classrooms, gymnasiums, lecture halls, community centres, sanctuaries and all the other places where people gather to connect and co-create.

This thesis is dedicated to my mother, Mary Rodgers Connelly, who joined the Silver Sounds choir at the same time that I embarked on this PhD. She sang her way through my years of research and it breaks my heart that she is not here to read the finished product.

Chapter 1: Thesis overview

"We can only explain the human propensity to make and listen to music by recognizing that it has been encoded into the human genome during the evolutionary history of our species." – Steven Mithen, The Singing Neanderthals[1]

Introduction

Music is a ubiquitous human behaviour that is both ordinary and mysterious. Although present in every known culture throughout history (Brown & Jordania, 2013), and despite the complex cognitive capabilities required to decode and create music (Koelsch & Siebel, 2005), it remains unknown why humans developed the ability. Does it serve a survival purpose, or is it merely a spandrel, left over from other advantageous capabilities that were developed over time?

While the evolutionary origins of music are debated from a range of perspectives (Brown et al., 1999; Honing et al., 2013; Mithen, 2011; Wallin et al., 2003), some theorists have proposed that joint music-making may have created a shared emotional experience which was generally positive, facilitating enhanced group cohesion; this in turn led to increased expressions of pro-social behaviours (Cross, 2009; Cross & Morley, 2009; Dunbar et al., 2012; Fitch, 2006; Perlovsky, 2010; Perlovsky, 2011; Savage et al., 2020; Schulkin & Raglan, 2014; Tomlinson, 2013). It could be that cooperative music-making continues to provide these benefits today. While these changes are generally discussed as immediate and short-term (that is, experienced during and directly after group singing), it has also been proposed that regular participation in group singing will lead to stable, persistent changes (Greenberg et al., 2008; Koelsch, 2013). This reflects evolutionary theory with regards to music's facilitation of cooperation and social bonding (Schulkin & Raglan, 2014), leading to the development of what Dunbar (1998) terms the 'social brain'. The evolutionary theory base for understanding adaptive benefits of group singing is reviewed in Chapter 2 of this thesis.

There has been increasing interest both in research and clinical settings (Dingle et al., 2019), as well as by the public[2], in understanding whether group singing continues to yield these theoretical

[1] Mithen, S. (2011). *The singing Neanderthals: The origins of music, language, mind and body*, p. 1.
[2] See for example, Stanborough, R. J. (2020). "10 ways that singing benefits your health." Healthline (10 November 2020) access at https://www.healthline.com/health/benefits-of-singing ; Claydon, S. (2018). "The science behind

benefits in contemporary populations. Much of this work is nested within a broader music psychology research agenda exploring the ways that music engagement may influence physical, cognitive and socio-emotional changes (see for example Hargreaves & North, 1999; Juslin & Sloboda, 2010; MacDonald et al., 2013; Rentfrow, 2012). Music-based endeavous have gained an almost privileged status as a healing activity, supported in part by startling transformations resulting from highly clinical therapeutic interventions such as enabling patients with Parkinson's Disease to synchronise their gate in order to walk with greater ease (Pereira et al., 2019), or providing access to deeply hidden memories in people with Alzheimer's disease (Moreira et al., 2018). Music use is increasingly considered as a complementary therapy to health interventions, including as a non-pharmaceutical pain management tool (Lu et al., 2020) or assisting people to overcome addiction withdrawal symptoms (Carter & Panisch, 2020).

'Social prescribing' describes how health professionals are incorporating arts-based activities, including music engagement, further 'upstream' as a proactive and protective health measure (Robinson, 2018; Roland et al., 2020). The social prescribing movement promotes non-medical interventions to address the negative health impacts of various social determinants of health, including for example the well-known consequences of loneliness and social isolation (Haslam et al., 2018; Steptoe et al., 2013). Participation in community choirs, incorporating social connection, music engagement and the cognitive challenge of learning something new, is often promoted as an ideal intervention with important socio-emotional health benefits (Batt-Rawden & Anderson, 2020), particularly for older people who can struggle to remain socially connected but may not have the physical stamina for other interventions (Cohen, 2020; Joseph & Southcott, 2018). As bodies age and become increasingly frail, many formerly-enjoyed activities may become less viable, while singing remains an accessible activity that is available to virtually everyone. For older people, thoughtful repertoire choice can also raise nostalgic and positive memories, increasing positive affect (Costa et al., 2018; Jakubowski & Ghosh, 2019). While leisure activities are generally good for older people's health and wellbeing, choirs seem particularly well positioned to support aging well. As populations age globally, supporting older people to age well has become a priority for many governments – both because older people are making up a large portion of the overall population, but also to alleviate impending stress on the public health system (Christensen et al., 2009; Reeves et al., 2018; United

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why choir-singing is good for you." *CBC radio blog* (29 March 2018), access at https://www.cbc.ca/radio/blogs/the-science-behind-why-choir-singing-is-good-for-you-1.4594292 ; Keating, S. (2020). "The world's most accessible stress reliever." *BBC* (19 May 2020), access at https://www.bbc.com/future/article/20200518-why-singing-can-make-you-feel-better-in-lockdown

Nations, 2020). Understanding how group singing – an accessible and enjoyable social activity – may support wellbeing in older age therefore has important policy and social implications. This is explored further in Chapter 4.

Consequently, there is a growing body of research into the wellbeing effects of choir participation. Reported findings include improvements in mood (Bullack et al. 2018; Clift & Hancox, 2010; Kreutz, 2014; Kreutz et al., 2004; Sanal & Gorsev, 2014; Sandgren, 2009), sense of social connection (Bullack et al., 2018; Dunbar et al., 2012; Johnson et al., 2020; Pearce et al., 2017; Pearce et al., 2015; Weinstein et al., 2015), and pro-social behaviours (Cross et al; 2010; Egermann & McAdams, 2013; Miu & Baltes, 2012). Physiologically, changes in immune system responses, reductions in cortisol, increases in oxytocin or changes in pain tolerance have also been observed (Daykin et al., 2018; Dunbar et al., 2012; Kang et al., 2018; Kreutz, 2014; Kreutz et al., 2004; LiKamWa et al., 2020), concurrent with overall improvements in mental health and quality of life (Cohen et al., 2006; Coulton et al., 2015; Ganzoni, et al., 2020). Such findings further elevate group singing as a primary intervention strategy to effect a range of health and wellbeing outcomes. In fact, it is claimed by some to be itself a social determinant of health; Stewart and Irons (2018) have argued that situating music within a social determinants of health framework is timely "when we are increasingly looking to prevent high-cost health expenditure and promote ways to make people feel valued, engaged, connected, and empowered" (p. 28).

Research Rationale

There is substantial agreement that music engagement generally, and group singing in particular, can have a powerful effect on socio-emotional wellbeing. The evolutionary theories that underpin much of this body of research provide a robust explanation as to why group singing facilitates wellbeing, as reviewed in Chapter 2. However, the ubiquity of music in the community and the attractiveness of evolutionary explanations for its benefit may also have encouraged an inference that choir participation yields *greater* wellbeing benefits than those provided by other leisure activities, which is underpinned by how some research results have been reported. This inference, however, may not be entirely supported by empirical data. In Chapter 3 of this thesis, the literature is critically examined to provide an objective scrutiny of whether choir participation is likely to lead to greater improvements in wellbeing than other forms of leisure group participation. This analysis reveals that Chapters 5, 6 and 7 report on a series of empirical studies designed to explore the effects of group singing in comparison to other social leisure group activities, with the final chapter a general discussion of all empirical findings in the context of the broader research area. The research reported in this thesis attempted to address a number of key gaps identified in the literature review. The following section summarises these key areas of potential for future research, followed by the approach taken in the current research program to address these gaps.

First, an examination of comparative studies (Chapter 3) reveals that in an effort to provide a highly controlled experimental setting, many studies remove such fundamental contributors to wellbeing as preference and agency. Often, control conditions are a cessation state, in which individuals who are active participants in a choir setting are forced to refrain from singing – which, unsurprisingly, can lead to wellbeing decrements in the control condition. While such studies can provide some information about group singing and wellbeing changes, there is a notable lack of comparison research conducted in *natural* settings, where the positive benefits of choir participation predicted by evolutionary theory can be understood as it is experienced by individuals in everyday life, and whether these benefits compare to those experienced by people participating in other engaging and chosen leisure activities. Clarifying whether choir participation provides unique or enhanced benefits has important implications within clinical and community settings, where understanding how choice and preference influence benefits from leisure activities is critical for effective interventions.

To address this gap in previous research, the studies reported here recruited participants who were already active a choir, and at no point in the research process were participants required to cease participation. The operationalisation of 'group singing' in this thesis was the 'community choir'. The rationale for this decision was that the emphasis in these choirs is on participation, inclusion and enjoyment rather than on technical ability. Untrained group singing more closely approximates ancient group music-making while also incorporating an emphasis on wellbeing through providing positive experiences and social opportunities.

Second, where previous research has compared group singing to another activity, comparison groups are often chosen that share few characteristics with choirs, such as creative writing, discussion groups or crafting groups (Allpress et al., 2012; Dingle et al., 2017; Grape et al., 2010; Pearce et al., 2017; Unwin et al., 2002). This is entirely appropriate for providing greater contrast between condition and control groups. However, a limitation of this experimental choice is that it may exaggerate the effects of choir participation on wellbeing when compared to other common and enjoyed leisure activities that incorporate music exposure and/or movement. Where comparison activities are more similar, such as exercise or other kinds of music creation, differences between groups are generally negligible (Lonsdale

& Day, 2020; Valentine & Evans, 2001). It has therefore been recommended that findings from both types of design will generate more robust conclusions about effects sizes of group singing (Dingle et al., 2019).

In the current research, comparison groups were drawn from leisure activities that individuals choose to participate in for enjoyment. Across the studies reported in this thesis, there is a focus on exercise groups as a primary comparison group. Exercise groups were chosen because, like choirs, they are known to improve wellbeing, and they also share some of the nonspecific components of choirs, such as social opportunities, music exposure, and movement that is often synchronous or coordinated. Comparison groups that share some of the characteristics and wellbeing outcomes of choirs may have been absent from some experimental research studies because of the feasibility of observing them authentically in research settings. More naturalistic settings, however, enable inclusion of a greater range of robust control group activities. More sedentary leisure groups were also used as a third control group in some comparisons.

Third, the majority of studies have followed effects across a very short timeframe (pre- to post-session). While such studies can answer questions about short-term changes in wellbeing markers, fewer studies examine whether longer-term engagement with group singing might consolidate changes over time, impacting on more stable wellbeing constructs, for example emotional wellbeing rather than affective state (Frederickson & Joiner, 2002). For example, there is interest in whether musical interventions can promote pro-social behaviours in children (Beck & Rieser, 2020; Good & Russo, 2016; Kirschner & Tomasello, 2010) and people with autism spectrum conditions (Greenberg et al., 2015), or in assisting people with affective disorders such as depression (Aalbers et al., 2017; Zhao et al., 2016) or anxiety (Ing-Randolph et al., 2015). If music is efficacious in these instances, it could be that regular group singing may have potentially less dramatic but more universal benefits such as facilitating a positive affective style, greater empathic responses, or increased expression of prosocial behaviours. Persistent effects are clearly more beneficial for long-term health and wellbeing, so this extended timeframe provides necessary additional insight. For studies which have assessed effects over longer periods of time, the findings are mixed. For example, the studies reviewed in Chapter 3 variably demonstrate persistent effects at 12 months (Cohen et al., 2006), effects which peak at 3 months then decline at 6 months (Coulton et al., 2005), or are absent at 6 months (Johnson et al., 2020) for several measures and similar study designs with older populations and a no-activity control. The variable outcomes, including measures that fluctuate across the length of the studies, make it unclear whether benefits consolidate into traits across time.

As reported in Chapter 6, the current research was designed to enable examination of whether wellbeing effects from choir participation are transient, or whether they accumulate into more stable traits through regular exposure – for example, in the consolidation of pro-social behaviours, a more positive overall emotional state, or overall improved mental wellbeing. These changes are tracked in a non-clinical population, to determine whether choir participation may promote longer-term changes in socio-emotional wellbeing for healthy older adults.

Fourth, most studies use methodologies that fail to capture variations in wellbeing from day to day. Better understanding such fluctuations could illuminate how engaging in community choirs, or other leisure activities, influence wellbeing in everyday settings and alongside various types of activities. While utilising pre-to post-session surveys or intermittent sampling can provide information on in-the-moment changes, an experience sampling methodology (ESM) provides insight into how choir participation influences wellbeing across concurrent days that also includes other social encounters, everyday hassles, and responsibilities such as employment or caring duties.

The research reported in Chapter 7 used an ESM to provide an additional perspective in the measurement of how the characteristics of the choir experience may influence wellbeing. By collecting data on a daily basis over several days, it could be determined whether certain activities, for example music engagement, exercise, or social interactions, consistently raised wellbeing markers despite the variety of other activities that individuals engage in from day to day.

Fifth, much of the research conducted with older populations within the discipline of music psychology focus on older people who are already experiencing health challenges, with a particular focus on dementia (e.g., Baird & Thompson, 2018; Cooke et al., 2010; Sung & Chang, 2005; van der Steen et al., 2018). While there is much interest in how music engagement can facilitate ageing well reflected in many qualitative reports (Batt-Rawden & Andersen, 2020; Creech et al., 2013; Hays & Minichiello, 2005; Joseph & Southcott, 2018; Lee et al., 2018; Varvarigou, et al., 2012), there are fewer mixed methods studies which focus specifically on healthy and active older people and how their participation in community choirs or other selected social activities may be supporting successful ageing.

The current research focuses on an older sample of the population, thereby providing insight into how community choir participation might promote maintenance of social connections and quality of life into older age. Healthy older adults who were socially active were recruited, in order to better understand how wellbeing is experienced outside of clinical settings and in everyday environments. This decision was made to ensure the findings from this research would be relevant for a range of community-based interventions, including social prescribing, selection of leisure activities within institutional settings, or for government-funded programs targeted at older individuals.

Finally, the majority of previous research on choir participation benefits has been performed within the music psychology discipline. As a result, the focus has largely been on the unique properties that the choir experience may provide, with an assumption that changes in wellbeing are driven by the characteristics of the activity, such as music engagement, movement and social opportunities. However, the wellbeing literature can provide a much-needed adjunct to this theoretical framework. Effects of participating in any leisure group activity can also be understood by considering individual differences in mindset and needs. For example, self-determination theory (SDT) proposes that autonomy, competence and relatedness (that is, that a person's contribution is both necessary and valued by others) are basic psychological needs, and fulfilling them leads to improved wellbeing (Deci & Ryan, 2008). While some researchers have utilised an SDT framework to understand changes in wellbeing as a result of music participation (Krause et al., 2019; Lonsdale & Day, 2020), this approach is seldom considered when exploring informal or untrained music-making. SDT considers motivation as central to fulfilling psychological needs, with people who are intrinsically motivated, or at least freely choosing to participate in an activity (for example, because they are motivated by the outcome even if the activity is not enjoyable), much more likely to experience improvements in wellbeing (Marcinko, 2015; Ryan & Deci, 2000). Closely associated with intrinsic motivation are experiences of flow, which is commonly reported when engaged in musical activities and is known to positively influence wellbeing (Chirico et al., 2015; Fritz & Avsec, 2007).

In the current research, the contributions of both the core elements of the choir experience and those of individual mindset towards participation were explored, as reported in Chapter 7. This approach allows for better understanding of what their unique contributions to improved wellbeing may be in a community choir setting. This dual focus elevates two distinct contributors to wellbeing with the intention of better elucidating correct attribution of wellbeing changes.

In summary, evolutionary theories of music's capacity to improve socio-emotional wellbeing and enhance social cohesion are of great interest to researchers, practitioners and the general public. It could be that community choir participation, with its overlay of music engagement, movement and social opportunities, can provide superior wellbeing benefits when compared to other kinds of organised social activities. However, limitations in methodological designs prevent a definitive conclusion to be drawn on this question. Furthermore, the relative contribution of the characteristics of the choir itself as opposed to the effect of individual differences in motivation and agency to positive effects of choir participation are not clear. Clarifying these points is particularly salient for supporting older people to age well, for example through social prescribing initiatives or when providing clinical or community leisure group offerings to support better health and wellbeing.

Current Research Purpose

The research reported in this thesis explores whether community choir participation elicits both immediate and persistent benefits for wellbeing in older people, and whether these changes are superior to those experienced by other social groups which share some of the nonspecific characteristics of the choir experience. An attempt was also made to clarify whether the mechanisms underlying any benefits observed are similar across choir and other social leisure group activities, and the relative importance of group characteristics (e.g., music, movement, and/or social connection) to this effect as opposed to individual differences in mindset (e.g., motivation, agency, experiences of flow).

Research Aims and Specific Research Questions.

The aims and specific research questions of this research program were:

Aim 1: To assess short-term changes in wellbeing following participation in a community choir in comparison to group leisure activities.

Specific Research Questions:

1. Does group singing provide short-term wellbeing benefits, specifically increases in positive affect, reductions in negative affect, increases in energy levels, and increases in sense of social connection?
2. Does group singing provide greater short-term wellbeing benefits than comparison social group leisure activities that may or may not share similar activity characteristics?

Aim 2: To assess longer-term changes in wellbeing following participation in a community choir in comparison with other group leisure activities.

Specific Research Questions:

3. Does group singing provide longer-term wellbeing benefits, specifically increases in emotional and mental wellbeing, empathy and sense of social support?
4. Does group singing provide greater longer-term wellbeing benefits than social group leisure activities that share similar activity characteristics?
5. Do members of a choir describe wellbeing benefits of their participation qualitatively differently than comparison groups?

Aim 3: To identify mechanisms underlying changes in wellbeing following participation in a community choir in comparison with other group leisure activities.

Specific Research Questions:

6. What mechanisms explain wellbeing benefits for choirs? Are they similar to other kinds of social group wellbeing mechanisms?
    a. What is the role of the activity's characteristics? Specifically, this thesis examines the role of music engagement, movement, and social interactions.
    b. What is the role of individual mindset towards participation? Specifically, this thesis examines the role of motivation, experiences of flow, and sense of agency.

General methodological approach

A mixed-methods approach was employed in this research program. Quantitative data drawn from psychometrically validated questionnaires were used, which has the advantage of being comparable with other published research. Additionally, qualitative data were generated from a custom-designed observation method that could track emotional changes across a group and over time. Qualitative data were also obtained from inclusion of open-ended questions that allowed both condition and control group participants to reflect on how their social group participation impacted on their wellbeing and may provide benefits that become embedded in their daily lives, external to the group. Finally, the ESM methodology allowed individuals to quantitatively report on their wellbeing 'in the moment' (i.e., how happy, how connected, how active they felt) as well as any musical, exercise or social activities they had engaged in on a daily basis. This process avoided recall bias and acknowledges that many diverse experiences across a day influence wellbeing. All data were collected prior to the onset of COVID-19 and the concurrent lockdown orders that have made it difficult or impossible in many cases to meet in person for organized social group activities in much of the world.

Emotional, social and mental wellbeing were the primary outcomes across this set of studies, and were identified from the literature as the primary forms of wellbeing that group singing is expected to influence. These constructs were operationalised as follows:

- Emotional wellbeing: Increases in positive affect, decreases in negative affect, increased arousal.
- Social wellbeing: Increase in sense of group bonding, social connection and empathic responses.
- Mental wellbeing: Affective, cognitive and psychological functioning.

A full description of methodologies and measurement tools is provided for each study within each empirical chapter of this thesis, and each of the tools provided in full in the Appendices. The methodological approach is, however, summarised in Table 1.

Table 1.1

Research aims and summary of employed methods

Research aims	Method 1	Method 2	Benefits of approaches
Investigating immediate wellbeing benefits	Psychometric questionnaires were administered to participants (choir, exercise group and discussion group members) directly before and immediately after a session to determine changes in emotional, social and arousal levels.	An observation methodology was developed to visually observe emotional changes across each group under observation (choir and exercise groups), by tracking specific physical behaviours. These included changes in facial expressions (e.g., smiling, raised eyebrows) and stance (e.g., arms crossed or touching another participant).	The questionnaires provided a psychometrically validated and reliable method of measuring changes across a short period of time, while the observation methodology provided criterion validation for the survey outcomes, as reflected in changes in individual behaviours. The observation methodology is also one of the few processes that can track changes across a group, e.g., identifying the 'contagion effect' of positive emotions. It also provided a more granular method of identifying changes in mood and behaviour.
Investigating persistent wellbeing benefits	Psychometric questionnaires were filled by participants (choir and exercise group members) to measure whether changes in socio-emotional wellbeing were consolidated across seven months. Questionnaires were filled at a time and place of their choosing at the start of the year when activities were starting up, at mid-point, and close to the end of the year when activities were close to their end-of-year break.	Open-ended questions were completed by participants (choir and exercise group members) concerning their expectations of benefits from group participation, actual benefits they identified, and whether any benefits were consolidated into their life more generally (that is, manifesting external to the group).	The longer time-frame provided an opportunity to identify whether short-term wellbeing changes were consolidated over time, moving from state to trait characteristics. It is unusual to use an open-ended response for both intervention and control groups, which allowed for a unique comparison of how choir and exercise group members discussed the benefits of participation in their lives.
Investigating possible mechanisms for changes in wellbeing	An online psychometric questionnaire was filled by participants (choir, exercise group, and other social group members) which asked about wellbeing outcomes (emotional, social and mental) as well individual mindset towards participation that may explain wellbeing changes (motivation, flow, and the components of self-determination theory).	A daily diary methodology asked participants to rank their wellbeing levels each night (happy, connected, active) as well as activities they had participated in that day (music engagement, singing or exercising alone or with others). Responses were analysed to identify correlations between activities, social experiences, and wellbeing markers.	The online questionnaire allowed for an examination of whether individual mindset towards participation may explain wellbeing changes, and whether these mechanisms were shared or differed across different kinds of leisure groups. The daily diary data provided unique insight into how everyday activity influences daily fluctuations in wellbeing markers.

Organisation of thesis

This thesis incorporates both theoretical framing and empirical research. CHAPTER 2 provides an overview of why group singing may be expected to provide enhanced wellbeing benefits, drawing on an evolutionary framework. While this chapter incorporates the first published paper of this thesis, it has been rewritten, first to better align with the empirical research which is focused on older people, and second to provide updates as needed since publication. The original article is entitled "Wellbeing in the classroom: How an evolutionary perspective on human musicality can inform music education," and is provided in its published form in the appendices.

CHAPTER 3 reviews choir wellbeing research that utilises comparison groups. This review provides a critical examination of methodological shortcomings that may have led to an exaggeration of the wellbeing benefits that choir participation can provide.

CHAPTER 4 provides an overview of leisure groups and wellbeing research, as well as the links between exercise and wellbeing. This situates the comparison studies within a wider framework of wellbeing research focused on organised social groups, and provides a justification for using exercise groups as the primary comparison group.

CHAPTER 5 reports on two studies exploring immediate (pre- to post-session) changes in wellbeing. Study 1 compares older participants in either a choir, an exercise group or a discussion group on short-term changes (pre- to post-session) in wellbeing, while Study 2 utilises an observation methodology to compare changes in behaviours across both the choir and exercise groups. This chapter comprises the second published paper of this thesis, titled "A comparison of the effects of short-term singing, exercise, and discussion group activities on the emotional state and social connectedness of older Australians."

CHAPTER 6 reports on a quantitative study comparing longer-term (7 months) changes in wellbeing for both older choir and exercise group members, and qualitative responses to how individuals in both groups describe the benefits of participation across time. This chapter is the third paper published as a part of this thesis, titled "The benefits of participation in a choir and an exercise group on older adults' wellbeing in a naturalistic setting."

CHAPTER 7 reports on two studies designed to identify potential mechanisms for wellbeing improvements. Study 1 surveyed members of choirs, exercise groups, and other kinds of organised social groups on measures of wellbeing as well as individual experiences of potential moderators, to explore what may mediate wellbeing changes and whether there are differences by group. Study 2 included a sub-set of Study 1, and collected ESM data across 14 days on ratings of wellbeing as well as daily activities, to understand how the core characteristics of the choir experience may influence wellbeing on a day-to-day basis.

CHAPTER 8 provides an integrated summary of findings and main contributions to the evidence base. Distinctive contributions from this set of studies are discussed, along with limitations and future directions for research.

Published papers and sharing expertise

This is a thesis by publication, and as such there is some necessary repetition, particularly in the introductory materials for the published papers. The document is organised with a comprehensive reference list at the end of the document and natural pagination in the bottom centre of the page.

Three published papers and one currently under review incorporate four chapters, drawn from the theory that informed the approach and the research conducted as part of this thesis. They are:

Paper 1: Maury, S., & Rickard, N. (2016). Wellbeing in the classroom: How an evolutionary perspective on human musicality can inform music education. *Australian Journal of Music Education, 50*(1), 3-15.

Paper 2: Maury, S., & Rickard, N. (2018). A comparison of the effects of short-term singing, exercise and discussion group activities on the emotional state and social connectedness of older Australians. *Music & Science, 1*, doi.org/10.1177/2059204318800607.

Paper 3: Maury, S. & Rickard, N. (2020). The benefits of participation in a choir and an exercise group on older adults' wellbeing in a naturalistic setting. *Musicae Scientiae*, June 2020. doi:10.1177/1029864920932633

Paper 4 (under review): Maury, S. Vella-Brodrick, D., Davidson, J. & Rickard, N. (submitted January 2021). Socio-emotional benefits associated with choir participation for older adults related to both activity characteristics and motivation factors.

Other forms of sharing expertise include the following:

- Contributed 60-second video on using music to enhance wellbeing during quarantine, 30 March 2020.
- Maury, S. (2020). Virtual Group Singing in the Time of COVID-19: Frivolous or Vitally Important? *PsychReg* (25 March 2020).
- Maury, S. (2019). Community May be the Key to Wellness. *PsychReg* (30 June 2019).
- Maury, S. (2019). Social Prescribing. *Case Magazine* (15 May 2019).
- Spoke to Triple J Radio about Pub Choir, 19 March 2018.

- Paper presentation: Comparing short-term benefits of singing, listening, and no-music group activities on socio-emotional wellbeing in older Australians. *3rd Conference of the Australian Music & Psychology Society (AMPS), incorporating the 5th International Conference on Music and Emotion,* 7 – 9 December 2017.
- Curator of @RealScientists Twitter account, 30 October – 5 November 2016.
- Maury, S. (2015). Join a choir for the human race, *Spoonful*, Issue 4.
- Radio interview on 2ser, 26 January 2015.
- Interview on Radio National, 14 January 2015.
- Maury, S. (2014). All together now: Three evolutionary perks of singing. *The Conversation* (24 December 2014).

Chapter 2: An evolutionary framework linking group singing with wellbeing outcomes

Preamble

This chapter considers group singing within an evolutionary framework. Evolutionary theories propose that group singing is advantageous for specific socio-emotional benefits that may have facilitated improved cooperation amongst hominids. This framework is overlayed with the research on wellbeing and aging well to develop specific and testable hypotheses.

This chapter is drawn from an article published in the Australian Journal of Music Education. Approximately 80 per cent of the text remains unchanged, however the article has been re-written to conform to the focus on older populations, and to also update to more current references in some instances. The original article is provided as an appendix.

Citation (original article): Maury, S., & Rickard, N. (2016). Wellbeing in the classroom: How an evolutionary perspective on human musicality can inform music education. *Australian Journal of Music Education, 50*(1), 3-15.

Abstract

Group singing is increasingly recommended as a leisure activity for older people. This article proposes that an evolutionary lens provides a helpful framework for understanding how untrained community choir experiences may facilitate wellbeing improvements. Specifically, group singing may a) create a shared emotional experience which is generally positive; and b) increase group cohesion and pro-social behaviours. It is proposed that, while these changes are generally immediate and short-term, regular participation in group singing may lead to stable, persistent changes in affective style and sociability. These proposed benefits align with socio-emotional wellbeing markers that are linked to successful aging. Furthermore, there may be important cognitive benefits for the ageing brain.

Key words: successful aging; singing; wellbeing; emotion; social bonding; evolution

The role of social and emotional wellbeing in aging well

In recent years, there has been increasing recognition that social-emotional wellbeing is a significant contributor to aging well. Globally, older populations are expected to outpace growth of younger populations for the next 35 years, resulting in an estimated tripling in the population aged 65+ by 2050 (He et al., 2016). This demographic shift presages many socio-economic changes, not least of which is how governments will provide sufficient and tailored health services for this aging population (Kinsella & Phillips, 2005). Interest in understanding how to support people to age well has therefore increased significantly in recent years.

'Aging well' is defined in various ways, but generally incorporates dimensions related to physical and mental health, cognitive functioning, and subjective quality of life, such that people are able to thrive into advanced age (Depp & Jeste, 2006). While academic definitions of aging well often include a lack of chronic conditions, individuals are less likely to consider a chronic condition to be a detriment to leading a fulfilling life (Parslow et al., 2011; Strawbridge et al., 2002); this indicates that factors other than physical functioning may be weighted higher in assessing the quality of life day-to-day for older people. While predictors of aging well include an adequate income (Luo & Waite, 2005) and a healthy lifestyle (Kendig et al., 2014), importantly for this review it also includes the wellbeing markers of social connection (Coll-Planas et al., 2017; Holt-Lunstad et al., 2017; Nyqvist et al., 2013; Rohr & Lang, 2009), positive emotional states (Mhaske, 2017; Reichstadt et al., 2007), and cognitive and affective functioning (Greenwood, 2007; Reuter-Lorenz & Lustig, 2005; Yaffe et al., 2009).

A range of initiatives and programs have been developed to provide older people with opportunities to enhance their wellbeing, and group singing has long been a popular option across a variety of settings (Bungay et al., 2010; Cohen, 2020; Daykin et al., 2018; Skingley et al., 2016). From an evolutionary perspective, it has been argued that joint music-making was adaptive because it helped individuals to regulate emotions and strengthen bonds. By understanding music as a positive social-emotional activity, its importance is augmented in assisting older populations to age well. In this chapter, evolutionary theories of group singing are linked to a wellbeing framework to help understand how this leisure activity may be best tailored to the needs of an older population. While the benefits highlighted by evolutionary theories are likely to be found in any joint music-making activity, the focus in this chapter is on singing because it: a) is accessible to virtually everyone even without training; b) there is little to no cost associated with participation; and c) from an evolutionary perspective, it is assumed to have been the first and primary mode of collective music-making.

An evolutionary perspective on music

Music is a universal expression in both individuals (with very few exceptions of individuals with amusia) (Blacking, 1973; Koelsch, 2012; Tomlinson, 2013; Trehub, 2001) and societies, throughout history (Brown & Jordania, 2013; Cross, 2003; Titon & Slobin, 1996). While instruments have been dated back at least 40,000 years (Zatorre & Salimpoor, 2013; Zhang et al., 1999), Morley (2014) suggests vocal music could extend between 400,000 – 600,000 years ago. The creativity and emotional content associated with music-making appears to be uniquely human, as animal-generated music is generally thought to lack improvisation, instead being used to communicate specific information (Tomlinson, 2013; Trehub & Hannon, 2006). Additionally, the significant cognitive resources required to create, decode, and appreciate music suggests it provides valuable human benefits (Warren, 2008).

There is much debate about what role music-making, and singing in particular, may have had in evolutionary terms. Steven Pinker famously mooted that music is nothing more than a spandrel – a by-product of other cognitive and social functions which provided no evolutionary advantage and is in effect a pleasant but accidental curiosity (Pinker, 1997). Many others have suggested that music and language are closely linked (see Arbib, 2013 for a comprehensive exploration), and that proto-music led to the development of language, that language led to the development of music, or that they co-developed (see Mithen, 2005 for overview). Theories linking music and language tend to agree that the most important evolutionary contribution of music is the development of language.

In recent years, an alternate explanation for music's development has been suggested: that music is neither a spandrel, nor does its importance rest solely on its links with language. Rather, music provided very specific and unique benefits to human evolution, through at least two pathways. Specifically, group singing may have created a shared, overwhelmingly positive emotional experience; and it may have increased group cohesion and pro-social behaviours.

Music is first and foremost affective messaging, which prior to modern times was by necessity co-created (Cross, 2014). For hominids, developing a shared emotional state may have strengthened the group bond while facilitating group decision-making and prioritising, as emotions serve the purpose of prioritising actions (Carver & Sheier, 1998; Cosmides & Tooby, 2000; Lang & Bradley, 2010; Lang & Davis, 2006). Dunbar (1998) proposes that, for primates, the complexity of the brain is directly correlated to social network size; extended cooperative groups enhanced cortical development in hominids. Through its ability to create a shared emotional experience and increase pro-social behaviours, it has been argued that music also facilitated the development of the modern brain (Cross, 2001; Perlovsky, 2011).

The ubiquitous use of music in communal rituals and celebrations has been argued to reflect the role of music in creating a shared emotional state and increasing social bonds (Hirabayashi, 2009; Morley, 2009). Taking an ethnographic approach, Dissanayake (1997) argues that ancient music-making was purposeful, and its use in ritual reflects the wilful manipulation of emotions in order to increase social cohesion. She identifies several social functions of music use in rituals, including displaying resources, providing a controlled outlet for aggression, facilitating courtship, establishing and maintaining social identity (e.g., through rites of passage), relieving anxiety, and promoting cooperation.

Infant musicality

To supplement analysis of the archaeological record, music's role in human development can also be explored through research conducted with newborns. Infants are innately musical. They have a memory for musical performance (Volkova et al., 2006), and can process musical patterns in an adult-like manner (Trehub & Hannon, 2006). Infants respond with enthrallment when their mothers sing to them, compared to a less intense response for talking (Nakata & Trehub, 2004). Maternal singing has an immediate and profound impact on an infant's arousal and attention, which is often accompanied by physiological changes (Trehub, 2001).

Trehub (2000) points out that mothers innately know what type of singing infants prefer. She also suggests there are benefits to the mother, including an increased sense of wellbeing. McDermott and Hauser (2005) cite evidence that lullabies have universal qualities across cultures and perhaps even through history. Even infant-directed speech is highly prosodic in nature across cultures, and communicates information through its music-like qualities rather than through the language content (Fernald, 1989). Like infant-directed speech, infant-directed music appears to have pre-determined qualities that are innately understood by mothers and others who interact with infants.

Across cultures, music plays a central role in the first social contact humans experience, by creating and reinforcing parent-child bonds (Malloch, 2000; Schulkin & Raglan, 2014). The experience for both child and parent is highly companionable and rewarding. There is also growing evidence that musical experiences, especially those incorporating entrained movement and familiar songs, promote pro-social behaviours in young children (Cirelli et al., 2018).

Group singing and shared emotional experiences

One of the primary uses of music for modern consumers is emotion arousal and regulation (Juslin & Sloboda, 2010; Juslin & Västfjäll, 2008; Salimpoor et al., 2009; Schäfer et al., 2013); positive emotional experiences are also identified as a primary benefit of choir membership (Clift & Hancox, 2010). For most people, music elicits emotions which can be very strong, and are sometimes accompanied by physiological arousal, such as chills, increased heart rate, and skin temperature (Rickard, 2004; Roy et al., 2009; Sammler et al., 2007). In addition to the important implications for personal well-being, the link between music and emotion is interesting from an evolutionary perspective for several reasons. First, there is the central role that emotions play in attention processing and prioritising decisions. Second, music's ability to increase positive affect and reduce negative affect may promote pro-social behaviours. Third, the ability to correctly "read" another's emotional state enhances theory-of-mind skills. And finally, facilitating a shared emotional state has implications for the establishment of co-operative groups.

Emotion serves as a psychological motivation for thought or action (Lang & Bradley, 2010; Lang & Davis, 2006). Carver and Sheier (1998) are more specific, identifying emotions as a response to an event that has the capacity to effect goal attainment. Emotions are understood to reduce chaos between competing brain functions by drawing attention to what requires immediate attention, while subsuming attention on less pressing matters (Cosmides & Tooby, 2000). For early hominids, survival may have depended on the ability of the group to share a sense of panic at the approach of a predator, for example. This panic needed to override individual cognitive assessments such as a sense of hunger or a desire to sleep.

Alerting a group to the presence of a predator is a basic survival practice, and is common amongst social animal species, and may even operate across species (Griffin et al., 2005; Manser, 2001; Rainey et al., 2004; Schmidt et al., 2008). However, it may be that finding ways to share more subtle emotions gave hominid groups an increased sense of social cohesion and an ability to entrain, leading to more sophisticated social and cultural expressions. Cross (2003) suggests that the co-creation of music is a uniquely human trait, and that when early hominid groups made music, they also created a shared emotional state. Because emotions serve an attentional function for thought or action, sharing an emotional state may have been pivotal in ensuring group cooperation.

Sharing emotions across the group may have increased empathic responses and helped to develop theory-of-mind abilities (Singer, 2006). Identifying and being susceptible to emotion contagion from music is moderated by high levels of empathy (Eerola et al., 2016; Kawakami & Katahira, 2015;

Sittler et al., 2019). There is evidence that decoding music structures and decoding emotion in prosodic phrases are linked, and may also improve the ‘reading’ of another’s emotional state (Thompson et al., 2013). The affective messaging of music may have supported these skills to develop in early hominid groups.

Recent research into music anhedonia may also support this analysis. For the majority of people, music activates the reward circuitry of the brain, leading to a pleasure-inducing dopamine release (Menon & Levitin, 2005). Research conducted by Mas-Herrero et al. (2014) demonstrated that some individuals do not experience activation of their neural reward network in response to music; however, the network was activated in response to a financial stimulus, indicating that the reward network was not damaged. Additionally, the music anhedonics were able to correctly identify the emotion being expressed in the music, despite being unable to experience it.

Clark et al. (2014) argue that music-specific anhedonia which leaves intact the ability to decipher music’s emotional content implies that there are music-specific brain reward mechanisms. This in turn implies a biological imperative for music, as there are for other biologically critical functions which activate the reward system, such as are triggered by food or sex. The authors hypothesise that music’s utility is embedded in this emotional response: music is a way of encoding emotions in order to share them with a community. The process of decoding music’s emotional text is the same used in decoding emotions in others, and which support the development of theory-of-mind skills. Music is affective messaging.

Emotion is known to spread from person to person, through direct contact (Decety & Ickes, 2011), indirect contact (Coviello et al., 2014), and through music listening (Juslin & Västfjäll, 2008). Successful emotional transfer from person to person is a key indicator of empathy, which is also linked to developing robust theory-of-mind abilities. Sharing the emotions of another is considered a primary factor in the cognitive, affective, and behavioural development of early hominids (Decety & Ickes, 2011). Because music is known to both induce and enhance emotional experiences, it is possible that corporate music experiences would serve the same function, creating a shared emotional experience.

People often experience emotion contagion when listening to music. For example, many athletes use music to put themselves in a mood state which will encourage peak performance (Bishop et al., 2007; Lane et al., 2011). Adolescents regularly use music as an effective mood regulator (Saarikallio & Erkkilä, 2007). Vuoskoski and Eerola (2012) demonstrate that sad music can transfer a sad emotion state to a listener, particularly if the piece has relevance to the listener. They also found that listeners high in trait empathy were more likely to adopt the sad emotion state, which indicates that an emotional response to music is at least in part a social response. Finally, there is evidence that music listening can serve as a form of social surrogacy when individuals are isolated from others, and reduce loneliness (Schäfer & Eerola, 2018; Schäfer et al., 2020).

Music is often used to manipulate emotions in public spaces (Garlin & Owen, 2006; Morrison et al., 2011; Spence & Shankar, 2010) and public events (Steinberg, 2004; Street, 2013). However, little empirical research has been conducted into whether music may augment emotion contagion amongst individuals. A study with 50 university students found that intentional music listening with a friend or partner increased reports of positive mood states, but not negative states, compared to listening alone (Liljeström et al., 2013). However, these findings appear to contradict the findings of an earlier study, which found that 14 members of an orchestra experienced more intense emotional response (as measured by self-report and skin conductance) when listening alone than when listening as a group (Egermann et al., 2011). While both studies focussed on how social context affects emotional responses to music listening, the size differences of the groups (two and 14), the differences in group relationships (a close friend/partner and a larger social/work group), the lab-based nature of the studies, and the focus on listening to rather than creating music may limit their relevance to the current discussion.

Due to the strong links between music and emotions, and the use of group singing in pre-historic and traditional cultures, a positive shared emotional state is likely to be one of the primary benefits of these experiences. Group singing may have provided a rewarding way to create a shared emotional experience. Enjoyable, and therefore repeated, musical experiences would have aided the development of the necessary empathic skills needed for sharing emotions more generally. There is likely therefore to be both short-term and long-term effects: while participation in group singing may lead to a short-term positive emotional state, repeatedly engaging in group singing may lead to persistent long-term changes, including developing a more stable positive affective state and reduction of negative emotional states such as stress or anxiety. A positive affective style is associated with overall thriving (Lyubomirsky et al., 2005) and improved health (Pressman & Cohen, 2005), and may create a positive spiral towards overall improved wellbeing (Fredrickson & Joiner, 2002). Positive emotion states are argued to be evolutionarily adaptive, through the benefits of health, improved fertility, creativity, improved planning, more successful mating, and improved sociability (Diener et al., 2014).

Group singing, group cohesion and pro-social behaviours

Music engagement is also strongly linked with social bonding. For example, a range of studies demonstrate that background music can have a positive impact on social interactions, including increasing a sense of 'liking' in initial meetings (Stratton & Zalanowski, 1984b), increasing verbal exchange in social settings (Stratton & Zalanowski, 1984a), and increasing the positive assessment of an individual during an initial meeting (Ortiz, 1997). More recently, Loersch and Arbuckle (2013) demonstrated that music listening enhanced a sense of in-group membership.

Social bonding is reported as one of the primary benefits of choir membership. In a survey of 600 English choral singers (Clift et al., 2007), and a follow-up study of 1124 choir members across England, Australia and Germany (Clift & Hancox, 2010), choir members identified social support as one of six generative mechanisms to improved wellbeing and health (also mentioned was positive affect, focused attention, deep breathing, cognitive stimulation, and regular commitment). This was described both in general terms of participating in a social experience, as well as comments reflecting the focused, unified discipline of co-creating a piece of music.

The impacts of choir membership have been studied on marginalised groups who struggle with making social connections. In a unique longitudinal study looking at the effects of choir membership on older adults (Cohen et al., 2006; Cohen, 2007), the researchers found that their control group (engaged in self-selected activities) trended towards reduced participation in social events, while the choir members trended towards increased participation. The authors also reported fewer doctor visits, reduced medication, fewer falls, and improved health in the choir cohort compared to the control group.

von Lob, et al. (2010) interviewed English members of non-audition singing groups who had also experienced adverse life events, to understand whether and how membership assisted with coping. The social support provided by the singing group was a primary factor, encompassing both building significant relationships within the choir as well as sharing in the collective experience of music making.

A systematic review into the effects of group singing on well-being and health (Clift et al., 2010) indicates that singing programs for individuals with dementia increase social behaviours, encourage participation, and reduce anxiety and agitation. Dingle et al. (2012) examined the effects of choir membership for adults experiencing a range of disadvantage (chronic mental health problems, physical disabilities and intellectual disability) in a 12-month longitudinal study which coincided with the choir's start-up. A positive social impact was one of three primary benefits identified by the choir members (along with personal impact and personal function). Members identified a strong social connection within the choir, but also with audiences during performances. Several members also mentioned that these effects were apparent in their life separate from the choir; they were more easily able to engage in pro-social behaviours as a matter of course.

Joint music creation may encourage pro-social behaviours by promoting empathic responses (Kirschner & Tomasello, 2010; Rabinowitch et al., 2013; Sevdalis & Raab, 2014), thereby promoting increased theory-of-mind abilities (Livingstone & Thompson, 2009). Theory-of-mind abilities rely on both affective and cognitive assessments, and empathic abilities have a demonstrable correlation to theory-of-mind skills (Shamay-Tsoory et al., 2005). There is evidence that musical engagement generally, and group singing activities in particular, can promote oxytocin release (Chanda & Levitin, 2013; Grape et al., 2002; Kreutz, 2014). Oxytocin is a hormone associated with strong feelings of love and connection, reduced stress, and increased trust amongst individuals (Gimpl & Fahrenholz, 2001; Kosfeld et al., 2005). Additional studies indicate that group singing also increases the release of endorphins, another hormone implicated in the bonding process, as measured by increased tolerance for pain (Dunbar et al., 2012; Weinstein et al., 2015, LiKamWa et al., 2020).

While there is speculation of a link between music and increased pro-social behaviours (Greenberg et al., 2015; Vuoskoski, 2015), the research into this area is limited and exploratory. People high in trait empathy are more responsive to the emotional content in music (Egermann & McAdams, 2013; Vuoskoski & Eerola, 2012). Rabinowitch et al. (2013) found that primary school children who participated in a musical group across the school year showed higher emotional empathy scores than children in the control group. Similarly, Kirschner and Tomasello (2010) found that 4-year-old children who participated in a one-off musical play-based game demonstrated increased pro-social behaviours compared to children who participated in the same game without the musical components. More recently, Beck and Rieser (2020) reported that preschool children were more likely to spontaneously help and share with an adult who was unknown to them after a musical interaction. More research is needed to better understand whether music engagement can facilitate increased pro-social behaviours.

Implications

Taking an evolutionary perspective on human musicality facilitates an examination of how everyday, non-professional, accessible musicality may facilitate wellbeing improvements. Music-making has traditionally been an activity that is engaged in by all community members, most often through group singing. While there have been several possible explanations proposed pertaining to music's persistence and value across time, these ideas have not been systematically tested. There are many implications for further research which in turn may inform provision of music-based leisure activities to older adults.

First, it may be that level of engagement, rather than level of proficiency, is the most important factor for realizing benefits. This possibility has already been mooted, including the development of a tool for measuring strength of engagement (Chin & Rickard, 2012). If engagement is the key to increasing well-being, there are implications for how musical experiences are delivered. For example, it is well established that wellbeing benefits of listening to music are mediated by whether the music is liked (Liljeström et al., 2013; MacDonald, 2013), including for older people (Costa et al., 2018a, 2018b); therefore, attention to selecting music that is likely to be preferred by the participants is an important consideration.

Second, if the intention is to promote socio-emotional wellbeing, it may be advisable to relax standards of excellence so that the focus is on inclusion and active participation rather than on technical achievement. A focus on technical expertise may reduce a sense of enjoyment and camaraderie.

Third, it would be beneficial to examine other possible benefits of music engagement other than mood regulation – particularly the social benefits. There are already some indications that co-creating music has social benefits for children, disadvantaged populations, and older adults. These studies are exploratory and inconclusive; there is the opportunity to systematically test these theories and build up a robust body of knowledge for the social benefits of music-making. There are also implications for how musical experiences are delivered in order to encourage group cohesion. If a core evolutionary function of music is to increase social bonding, then the focus for facilitators may expand from a goal of excellence in production to including promotion of positive group interactions. Community choirs are well-placed to address issues of social isolation. However, it is important to match how choirs are facilitated to the intended goal.

Fourth, there is a need to increase the level of research conducted with populations that are co-creating music but without technical expertise. Currently, the vast majority of research is conducted with either trained musicians or music listening. If evolutionary theories of music utility are correct, it is important to include untrained groups co-creating music in the research portfolio. This under-studied group can illuminate ways that everyday, untrained music making may affect individuals and groups. It may well be that community choirs can fill a gap in promoting active music making by untrained non-musicians, leading to many individual and social benefits.

Fifth, if evolutionary theories are supported, benefits may be expected to accrue over time. For example, an increased sense of social bonding is expected to lead to increases in pro-social behaviours, or repeated experiences of positive mood states could lead to an overall increased affective state. It would therefore be useful to design longitudinal studies that track possible changes over time. These should incorporate both individual and group experiences.

Finally, it is likely that there are very specific cognitive benefits to group singing (Christie et al., 2017; Cross, 2008; Perlovsky, 2011). The aging brain is known to undergo some deterioration and cognitive decline, which was previously considered an almost inevitable aspect of growing old. However, increasing understanding of the brain's ability to successfully adapt and compensate for deficits into very old age (Greenwood, 2007), has challenged the research agenda to consider the role that environmental enrichment can have on cognitive function (Allerhand et al., 2014; Dause & Kirby, 2019; Debreczeni & Bailey, 2020; Haslam et al., 2014, Leon & Woo, 2018). Lifestyle factors such as engaging in leisure pursuits, socializing, developing expertise and maintaining physical activity have been found to be protective of cognitive function (Williams & Kemper, 2010), and are also often aspects of the community choir experience. While there are indications that trained musicians exhibit cortical differences from untrained controls, providing an advantage into old age (Hanna-Pladdy & MacKay, 2011), a growing body of research indicates that untrained shared musical interactions, such as singing, may also provide cognitive benefits and protections against age-related decline (Dingle et al., 2020; Feng, 2020; Fu, 2018; Mansens et al., 2017; Pentikäinen, 2021; Särkämö et al., 2014). Music engagement may be protective of general cognitive function through several pathways, including the challenge of learning new things, the multimodal dimension of music engagement across multiple cognitive domains, synchronizing motor movements, and maintaining social cognition function through frequent social opportunities (Sutcliffe et al., 2020).

It is also possible that music co-creation – that is, joint music-making in a group setting – may increase cognitive flexibility. Cognitive flexibility is a style of fluid cognitive processing that successfully pairs concepts and ideas that are generally not associated, resulting in creative or insightful thinking. This process is in contrast to applying an inflexible and rule-bound application of information, also known as entrenched thinking (Walker et al., 2002). Cognitive flexibility tends to decline with age (Gajewski et al., 2018). It is already established that high levels of positive affect and low levels of negative affect are positively correlated with increased cognitive flexibility (De Dreu et al., 2008; Isen, 1987; Isen et al., 1987; Subramaniam et al., 2009). There are also indications that positive, empathic social interactions also positively influence cognitive flexibility (Andreasen & Ramchandran, 2012; Ybarra et al., 2008, 2010).

It is, therefore, logical to hypothesise that, if music co-creation improves affective state and increases a sense of social connection, it may also facilitate cognitive flexibility. There is already an understanding that musical creativity relies on high levels of cognitive flexibility (Charyton & Snelbecker, 2007); it is possible that it may be a virtuous cycle, in which music engagement increases cognitive flexibility, which in turn increases music engagement through increased creative expression, and so on. Some experiments indicate a positive association. For example, people listening to classical music yielded higher scores on a divergent thinking task compared to those who did the same task in silence, although notably this difference was only for music classified as high valence and arousal (Ritter & Ferguson, 2017). Similarly, people employed in a cognitively demanding role demonstrated increases in both positive affect and cognitive flexibility when allowed to listen to the music of their choice (Lesiuk, 2005). Comparing listening to a singing condition, a school-based study conducted by Schellenberg et al. (2007) reported that schoolchildren drew for longer periods of time and their drawings were judged as more creative after singing familiar children's songs. This was compared to efforts in a range of listening experiments; creativity and effort was independently judged as highest in the singing intervention, followed by listening to familiar children's songs, listening to upbeat classical music, and lowest when listening to ponderous classical music. This effect indicates that positive music interactions may influence cognitive flexibility, the cognitive process that facilitates creativity.

Summary

An evolutionary lens placed over music engagement is useful to illuminate gaps in the current research literature concerning the utility of music co-creation, which has significant implications for its use with older populations to support positive aging. Possible avenues for future exploration include an increased focus on untrained music creation, longitudinal studies, and a focus on unexplored affective, social, and cognitive benefits.

Chapter 3: Examining the evidence base for group singing and wellbeing improvements

Overview: Evolutionary theories of group singing

Music is a near-universal expression in both individuals (Blacking, 1973; Koelsch, 2012; Tomlinson, 2013; Trehub, 2001) and societies, throughout history and across cultures (Brown & Jordania, 2013; Cross, 2003; Snowdon et al., 2015; Titon & Slobin, 1996). Evolutionary theories concerning the utility of group singing, as the first and most fundamental form of joint music-making (Bannan, 2012; Fitch, 2006; Mithen, 2009), argue that it creates a shared, positive emotional state, facilitates group cohesion, and increases empathic responses (Cross, 2001, 2003, 2007, 2008; Greenberg et al., 2015; Harvey, 2018; Loersch & Arbuckle, 2013; Perlovsky, 2010, 2011; Savage et al., 2020; Schulkin & Raglan, 2014; Snowdon et al., 2015). Empathy is linked to the development of pro-social behaviours (Eisenberg et al., 2010; Eisenberg & Miller, 1987; Telle & Pfister, 2015), which in turn reinforce group bonds and cohesion. Some theorists have argued that music was a key contributor to enabling social cooperation more generally (Freeman, 1998; Harvey, 2018; Savage et al., 2020). These theories of group singing's utility provide a framework for predicting and testing socio-emotional wellbeing improvements as a result of participation.

Many studies report positive changes as a result of choir participation, including improvements in emotional wellbeing (Clift & Hancox, 2010; Sandgren, 2009), social cohesion (Dunbar et al., 2012; Weinstein et al., 2015), and empathic responses (Cross et al., 2010; Egermann & McAdams, 2013; Miu & Baltes, 2012). Positive outcomes are also reported for certain demographics, including for young children (Rabinowitch et al., 2013), disadvantaged adults (Bailey & Davidson, 2005; Dingle et al., 2012), people experiencing life challenges (Clift & Morrison, 2011; von Lob et al., 2010) cancer patients and carers (Fancourt et al., 2016), stroke recovery patients (Tamplin et al., 2013), women with post-natal depression (Perkins et al., 2018), and older people (Bungay et al., 2010; Davidson et al., 2014). A meta-analysis of music interventions and wellbeing (n = 61 studies) concluded that there are convincing indications that "engaging in community music and singing activities can enhance and maintain wellbeing and prevent isolation, depression and mental ill health" (Daykin et al., 2018, p. 44).

Nevertheless, comparison studies are less convincing. While several studies report significant differences between choirs and control groups, in most cases the study design points to alternate explanations for findings. These studies can be classified into three groups: those which compare a singing to a refraining-from-singing condition; those which compare a singing to a no-activity condition; and those which report on increases which reflect differences in baseline measures.

Singing vs. refraining-from-singing studies

There are several studies which report significant socio-emotional improvements in wellbeing markers for a singing condition when compared to a non-singing control. These studies may include the same choir at two different time points (Kreutz, 2014; Kreutz et al., 2004), one choir with some members singing while others refrain (Bullack et al., 2018), or two choirs, one of which sings while another does not (Sanal & Gorsev, 2014). While there is some evidence which indicates positive changes for the singing condition, many of the differences between the singing and control groups reflect an erosion of wellbeing for the non-singing (control) condition; see Table 1 (with changes for the control [refraining from singing] highlighted in the far right column).

Table 3.1

Summary of data from Singing vs. Refraining from Singing study designs

Measure	Singing T1 M(SD)	Singing T2 M(SD)	Refraining T1 M(SD)	Refraining T2 M(SD)	Changes & significance
Sanal and Gorsev (2014). Study summary: Two choirs practiced for 8 weeks to learn the same song. On the day of the study, one choir (n = 35) practiced while the other (n = 35) sat in a classroom. The differences in PA is due to a decrease for the Control group. Differences in state anxiety were due in part to a decrease in Singing and in part an increase for Control. There were no significant findings for salivary amylase and amylase/protein level changes.					
Positive affect (PA)	3.26 (.5)	3.29 (.64)	3.43 (.56)	3.15 (.72)	Sig interaction effect Decrease in PA for Control.
Negative affect (NA)	1.35 (.45)	1.25 (.41)	1.2 (.28)	1.26 (.37)	Sig interaction effect Decrease in NA for Singing. Slight increase for Control.
State anxiety	1.71 (.33)	1.53 (.33)	1.55 (.38)	1.67 (.43)	Sig interaction effect Decrease for Singing. Increase for Control.
Trait anxiety	2.18 (.45)	2.11 (.47)	2.14 (.42)	2.13 (.40)	Non-sig.
Kreutz (2014). Study summary: A group (n = 21) were recruited to learn three choral pieces over 10 weeks, with 9 individuals having no previous choral experience. At rehearsal 7 they practiced as usual for 30 minutes (Singing), while at rehearsal 8 they chatted for 30 minutes with another member about a positive life experience (Control). Differences in PA and NA are attributable to changes in the Singing condition. Biological markers found a significant interaction effect for oxytocin, with significant increase for Singing; no significant effects for cortisol, DHEA or Cortisol/DHEA ratios. However, oxytocin changes should be treated with caution due to small number in study and large variation in readings.					
PA	3.71 (.28)	5.39 (.27)	3.95 (.24)	4.55 (.27)	Sig interaction. Sig. increase for Singing. Sig increase for Control.
NA	2.73 (.25)	1.86 (.20)	2.76 (.28)	2.8 (.35)	Sig interaction. Sig decrease for Singing.

Measure	Singing T1 M(SD)	Singing T2 M(SD)	Refraining T1 M(SD)	Refraining T2 M(SD)	Changes & significance
Kreutz et al. (2004). Study summary: A choir (n = 31) practiced for 60 minutes one week (Singing) and the week following listened to the piece they were learning (Control). Differences in PA are attributable to an increase for the Singing condition and a small drop for Control. Differences in NA are also attributed to a decrease for Singing and an increase for Control. Physiological measures found an interaction effect for S-IgA/albumin, with a significant increase for the Singing condition. Cortisol had a significant effect for time, with only the Control condition experiencing a drop.					
PA	2.86 (.51)	3.15 (.64)	2.85 (.67)	2.79 (.81)	Sig interaction effect Sig increase for Singing. Slight decrease for Control.
NA	1.31 (.4)	1.18 (.24)	1.23 (.25)	2.2 (.31)	Sig interaction effect Sig decrease for Singing. Sig increase for Control.
Bullack et al. (2018). Study summary: An established choir practiced for 30 minutes (Study 1, n = 54) and 60 minutes (Study 2, n = 49) with half of the participants randomly assigned to remain embedded in the choir and follow all directions (e.g., sitting up, following music) but without singing (Control). In Study 2, the Control group experienced a decrease in PA and social connection and an increase in NA, while the Singing group experienced increases in PA and social connection and a decrease in NA. This divergence explains the gap between the two groups. There were no significant findings from physiological measures (cortisol and salivary alpha-amylase).					
PA Study 1 (30 min)	1.91 (.75)	2.14 (.61)	1.97 (.63)	2.03 (.61)	Non-sig
NA Study 1 (30 min)	.95 (.63)	.54 (.56)	1.02 (.5)	1.0 (.53)	Non-sig
Social connection Study 1 (30 min)	3.61 (1.42)	4.93 (1.31)	3.78 (1.13)	4.04 (1.15)	Non-sig
PA Study 2 (60 min)	1.95 (.64)	2.22 (.59)	2.24 (.51)	1.76 (.63)	Sig x time Non-sig increase for Singing. Sig decrease for Control.
NA Study 2 (60 min)	.78 (.72)	.67 (.58)	.86 (.47)	1.63 (.80)	Sig interaction effect Sig decrease for Singing. Sig increase for Control.
Social connection Study 2 (60 min)	3.24 (1.3)	4.41 (.98)	3.81 (1.33)	3.5 (1.37)	Sig x time Increase for Singing. Decrease for Control.

While the singing conditions do demonstrate some wellbeing improvements, the changes in the control condition in many cases (Bullack et al., 2018; Kreutz et al., 2004; Sanal & Gorsev, 2014) indicates that the differences between the groups may be an artifact of how the experiment design negatively impacted the control participants. Only in the study conducted by Kreutz (2014) is the change purely explained through improvements in the singing condition.

This is not a surprising outcome when considering that participants in these studies had chosen to join a choir, motivated through enjoyment or other compelling reasons. It is therefore likely that studies that require choir participants to *refrain* from participation in an activity they have chosen is likely to erode their wellbeing, which in turn will at least partially explain significant differences between the groups.

Choir vs. no-activity conditions

Several studies have employed a design in which choir participation is compared to a usual activities (no intervention) condition. Study designs that allow for self-selection but do not compare experimental activities against other kinds of engaging, chosen and/or preferred social activities may be measuring the positive impacts of preference and choice for the intervention group, or benefits which would have accrued from another engaging and chosen non-singing activity, rather than benefits unique to choral participation. Examples in this section include three studies conducted with older people using a similar design (Cohen et al., 2006; Coulton et al., 2015; Johnson et al., 2020) and one study with schoolchildren who participated in a nation-wide choir event (Hinshaw et al., 2015).

Cohen et al. (2006) compared a group of older adults who participated in a choir (intervention) to their peers who went about their normal activities (control). The two groups were matched for level of fitness and number of social activities, and were compared on a range of health measures at baseline and again after 12 months. The choir group reported fewer visits to a doctor, use of medication and falls, and better physical health, better morale and less loneliness. Further, over the 12-month period, the intervention group increased the overall number of activities in which they participated, while the control group participated in fewer activities. While the results may seem dramatic, allocation of participants to groups was not randomised and participants knew which activities they would be undertaking in advance. The differences between the groups may therefore be the result of the intervention group choosing and enjoying a preferred activity – in this instance, singing – in a social group. The control group, in contrast, expressed a disinclination to participate in a choir. They were not, however, offered alternative activities that may have been more appealing to them and that might have elicited similar improvements in their health and wellbeing. It cannot be determined whether similar results would have been obtained from research involving a non-musical social intervention group, or a control group which participated in a different kind of (new) activity.

This design weakness is partially overcome in randomized control trial (RCT) studies. Coulton et al. (2015) randomly assigned 258 older (60+) research participants into either a choir intervention group or a usual activities (e.g., no intervention) control group. Control group participants were told they could join a choir at the conclusion of the study, which ran for six months. Choirs met weekly for 90-minute sessions. There were no significant differences between the groups on measures of physical health at either three or six months. There were significant differences on mental wellbeing at both the three-month and six-month surveys, and significant differences on measures of anxiety and depression at the three-month timepoint only, with choir members experiencing a significantly greater drop in scores for both. At the six-month survey choir members' scores on both anxiety and depression scales were still lower than at baseline but higher than at the three-month timepoint, with no significant difference from the control group. While this research design is stronger than the self-selected procedure reported by Cohen et al. (2006), there is still a bias towards individuals who are interested in choir participation since all who chose to participate in the study were aware of the choir activity on offer. In contrast, the control involved no alternative activity about which participants might become motivated. It could therefore be that the difference in groups is still measuring the enjoyment of participating in a valued activity rather than group singing per se. It is also interesting that the choir condition seems to have experienced a 'boost' in their wellbeing measures at the three-month timepoint, which was not sustained at the six-month timepoint; this points to the importance of utilizing various timeframes in study designs to better understand how wellbeing is sustained.

In a similarly-designed study, Johnson et al. (2020) provided six months of weekly, 90-minute choir sessions for older adults at senior centres; a matched control group had delayed entry into the choir program (N = 390, mean age 71.3, SD = 7.2 years). Psychosocial, cognitive and physical measures were taken at baseline and again at six months for both groups. There were no changes for cognitive or physical measures. Psychosocial measures of sadness, positive affect and fear also demonstrated no significant changes for either group. However, the intervention group reported a significant drop in loneliness scores and a significant increase in interest in life scores, which was not matched by the control group. It could be, however, that a similarly-engaging alternative for the control group – or indeed the intervention group – may have provided similar results.

Considering a younger demographic, Hinshaw et al (2015) compared a school choir intervention that was run for five months, with a collective high-profile performance at the end of the period, with follow-up measures collected four months later. Children who participated were aged between seven and 11 years, with 50 in the intervention group. Children who were not taking part in the choir were invited to participate as a no-activity control group, but only 10 agreed to do so; the imbalance between the intervention and control conditions should therefore be considered when interpreting the results. Measures of psychological wellbeing dropped for the choir group from time 1 to time 2, and remained lowered for the follow-up, while the control experienced an increase across the same time, with the highest rating recorded at time 2, and these differences were significant. There were no significant changes on a psychological difficulties scale, completed by a teacher, for time, group or interaction effects. Qualitative responses reported a positive experience from the intervention group, so changes in wellbeing scores may have been related to other factors outside of the study's scope.

Studies with engaging activities as controls

There are some studies which compare wellbeing changes in choir participants with other, engaging activities. In this group, findings are mixed. The studies reported here are grouped into those that take place within a clinical setting (Fancourt & Perkins, 2018; Grape et al., 2010; Perkins et al., 2018), those that compared engaging activities in a lab setting (Allpress et al., 2012; Unwin et al., 2002), those that compare to other organized leisure activities in natural settings (Dingle et al., 2017; Dunbar et al., 2013; Pearce et al., 2015; Pearce et al., 2017), those that compare choir participation to other kinds of musical or sport activities (Lonsdale & Day, 2020; Schladt et al., 2017; Valentine & Evans, 2001), and those that explore links between singing and pro-social behaviours in children (Beck & Rieser, 2020; Good & Russo, 2016; Kirschner & Tomasello, 2010).

Comparing choir singing to other activities in a clinical setting.

The efficacy of a 12-month choir condition was compared to a discussion group (N = 27) on testosterone levels of people diagnosed with irritable bowel syndrome, with an increase indicating reparative physiological changes (Grape et al., 2010). Samples were taken pre-intervention, then at three, six, nine and 12 months. The choir condition experienced greater variability across the 12 months, with significant increases at the six-month level, but there were no overall group or time effects at the end of the study. The discussion group met three times per month rather than monthly after the six-month mark while the choir continued to meet monthly, which may have been a confounding factor;

the groups were also very small in size, which may have influenced the outcome. It may also be that the discussion condition was less engaging than the choir condition, however if this were the case a more dramatic difference between the two groups would be expected.

Women who were experiencing post-partum depression were randomly allocated into either a mother-and-baby singing group, a mother-and-baby play group, or a no-activity (usual treatment) condition (Fancourt & Perkins, 2018). Between eight – 12 women were enrolled in a free 10-week course of either singing or play, each running for 60 minutes once per week (N = 134). There was an effect of time, but not by group, for reductions in post-partum depression scores across the 10 weeks. However, members of the singing group had a faster recovery when measured at week six, which was not significant compared to the play group but significant when compared to the no-activity group. This study also incorporated a rare comparative qualitative study between the singing and play groups (Perkins et al., 2018). Researchers conducted a brief focus group at the end of half of the sessions (five focus groups for singing, five for play). They report similar themes of benefiting from new skills or ideas that can transfer to other settings, an activity that engages with their children in creative ways that is shared across the group, improved mood, group cohesion, appreciation for structure and routine, and a calm and inclusive environment with a good facilitator. Unique to the singing group was an appreciation for the activity's "authentic" (e.g., non-commercial) nature. Both groups also reported similar experiences of group bonding, although singing group participants said the act of singing strengthened this sense of belonging. Unique themes from the singing participants included benefits to the mother such as a sense of achievement and enjoying the immersive experience of singing, which made them feel cared for and nurtured as struggling mothers. Singing was also seen as a useful tool to help calm a distressed baby, and was considered distinct from the play group in its sense of increasing the parent-child bond. In sum, women experiencing post-natal depression benefited equally from all conditions over the course of the 10 weeks, with many shared benefits mentioned by mothers in both the play and singing groups. However, the mothers in the singing condition appeared to recover more quickly from their depressive symptoms and also mentioned several benefits unique to that group.

Choir singing compared to other activities in a lab setting.

A study conducted by Unwin et al. (2002) recruited 81 participants and randomly assigned them to either a singing or a listening (to the singing group) condition. The Profile of Mood States was administered beforehand, immediately afterwards and again 1 week later. As there were effects of time but no interaction effects, results indicated that both singing and listening conditions had similar positive effects on mood.

In a well-controlled study design, Allpress et al. (2012) randomly assigned recruited participants into two groups, who took part in a group singing activity (Group A: n = 8) and a cooperative Lego-building activity (Group B: n = 10) on Day 1; on Day 2 the groups switched activities. Positive affect rose similarly for both groups while negative affect dropped similarly for both groups from pre- to post-session. Flow and social connection were only measured post-session, with no significant differences between the groups. Cortisol levels decreased significantly for both groups and for both activities, with no interaction effects. It is notable that this study is unique in that it used a naïve population; that is, the participants were not attracted to the possibility of a group singing opportunity.

Comparing choir singing to other organized leisure activities in natural settings.

Dingle et al. (2017) compared 41 members of a community choir (21 with chronic mental health conditions) with 18 members of a creative writing group (all with chronic mental health conditions), both of which ran for 10 weeks. Measures were taken between four and eight weeks. To measure fluctuations in mood, the Positive and Negative Affect Schedule (PANAS) was given to individuals at four times across one day that included their creative writing or choir class. There were significant effects of time but not group for improvements in emotional wellbeing, with PA highest and NA lowest during the class activity, indicating that both singing and creative writing had similar effects on measures of wellbeing. The unusual timeframe used to measure positive and negative affect found that increases in positive affect had dissipated by evening but decreases in negative affect had persisted.

At least one study reports on changes that are significant due to differences in baseline measures between the intervention and control groups. In a well-designed study, Pearce et al. (2015) set up seven classes in a community centre specifically for their research: four singing, two craft, and one creative writing. Participants self-selected. The PANAS was administered directly before and after a two-hour class at three timepoints: Month 1, Month 3, Month 7. The pre- and post-scores were combined (T1 + T2 + T3) by group prior to analysis. While NA decreased, the difference between the groups was not significant. PA increased across both groups, and there was a significant time x group interaction; however, this appears to be due to a lower PA rating for the singers when the pre-test was given (Choir Time 1: M=2.93, SD = 0.97; Choir Time 2: M=3.58, SD=1.04) compared to the control group (Control Time 1: M=3.5, SD=0.99; Control Time 2: M=3.50, SD=0.99), rather than a significantly higher report of PA at the end of class (3.58 for Singing compared to 3.50 for Control). Therefore, the difference may be due to a confounding factor which depressed PA scores prior to the start of the session for the singing group rather than the ability of the singing condition to facilitate higher rates of PA compared to other types of activities. This same study found that the singing condition rated their sense of closeness to the class as higher (Singing T1: M=4.28 SD=1.89; Singing T2: M=5.23 SD=1.64) than the control condition (Control T1: M=4.23 SD=1.90; Control T2: M=4.68 SD=1.79). A post-hoc analysis found that these differences were due to a significantly higher sense of closeness after the first data collection timepoint, at Month 1; the change in closeness at timepoints 2 and 3 did not reveal significant differences between the singing and control conditions. The self-rating was complemented with a pain measure using a blood pressure cuff as a proxy measure for increased endorphin levels. All groups experienced a similar increase in pain tolerance from pre- to post-session.

The same research team conducted a more in-depth analysis of differences in social bonding between the singing, creative writing and crafting classes (Pearce et al., 2017), using measures of relational bonding – that is, how closely members of each group felt to other individuals within the class – and collective bonding, reflecting how connected each individual felt to the group as a whole. Measures were taken at month one, month three and at the end of the classes in month seven. Comparing singers (n = 55 at time 1) to non-singers (n = 41 at time 1), the increase in interpersonal relationships was significantly greater for the singing condition when measures were taken between time 1 and time 2, but not between time 2 and time 3. A social network analysis found that the singing classes had denser social networks than either the crafting classes or the creative writing class, although the differences with the creative writing class were not significant. Exploring collective bonding, the singing conditions demonstrated a significant increase in sense of bonding to the group as a whole from pre- to post-session when compared to the control conditions, with no differences between the creative writing or crafting classes. These findings indicate that group singing may facilitate faster social bonding, and furthermore that the type of bonding may differ, with a greater sense of closeness to the group as a whole compared to other kinds of social groups.

A charismatic church service (n = 13) which involved singing, clapping and upper body movement was compared to a prayer service with no singing (n = 9) to determine whether active singing may increase pain tolerance, a proxy measure for endorphin levels (Dunbar et al., 2013). The active singing condition demonstrated significantly higher levels of increased pain tolerance following the service than the non-singing prayer service attendees. The same paper also compared members of a choir, band and orchestra (n = 28) as a more passive musical control condition to a dance troupe (n = 17), to determine whether higher levels of activity may help explain differences. While the dance condition exhibited higher levels of pain tolerance to the more passive musician control, these differences did not reach significance.

Comparing choir singers to musical or sport activities.

In a study that compared choir singing to solo singing, 38 university choral students participated in both a 20-minute choir and solo singing condition, conducted four days apart (Schladt et al., 2017). Both conditions experienced similar increases in positive emotions and decreases in negative emotions and worry as well as similar reductions in cortisol, a hormone associated with stress. Oxytocin, a hormone implicated in social bonding, remained stable in the solo condition and, surprisingly, decreased in the choir condition. The researchers suggest that the high levels of stress and arousal in the group singing condition may have negated the anticipated oxytocin increases.

Valentine and Evans (2001) recruited three groups at a university: a choir (n = 13), solo singers (n = 10), and solo swimmers (n = 10); all participants were already engaged in their activity. Three dimensions of mood (tense arousal, energetic arousal and hedonic tone) were measured using the UWIST Mood Adjective Checklist just before and 30 minutes after engaging in their activity. Heartrate and blood pressure were also taken at the same interval. All activities measured significant changes by time, with a decrease in tense arousal and significant increases in energetic arousal and hedonic tone. There were also interaction effects for energetic arousal, hedonic tone and heart rate, with the swimming condition experiencing greater changes than either singing condition, which were similar to one another. Therefore, while singing alone or in a group had similar wellbeing effects, solo swimming had greater impacts on all measures.

In what is perhaps the most comprehensive comparison study with rigorous controls, Lonsdale and Day (2020) compared choir singers with solo singers, band or orchestra members, solo musicians, team sport players and solo sport players. While this is the only study included in this review that did not incorporate a pre- and post-test format, it is included here because the study design allowed for a comparison of conditions with or without the components of singing, music production and social opportunities, which is highly relevant to the set of studies reported in Chapters 5 and 6. The study design tested the hypothesis that the combination of the activity characteristics leads to enhanced wellbeing outcomes for choirs when compared to other activities that share some, but not all, of these characteristics. Participants (N = 194, mean age 31.43 years, SD = 16.25) completed an online survey which included questionnaires of psychological wellbeing and the components of Self-Determination Theory (autonomy, competence and relatedness) along with questions addressing demographics, personality and frequency of engaging in their chosen activity. Across the six activities included in the study, there were no significant differences in self-reported levels of hedonic, emotional, social or psychological wellbeing; happiness, life satisfaction, anxiety, depression or self-esteem. There were, however, several between-group differences on the components of Self-Determination Theory. Members of a band or orchestra reported higher levels of autonomy than choir or team sports players, and higher levels of relatedness than anyone engaged in a solo activity (whether a singer, instrumentalist or sport player). Individual sport players also registered lower levels of relatedness than team sport players or choir members. Findings should be considered in light of the nature of the online survey, which has the potential for biased recall compared to studies that collect *in situ* ratings at the time of activity. The authors suggest that any activity that provides a sense of accomplishment or mastery of a skill may provide comparable wellbeing benefits, although the differences in ratings of autonomy and relatedness may indicate that the underlying mechanisms may differ.

Exploring links between singing and pro-social behaviours in children.

There are a few comparison studies which examine links between pro-social behaviours and singing, all conducted with children. A short-term, highly controlled study conducted by Kirschner and Tomasello (2010) demonstrates a credible positive impact of music and movement on pro-social, cooperative and helping behaviours in pre-school aged children. Twelve pairs of males and 12 pairs of females participated in a game without a musical component, and another 12 pairs of both males and females participated with the musical component (singing and dancing). The authors report that, following the game activity, 66% of the male pairs without the musical priming failed to help their partner or make any kind of verbal excuse for not helping in tasks designed to require partner assistance, while for those with the music priming this dropped to 17%; female pairs without musical priming failed to help or provide excuses 33% of the time, while this dropped to 8% with the music priming. When presented with an opportunity to collaborate, 83% of male pairs without the musical priming failed to cooperate, while for those with the musical priming this dropped to 33%. For females, 33% failed to cooperate following playing the game without the musical component, and this dropped to 8% for those who experienced the musical version of the game. Experiencing the singing and dancing component of the game increased expressions of pro-social behaviours.

A similar study design was employed by Good and Russo (2016), comparing children (N = 50, age range 6 – 9 years) who were randomly assigned to a group that collaboratively wrote and performed a song (singing condition), collaboratively designed and painted a mural (art condition) or played a competitive coin-tossing game (competitive game condition). Following 30 minutes of the activity, the children played 20 rounds of the prisoner's dilemma game in dyads, in which they could choose to betray, compete, cooperate or collaborate. As hypothesized, the singing condition resulted in significantly higher number of dyads who chose to cooperate, and incidences of cooperation increased across the 20 rounds; this was not explained by age, gender or pre-existing friendships. There were no differences between the art and competitive game condition.

While these two studies provide strong evidence for a link between joint music-making and cooperative behaviours, there is still a question that such changes may have been facilitated by the dance portion of the study conducted by Kirschner and Tomasello. This possibility is deliberately explored in research conducted by Beck and Rieser (2020). Pre-school aged children (N = 62), comparable in age to the earlier study, engaged with an adult in one of four possible conditions: joint musical play with pro-social content (e.g., lyrics), musical play with neutral content, non-musical play with pro-social content (e.g., a spoken poem), or non-musical play with neutral content. All conditions included the use of egg shakers, but in the musical conditions they were used to promote synchronicity while in the non-musical conditions they were used erratically (not synchronized). Furthermore, the researchers measured both synchronous movement, which is highly coordinated, and what they term 'joint movement,' which did not meet the criteria of synchronous movement but was approximately coordinated. Following these activities, all conditions provided the same opportunities to offer unsolicited help to an adult and to share a resource (stickers) with an adult. There was a strong correlation between the music intervention, regardless of the content of the lyrics, and spontaneous helping (that is, help was not requested) and sharing of stickers. Higher levels of synchronicity were not correlated to changes in pro-social behaviours, but joint movement appeared to have a mediating effect.

Summary of engaging comparison studies.

Across the fifteen studies that compare group singing with similarly engaging and enjoyable alternatives, findings are mixed. The comparison studies with clinical populations (Fancourt & Perkins, 2018; Grape et al., 2010; Perkins et al., 2018) found a short-term improvement for the singing condition, but this improvement over the control condition disappeared by the end of the study period in both cases; it is noteworthy, however, that women experiencing postpartum depression described the benefits of the singing condition differently than the play condition. The two studies described in lab settings (Allpress et al., 2012; Unwin et al., 2002) found no differences between a singing condition and either a listening or a Lego-building condition on wellbeing measures. The three studies comparing a choir condition to other organized leisure activities (Dingle et al., 2017; Pearce et al., 2015; Pearce et al., 2017) found no differences at the conclusion of the study period; while Pearce et al. (2015) reported a significant increase in positive affect scores for choir members, this was due to baseline differences between the groups. Of more interest is their finding that the singing condition appeared to bond faster than the control groups as measured between time 1 and time 2, although all groups had similarly-rated social bonding scores by time 3. Their follow-up study (Pearce et al., 2017) confirmed that the choir condition had higher scores in interpersonal relationships at time 2 than the control conditions, and that the singing condition also reported a greater sense of bonding to the group as an entity from pre- to post-session than the controls. None of the studies comparing choir participation to other musical or sports conditions report that the singing condition outperformed on wellbeing measures, excepting the research reported by Dunbar et al. (2013), which found that a church service with active singing outperformed a prayer meeting without singing when measuring pain tolerance. Schladt et al. (2017) found oxytocin reduced in the choir condition but rose in the solo singing condition, while Valentine and Evans (2001) reported that solo swimmers outperformed both solo and group singers. Most convincing within this group are the three studies exploring the links between singing and pro-social behaviours in children (Beck & Rieser, 2020; Good & Russo, 2016; Kirschner & Tomasello, 2010), although it appears that joint movement (describing a less precise condition than synchronicity) explains at least some of these differences.

Conclusions and knowledge gaps

This literature review indicates that group singing can provide important socio-emotional benefits for people. However, a close examination of comparison studies raises methodological questions regarding how some studies have been designed or, in some cases, how the results have been interpreted. It appears that many past studies have measured differences between groups that can be better attributed to negative changes experienced within control groups due to the withholding of an activity (that is, refraining from singing), differences between groups as a result of lower baseline ratings for choir members, or that comparing a singing intervention to a no-activity intervention has led to the conclusion that the benefits conferred by group singing are different to what might be experienced in other, non-singing group activities. This may have contributed to an over-estimation of the wellbeing effects group singing may provide in natural settings. Conversely, when a singing condition has been compared to an equally engaging control activity, the differences between groups are often negligible.

In order to better understand how group singing influences wellbeing, and whether its impacts are different to other kinds of social opportunities, research could place a greater emphasis on maintaining ecological validity. Understanding how various types of social groups impact on wellbeing in everyday settings requires that individual choice and agency are preserved, and that group singing is compared to equally engaging and enjoyed activities. *In situ* studies fill an important knowledge gap.

Studies which examined effects at different time points reported interesting fluctuations. For example, when comparing a singing (condition) to non-singing (control) condition, Bullack et al. (2018) found no differences between groups at 20 minutes, but at 60 minutes there were significant interaction effects (a decrease in PA and social connection and increase in NA for Control, and a decrease in NA for Singing). Dingle et al. (2017) found that increases in positive affect for both a choir and a creative writing group had dissipated by evening while reduction in negative affect were still in evidence. Coulton et al. (2015) reported that Choir member's anxiety and depression scores were higher at six months than they were at three months (although still below baseline), which indicates positive effects may not be maintained longer-term. Pearce et al. (2015) reported an 'icebreaker effect' for group singing because changes in ratings of social closeness were significantly higher at three months compared to controls while at six months they were not. Finally, the finding reported by Fancourt and Perkins (2018) that women experiencing post-partum depression appeared to recover faster in an infant-directed singing group compared to other kinds of groups may have clinical relevance for treatment. Therefore, employing varying timelines can assist with understanding similarities and differences between singing and other kinds of leisure activities that may vary from immediate effects (pre- to post-session), to longer-term consolidation of wellbeing improvements.

It could be too that wellbeing changes attributed to group singing may be too granular to be measured using traditional survey instruments, despite providing benefits to maintaining wellness. Other forms of measurement could assist with determining whether this is the case. For example, experience sampling methods (ESMs) can illuminate how wellbeing effects may be experienced from day to day when embedded in a range of other everyday activities. Other forms of assessing in-the-moment changes, for example examining changes in behaviour or facial expression, may reveal differences in how wellbeing changes manifest in real time.

Comparing against a greater range of engaging leisure activities would also assist with better understanding the unique benefits, if any, that group singing provides. There are few studies that compare against groups that share some of the nonspecific characteristics of choirs – such as music exposure, coordinated movement and social opportunities – which would provide better understanding of whether wellbeing changes are attributable to shared characteristics or are specific to group singing.

Finally, while there are many studies which aim to identify changes in wellbeing, few studies have focused on the underlying mechanisms that may contribute to such changes. These may be driven primarily by characteristics inherent in the activity itself or it may reflect individual attitudes towards participation – or perhaps a combination of the two. The apparent negative impact of withholding a favoured activity points to the importance of understanding the role that individual attitude towards participation plays in improving wellbeing.

Chapter 4: Leisure groups and wellbeing for older populations

Group singing as a leisure activity

Employing an evolutionary lens has highlighted the wellbeing benefits that group singing may provide, through the creation of positive and shared emotional states and increased sense of social cohesion. While many cultures integrate community singing into everyday life, contemporary western society, with few exceptions (e.g., church services, sporting events), provides few opportunities for regular shared singing experiences unless they are intentionally sought. For most people, group singing is a leisure activity that is engaged in by choice, because it is enjoyable (Wilson, 2011). Comparison with similar kinds of organised group activities in which people choose to participate would therefore be useful. There is evidence that self-selected leisure activities improve health and wellbeing.

Leisure group participation and wellbeing

Interpersonal relationships have been found to be a significant determinant of physical and mental health and wellbeing (Harandi et al., 2017; Siedlecki et al., 2013; Song & Fan, 2013). For example, a large population study of older adults and centenarians revealed that not smoking and being socially active were the two primary predictors of a healthy older age with few chronic diseases (Barak et al., 2020). A longitudinal study following 90 men across 70 years found that social supports mediated the relationship between positive psychological defence mechanisms and better physical health into old age (Malone et al., 2014). A meta-analysis found that people with stronger social relationships increased their likelihood of survival by an astounding 50%, and that these effects were greatest for people with strong social networks (Holt-Lunstad et al., 2010).

While older adults often have more time for socialising (Cornwell et al., 2008), they can also struggle to maintain social networks. Lost social opportunities and roles offered by employment can be a key contributor to reductions in health and wellbeing for older adults (Heybroek et al., 2015). For example, a longitudinal study of retirees found that those who maintained activity in at least two social groups had a 2% risk of death in the first six years of retirement compared to a 12% risk if they ceased all social group activity, while also recording a 10% drop in quality of life scores for each social group that they lost (Steffens et al., 2016). These changes mean older people may need to proactively manage their social networks for the first time, and at times when other resources – for example, driving capability (Pristavec, 2018), mobility or cognitive capabilities (Steverink et al., 2005) – are declining.

Organised leisure group activities have been identified as a potential mediator of diverse social networks for older adults (Chang et al., 2014), where "[p]erceptions of positive social relationships were associated with greater involvement in leisure activities, and greater involvement in leisure activities was associated with better health in older age" (p. 516). These findings have been corroborated by Fiori et al. (2006), who reported that diverse networks – which include social group attendance – are most predictive of mental wellbeing, while family-intensive networks were least predictive, implying that the breadth, as well as depth, of social contact may also be an important contributor to wellbeing. Similar findings were reported by Sharifian and Grühn (2019), who found that social participation was protective of psychological wellbeing for older adults across the 19 years of their study while social support was not.

Participating in leisure activities also supports wellbeing into older age. A meta-analysis (N = 42 studies) reported that there are correlations between leisure activities and a range of wellbeing measures for older adults, with social and 'productive' activities (that is, activities that are both meaningful and purposeful) providing the greatest benefits (Adams et al., 2011). Vozikaki et al. (2017) confirmed this finding, reporting a correlation between frequency of engaging in socially- and productively-oriented activities and higher levels of life satisfaction, quality of life, and psychological health, amongst other health measures, for older Europeans.

While these studies provide evidence for positive benefits associated with leisure group participation, the broad categorisations of leisure group types, incorporating a variety of activities, fails to provide a more nuanced understanding of the mechanisms underlying wellbeing facilitation. Such changes may be explained by certain characteristics of the activity itself; for example, activities which incorporate elements of coordinated movement or music listening, both of which have been linked to wellbeing improvements. If this is the case, it may be possible to predict which kinds of social group opportunities are most likely to enhance wellbeing.

Elements of social group activities and wellbeing

There are indications that elements of some social group activities, for example music engagement and synchronised movement, have a positive impact on wellbeing. Music engagement has been linked to improved mood (Saarikallio, 2011; Salimpoor et al., 2011; Schäfer et al., 2013), an increased sense of social cohesion (Cross, 2007; Loersch & Arbuckle, 2013; Schäfer & Eerola, 2018) and empathy (Fukui & Toyoshima, 2014; Greenberg et al., 2015). Creating a shared emotional state, a common experience in joint musical experiences (Egermann & McAdams, 2013; Peltola, 2017), has also been shown to increase a sense of social bonding (Páez et al., 2015). This may be one mechanism that facilitates wellbeing effects for social activities such as exercise classes (which often incorporate music), choirs and other forms of music-making groups.

Synchronised movement has also been found to influence wellbeing; for example, through elevating pain thresholds, a proxy measure of endorphin release, which facilitates social bonding (Codrons et al., 2014; Cohen et al., 2010; Jackson et al., 2018; Keller et al., 2014; Tunçgenç & Cohen, 2016; Valdesolo & DeSteno, 2011; Valdesolo et al., 2010). Synchronisation appears to influence social bonding in such movement-based social activities as group exercise (Davis et al., 2015) and dance (Tarr et al., 2015; Tarr et al., 2016), and is also a component of choirs (Himberg & Thompson, 2009; Müller & Lindenberger, 2011; Phillips-Silver & Keller, 2012; Weinstein et al., 2015).

The layering of coordinated movement, music engagement and social opportunities may augment wellbeing effects for leisure activities that incorporate these characteristics. Community choirs provide these experiences, which further supports the evolutionary theory of group singing in providing socio-emotional benefits. However, it could be that exercise groups may provide similar benefits since, like choirs, they also incorporate music, movement and social opportunities. It is also possible that exercise groups may be a superior facilitator of improved wellbeing when compared to choirs because they provide more rigorous and intensive movement, which also appears to have wellbeing effects (Davis et al., 2015). The following section provides an overview of exercise and wellbeing, with a particular focus on exercise groups.

Exercise and wellbeing

Exercise is known to have numerous physical and psychological wellbeing benefits. Physical benefits are perhaps the most obvious and are well documented, including overall fitness; recovery from cardiovascular disease, cancer, stroke and/or diabetes; reductions in body mass index and blood pressure; and overall quality of life (see for example Garber et al., 2011; Keogh & MacLeod, 2012; Naci & Ioannidis, 2013; Spence et al., 2010). However, there are also many psychological and social benefits which arise from exercise.

It is important to note at the outset of this brief review of benefits of exercise, that the research reported here does not reflect a consistent concept of exercise, movement or activity. Operationalisations of exercise differ across studies, for example, with some measures specific to solitary exercise, while others relate more to group or team exercise. Many studies are conducted in clinical settings, while others are in natural settings or report on population-level survey responses.

There are several variables which also make comparisons across studies difficult, such as the presence of absence of other people, degree of intensity, frequency and duration, and whether the activity is primarily conducted indoors or outside. Despite these differences, overall there appear to be positive associations between active behaviours, health and wellbeing.

Several reviews focus on the effects of exercise on depression and anxiety. Findings for depressive symptoms are consistent across all reviews, with significant improvements of a moderate to large effect size attributable to exercise (Conn, 2010b; Rebar et al., 2015; Rosenbaum et al., 2014; Silveira et al., 2013; Stanton & Happell, 2014; Wegner et al., 2014). Specific to anxiety, findings are mixed. A meta-analysis of exercise interventions (15 studies, N = 675) reported reductions in anxiety measures compared to a no-activity condition, with greater effects for high-intensity interventions (Aylett, et al., 2018). Conn (2010b), who compared 19 studies (N = 3,289) examining the role of exercise in reducing anxiety, confirmed that higher intensity exercise yielded greater reductions in anxiety levels, as did interventions that took place outside of the home. Other reviews report effect sizes for reducing anxiety symptoms as either small (Conn, 2010a; Herring et al., 2010; Jayakody et al., 2014; Rebar et al., 2015; Wegner et al., 2014) or not significant (Bartley et al., 2013). Exercise has been suggested as a useful complementary treatment method alongside more mainstream options for treating anxiety (Jayakody et al., 2014).

Specific to older populations, the effects of exercise on wellbeing are more complex, perhaps due to increasingly complex medical conditions. Despite this, exercise appears to provide important wellbeing benefits for older people. An eight-year longitudinal study of older adults in Singapore found that group exercise was one of several leisure activities that improved wellbeing (alongside gardening and walking, and comparative to more sedentary activities of reading, watching television and chatting) (Ku et al., 2016). A Canadian population study found that older adults who engaged in activities categorised as ‘active’ were more than twice as likely to be aging successfully, defined as absence of disease or disease-related disability, high functioning capacity, and active engagement with life (Baker et al., 2009), although it is possible this finding reflects capability, with those who are aging well being better able to engage in active persuits. A review of studies examining affective changes for non-clinical populations (14 studies, N = 1,360) found that exercise regimes in natural settings improved positive affect and energy levels for several hours post-session, while changes in negative affect were inconsistent (Liao et al., 2015). Hogan et al. (2013) reported that 15 minutes of moderate exercise both increased high-arousal positive affect scores and improved working memory across all participants regardless of age, although they found that a reduction in low-arousal positive affect was greater for younger than older participants.

Looking specifically at depression in older populations, in reviewing 9 studies (N = 667), exercise was found to be effective at reducing symptoms across a range of high-intensity and low-intensity interventions (Bridle et al., 2012). A review of studies specific to older people with dementia (13 studies, N = 896) found that there were physical improvements as a result of physical activity interventions that lasted a minimum of 12 weeks, but mixed results for quality of life, depression and wellbeing measures (Potter et al., 2011). Mura and Carta (2013) reported that, when examining several comparison studies (10 studies, N = 1,318), most demonstrate significant positive findings in relieving depressive symptoms when an exercise-only intervention was compared to standard treatment, and when exercise plus standard treatment was compared to standard treatment only. For the few studies which did not report significant findings, either improvements were made for both treatment and control groups, or non-significant results trended in a positive direction.

Kim et al. (2017) reported that, for older people experiencing loneliness, engaging in physically active leisure activities (including walking, sport or exercise, attending a social club or maintenance/gardening) was a predictor of increased optimism, life satisfaction, positive affect and psychological wellbeing. Similarly, a 12-year longitudinal study (Chao, 2016) explored correlates between older people's wellbeing and the types of leisure activities they engaged in; while physical activity was most protective of depressive symptoms, social activities predicted increases in positive affect and interpersonal skills. This finding indicates that exercise groups may provide enhanced benefits through the provision of both physical activity and social engagement.

While there has been less research on links between exercise and pro-social behaviours, an experiment conducted by Di Bartolomeo and Papa (2019) found that individuals who participated in 30 minutes of an exercise regime scored significantly higher on measures of trust in an online investment game, compared to participants who engaged in a writing activity. These effects were greater for male participants, and lasted for the (unspecified) duration of the eight rounds of play.

While exercise has been shown to increase subjective wellbeing for older adults, few researchers have isolated the role of social opportunities that are integral to most interventions. Similar to the research into choir membership and wellbeing, this is an oversight which can confound interpretation of results: Is wellbeing increasing due to the exercise regime (e.g., due to physiological changes or sense of mastery), or due to social interactions? Furthermore, while some research focusses on low-intensity interventions, fewer studies make a direct comparing between high-intensity and low-intensity workouts to determine whether there is an intensity threshold for achieving positive wellbeing results. A study conducted by McAuley et al. (2000) examines both the role of intensity and social cohesion on wellbeing effects. The researchers compared two groups of sedentary older adults (n=174) who were randomly assigned to either an aerobic exercise group (higher-intensity) or a stretching and toning group (low-intensity), with each group meeting three times per week for 6 months. Wellbeing measures were employed at baseline, at the end of the intervention (6 months) and again at a 6-month follow-up, for a duration of 12 months. Ratings of happiness and satisfaction with life rose from baseline to 6 months for both groups, while loneliness ratings decreased only for those who scored higher in sense of social support. All wellbeing improvements had deteriorated 6 months after the end of both programs. There were no significant differences between the two groups, which indicates that rigorous exercise may not be necessary to achieve positive wellbeing outcomes in older populations.

Older adults appear to enjoy exercise-related activities. A survey of over 5,000 seniors aged 65 years or older found that nearly all preferred activities that were categorised as ‘active,’ including walking or jogging, outdoor maintenance, playing sports, and other (unspecified) physical activities, with reading reported as the only sedentary activity in the top five responses (Szanton et al., 2015). However, a Swedish study found that as people reached age 70, they were most likely to reduce participation in physical leisure activities. For women, reductions in physical activities were offset by increases in cognitive/sedentary leisure activities, while also retaining the same number of social activities, while for men the overall number of activities reduced (Finkel et al., 2018). These findings confirm that as people age, the capacity for exercise declines and other, more sedentary leisure activities may be more accessible.

In sum, there are strong indications that engaging in active pursuits provides important physical and mental protective factors for older adults, despite differences across studies in measures and interventions. While fewer studies have considered specific measures of socio-emotional wellbeing in relation to exercise, there are indications that, like choirs, exercise groups may facilitate wellbeing improvements. This may be due to the shared characteristics of the activities, such as music engagement, coordinated movement and social opportunities. However, it is possible that changes in wellbeing rely on individual mindset towards the leisure activity and motivation for participation. If this is the case, the type of activity may be insufficient to determine whether it will be beneficial to an individual. The following section provides an overview of how individual differences in mindset may also contribute to wellbeing changes as a result of social group participation.

Individual mindset to participation

It may be that some wellbeing improvements are linked to the mindset or motivation of an individual towards their social group participation; that is, wellbeing improves because it fulfills a psychological need. 'Mindset' is used here to describe individual differences of motivation, choice, preference and attitude towards participation. Self-determination theory (SDT) is one possible framework that may explain how individuals benefit from social group participation. SDT argues that perceived autonomy, feeling competent, and experiencing a sense of relatedness (that is, the assessment that an individual's contribution is meaningful and valued by others) is fundamental to wellbeing across the life course (Ryan, 2009). Employing an SDT frame highlights the critical role that preference and choice may play in wellbeing improvements for an individual. A sense of being 'forced' into participation, or being motivated extrinsically to participate, may undermine a sense of autonomy, competence and relatedness, thereby countering any benefits for wellbeing. Similarly, wellbeing is predicted to be higher when an individual is intrinsically motivated, or at least choosing to engage in an activity (e.g., in cases of identified regulation, in which the outcomes of participation are the motivator), than when extrinsically motivated or not motivated at all (e.g., amotivation) (Deci & Ryan, 2008; Guay et al., 2000).

Intrinsic motivation is also associated with engagement in an activity, and, at its best, can lead to a sense of 'flow', characterised by enjoyment of the activity, intense concentration, a sense of mastery, and a distortion of time passing, which can be particularly positive (Nakamura & Csikszentmihalyi, 2004). Flow has been reported quite regularly by individuals engaged in music production (Chirico et al., 2015; De Manzano et al., 2010), and this experience has been linked to wellbeing improvements (Fritz & Avsec, 2007). It is also commonly experienced in exercise settings (Jackson et al., 2001; Swann, 2016), and may be enhanced in group settings as opposed to individual endeavours (Decloe et al., 2009; Walker, 2010). It could therefore be that individual motivation for participating in an activity influences wellbeing outcomes, with those who are intrinsically motivated gaining greater benefits. Hence, an individual's disposition towards the activity may be a critical factor for consideration, rather than solely the choice of a particular leisure activity (such as 'choir' or 'exercise' group).

It may also be that wellbeing improves when there is a good fit between the activity's characteristics and individual mindset or motivation. The concept of person-activity fit (Lyubomirsky & Layous, 2013) accounts for both the components of the activity as well as the motivation, engagement and enjoyment experienced by the individual. In this model, wellbeing is not mediated solely by the activity or by individual mindset, but rather is dependent on the congruence, or fit, between them. Activities which people enjoy performing (e.g., due to intrinsic motivation) will be performed more often, resulting in more boosts to wellbeing levels. Person-activity fit has been considered within the context of specific wellbeing interventions; for example, Thompson et al. (2015) found gender and age differences for wellbeing effects of gratitude journals, savouring life's joys and acts of kindness, while Schueller (2012) reported that extraverts had greater increases in wellbeing measures for the interventions of gratitude visits and savouring, while introverts reported greater benefit from active-constructive responding, signature strength and enumerating three good things. The construct of person-activity fit it may be useful in understanding how social group activities and individual mindset interact to improve wellbeing (or not).

Discussion

In sum, there is ample evidence that participating in leisure activities can support successful aging, and organised leisure groups play an important role for many older adults in maintaining supportive social connections. While group singing has been mooted as evolutionarily advantageous for socio-emotional wellbeing, individuals have many social group options which may provide similar benefits. Research on leisure activities indicates that these pursuits provide wellbeing benefits that accord with those attributed to group singing. It could be, however, that some of the characteristics of the community choir experience, such as music engagement, coordinated movement and social opportunities, mean that choir participation returns greater wellbeing benefits than other kinds of social groups. If that is the case, then organised group activities that share some of the same characteristics, such as exercise groups, may be expected to have similar effects on wellbeing. Individual differences in mindset towards participation, such as motivation, experiences of flow, or fulfilling the components of SDT (autonomy, competence and relatedness), should also provide a psychological benefit from participation.

The research reported here provides unique insights into how community choirs improve wellbeing by considering how individuals experience them in everyday, natural settings. Comparing choirs to other kinds of organised social groups, and exercise groups in particular, retains individual preference and choice across a range of activities, making for a more robust comparison than is often provided in a research setting. Finally, this research considers both the characteristics of the activity itself as well as individual mindset towards participation, since the relative contributions of each to wellbeing improvements is not clear. These distinctions are important so that research results reflect true differences between social groups in everyday settings; this in turn provides practitioners with a better understanding of what sits behind wellbeing changes, leading to better outcomes. This is particularly important in settings where individuals may have reduced agency, for example in institutional or health settings.

Chapter 5: An investigation of immediate wellbeing benefits

Preamble

This chapter contains a published article that reports on two studies investigating short-term wellbeing changes in a choir setting for older adults. These studies were designed to address the first aim and related research questions explored in this thesis:

Aim 1: *To assess short-term changes in wellbeing following participation in a community choir in comparison to group leisure activities.*

1. *Does group singing provide short-term wellbeing benefits, specifically increases in positive affect, reductions in negative affect, increases in energy levels, and increases in sense of social connection?*
2. *Does group singing provide greater short-term wellbeing benefits than comparison groups?*

This chapter provides several unique contributions to the field. First, the use of exercise groups as a control group allows for a more robust study design that demonstrates how wellbeing changes as a result of community choir participation compare to groups that share some of the nonspecific elements, including movement and music exposure. Second, including a more sedentary control group, in the form of the discussion groups, provided a control group with greater contrast to the choir experience (e.g., no movement or music exposure). Third, the natural setting retains important components for experiencing wellbeing in everyday settings, including preference and choice. Finally, the observation methodology that was specifically designed for this study provides a unique process for tracking changes across a group, providing more granular data that is not reliant on psychometric questionnaires.

Table 3 of the published paper, which reports the results from Study 1, incorrectly reports the time p *value for negative affect (it is correct in the text of the paper, however). A corrected table is* *presented below. It also provides combined results by time, which was not included in the publication. Furthermore, the degrees of freedom reported for the F statistic for all results by time should read (1, 76).*

Citation: Maury S, Rickard N. (2018). A Comparison of the Effects of Short-term Singing, Exercise, and Discussion Group Activities on the Emotional State and Social Connectedness of Older Australians. *Music & Science*. https://doi.org/10.1177/2059204318800607

Table 5.3 CORRECTED

Results on Phase 1 pre- and post-tests measures, all groups, with time and time x group interaction p value

Measure/ Sub-scale	Choir M(SD)	Choir T2 M(SD)	Exercise M(SD)	Exercise T2 M(SD)	Discussion M(SD)	Discussion T2 M(SD)	Combined M(SD)	Combined T2 M(SD)	Time *p* value	Effect size (Cohen's *d*)	Time x Group Interaction *p* value	Effect size (Cohen's *d*)
PANAS												
Positive affect	3.33 (0.92)	3.7 (0.85)	3.38 (0.86)	3.66 (0.84)	3.08 (0.95)	3.27 (0.85)	3.26 (.91)	3.54 (.86)	.000[a]	1.04	.187	0.29
Negative affect	1.22 (0.53)	1.07 (0.26)	1.20 (0.31)	1.09 (0.26)	1.27 (0.42)	1.27 (0.51)	1.23 (.42)	1.14 (.37)	.016[a]	.57	.270	0.38
AD ACL												
Energy	3.08 (0.77)	3.22 (0.75)	3.25 (0.76)	3.37 (0.67)	2.86 (0.86)	2.89 (0.68)	3.07 (.80)	3.16 (.72)	.152	.33	.784	0.16
Calmness	2.65 (0.59)	2.38 (0.59)	2.35 (0.69)	2.39 (0.73)	2.17 (0.97)	2.19 (0.67)	2.39 (.78)	2.32 (.66)	.423	.18	.302	0.36
Tension	1.38 (0.53)	1.25 (0.42)	1.37 (0.54)	1.29 (0.45)	1.42 (0.49)	1.49 (0.70)	1.39 (.51)	1.34 (.54)	.268	.255	.220	0.40
Tiredness	2.10 (0.74)	2.03 (0.63)	2.06 (0.75)	1.76 (0.48)	1.93 (0.63)	1.76 (0.37)	2.03 (.70)	1.85 (.51)	.012[a]	.059	.382	0.32
Group Cohesion	5.88 (0.78)	6.10 (0.72)	5.81 (0.80)	5.98 (0.73)	5.48 (1.01)	5.46 (1.05)	5.72 (.87)	5.85 (.88)	.047[a]	.46	.236	0.39

[a]The difference in mean values is considered significant at the .05 level

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A Comparison of the Effects of Short-term Singing, Exercise, and Discussion Group Activities on the Emotional State and Social Connectedness of Older Australians

Susan Maury and Nikki Rickard

Abstract

Choir membership has been shown to improve emotional states and facilitate social connectedness. It is, however, less clear whether these benefits are unique to group singing or are shared by other social group activities that include some of the characteristics of choirs other than singing, such as music listening and social interaction. This research compares older Australians who are members of either a choir that both produces and listens to music in a social context, an exercise group that incorporates music listening and movement with social interaction, or a current events discussion group with social interaction but no music content. Participants were administered emotional state and cohesion questionnaires at two test times, just prior to and immediately after the session, to determine the short-term (60–90 minutes) effects on emotional state and social cohesion as result of different social activities containing varying levels of music engagement. A two-way Analysis of Variance (ANOVA) revealed significant improvements in positive affect and cohesion scores, and a decrease in negative affect and tiredness scores, over time for all groups. The choir and exercise groups were also observed by two raters who recorded observable behaviors categorized using the circumplex model of emotion. Findings revealed that both groups demonstrated significant increases in Activated Pleasant (high positive affect, high arousal) behaviors over time, but with no differences between the two groups. Taken together, these studies suggest that well-being benefits are shared by self-selected leisure social group activities, and that the effects can be observed within a very short time frame using both self-report and behavioral measures. The authors suggest that future research incorporates suitable control groups into research designs to better articulate any unique benefits that group singing may confer.

Keywords

Music, choir, exercise, emotion, social cohesion, aging

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Introduction

Social connectedness is a primary protective factor for healthy physical and mental aging. Loneliness in older years is associated with increased mortality, decreased physical capability and poorer mental health (Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Luanaigh & Lawlor, 2008; Luo, Hawkley, Waite, & Cacioppo, 2012). While older populations have fewer social connections, they also have more time to invest in relationships and leisure activities (Cornwell, Laumann, & Schumm, 2008). Previous research has identified a range of positive outcomes for older populations who engage in social activities, ranging from improved emotional

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wellbeing and mental health (Horowitz & Vanner, 2010; Menec, 2003; Potočnik & Sonnentag, 2013), physical capability (Menec, 2003; Unger, McAvay, Bruce, Berkman, & Seeman, 1999) and cognitive functioning (Bennett, Schneider, Tang, Arnold, & Wilson, 2006; Seeman, Lusignolo, Albert, & Berkman, 2001). Importantly, supportive social connections with non-familial contacts have also yielded benefits (Fiori, Antonucci, & Cortina, 2006; Seeman, 2000), which highlights the role of broader community social opportunities for aging well. There has therefore been an interest in leisure activities for older populations which promote social connections as a means of maintaining mental health and wellbeing.

Group singing is a popular leisure activity which promotes social connectedness in several ways. It has been proposed that, from an evolutionary perspective, it creates a shared positive emotional state. Because emotions serve to focus attention on priorities for action (Cosmides & Tooby, 2000; Lang & Bradley, 2010; Lang & Davis, 2006), group-held emotions support the long-term viability of the group itself as well as commitment to jointly-held long-term plans (Niedenthal & Brauer, 2012). Thus, group singing may create a shared emotional state that facilitates both cohesion and cooperation (Cross, 2009; Maury & Rickard, 2016). Additionally, there is strong evidence that emotional musical experiences incorporate an empathic response (Cross, Laurence, & Rabinowitch, 2010; Egermann & McAdams, 2013; Miu & Balteş, 2012). A shared emotional state resulting from joint music-making may therefore encourage empathic responses to others. Increased empathy has strong links to increased prosocial behaviors (Eisenberg, Eggum, & Di Giunta, 2010; Eisenberg & Miller, 1987; Telle & Pfister, 2015), which reinforce group bonds and cohesion.

Groups which engage in music co-production have been shown to display both short-term changes in emotion and social connection (Clements-Cortés, 2015; Sanal & Gorsev, 2014) and more persistent changes (Bailey & Davidson, 2005, 2013; Dingle, Brander, Ballantyne, & Baker, 2013). While other types of social groups may also experience these benefits, there are indications that the pathway to these changes may be unique to music-producing groups (Pearce, Launay, & Dunbar, 2015; Pearce, Launay, MacCarron, & Dunbar, 2017). Studies which explore the short-term effects of music co-production may be able to perceive these differences, leading to a greater understanding of the mechanisms behind more persistent effects.

Group singing, affect and social bonds

Emotion regulation and social connection are often listed as the primary contributors to wellbeing for choir members. For example, increases in positive affect (PA) and social support were two mechanisms identified by choir members surveyed by Clift and Hancox (2010) (the others were focused attention, deep breathing, cognitive stimulation, and regular commitment). von Lob, Camic, and Clift (2010) interviewed people who asserted choir membership has assisted them in coping with adverse life events; they named the collective experience of the choir and building relationships with other members to be important interpersonal mechanisms. When comparing a choir of homeless men to middle-class trained choristers, Bailey and Davidson (2005) found that emotional benefits were similar across the choirs, but that camaraderie was a particularly important aspect for the homeless choir members. Further, the same authors report that members of the homeless choir identified adaptive, persistent changes in emotion state and social skills resulting from choir membership (Bailey & Davidson, 2013). A choir formed for people with a disability provided members with important social benefits, including connecting with other people within the choir, connecting with the audience at performances, and improving overall social functioning (Dingle et al., 2013). People with clinical mental health issues in the UK experienced improved mental health over 8 months of choir membership, identifying emotional and social benefits as the mechanisms behind the improvement (Clift & Morrison, 2011). Welch, Himonides, Saunders, Papageorgi, and Sarazin (2014) reported that schoolchildren in a school-based singing program ($n = 6{,}087$) had a higher sense of self-concept and social inclusion, although this may be attributable to children developing a sense of mastery since self-concept and social inclusion were also positively correlated with children's level of singing ability.

Studies that have examined the short-term effects of group singing on mood have all reported an increase in PA, with mixed results for decreases in negative affect (NA). For example, when measuring experiences of flow amongst 44 students at a music academy, Fritz and Avsec (2007) found that those who performed in a choir or orchestra were the most likely to experience flow, and that flow states were positively associated with high subjective wellbeing, higher levels of PA and lower levels of NA. Small increases in PA and small decreases in NA were reported following a 1-hour choir practice with university students (Sanal & Gorsev, 2014) and with cancer patients or carers (Fancourt et al., 2016). Others report significant increases in PA but negligible changes in NA (Sandgren, 2009), including for people with Parkinson's Disease (Abell, Baird, & Chalmers, 2017). In a study with carers and older adults experiencing dementia or cognitive impairment, choir participation increased both PA and energy levels, while experiences of pain fell from pre- to post-session, and also across the 16 weeks of the experiment (Clements-Cortés, 2015).

The research reviewed above, therefore, supports that group singing is a leisure activity that is likely to have a positive influence on emotion state and social bonding. However, it is less clear whether choir membership is *more* likely to provide these benefits than other leisure activities.

Few studies provide a comparison group, and fewer still use a comparison group that provides a strong control in terms of similarity to the group singing experience. The following section reviews comparisons between group singing and other, non-music activities, followed by comparisons of differing types of music interventions.

Comparison studies

There are some studies which compare group singing with other, non-musical activities. Johnson, Louhivuori, and Siljander (2017) compared older (60–93 years) Finnish choir members ($n = 109$) with a demographically-matched sample ($n = 1{,}296$), some of whom were actively engaged in unspecified hobbies and others not. A comparison of quality of life (QoL) scores indicated that choir members reported significantly higher-rated overall QoL as well as health satisfaction compared with both control groups. Kreutz (2014) reports significant rises in PA and drops in NA as well as increases in oxytocin, a hormone implicated in the human bonding process, when comparing a singing to a chatting condition. Allpress, Clift, and Legg (2012) conducted a small ($n = 18$) study in which two groups participated in a 1-hour joint singing session or a 1-hour team exercise using Lego building blocks (R. Allpress, personal communication, 15 January 2014); the following day, the groups were switched. Differences reported on the two activities were not significant, although on both days the choir participants recorded slightly higher levels of PA and social cohesion and slightly lower levels of NA. Finally, an innovative study with young children found that playing a game resulted in increased cooperation and prosocial behaviors when the game included joint music-making (Kirschner & Tomasello, 2010).

At least two comparison studies report no differences between groups. For example, Dingle, Williams, Jetten, and Welch (2017) found no difference in affective changes between members of a choir and those enrolled in a creative writing class; this study also compared a normal older population with socially marginalized individuals, with no differences in mood changes between the groups. Similarly, a choir intervention with school children aged 7–11 years found no significant differences between choir participants and non-participants, although it is worth noting that the control group was small ($N = 10$ compared with 50 in the choir intervention) (Hinshaw, Clift, Hulbert, & Camic, 2015).

Recent research points to possible differences between how musical and non-musical groups achieve these benefits. Pearce et al. (2015) found that members of singing groups reported a stronger sense of social bonding after meeting regularly for 3 months compared with crafts and creative writing groups, although self-reports were identical between all groups after 7 months. Exploring these differences further, the authors found members of both the choir and creative writing conditions demonstrated higher levels of person-to-person bonding than the crafts class, but the singers were the only group to develop a bond to the group as an entity (Pearce et al., 2017). These findings reinforce the need for examining wellbeing changes as they occur over a short period of time for music groups, in order to better understand how longer-term changes are achieved. Incorporating temporally sensitive methodologies into research – such as observations of behaviors over time (Bartel & Saavedra, 2000) or experience sampling methodology (Csikszentmihalyi & Larson, 2014) – may therefore illuminate subtle differences experienced in shorter time frames.

Few researchers have used a strong comparison group, such as those involving physical activity, exercise or sports. This is partly because "high exertive activity has been shown to increase social bonding" (Pearce et al., 2017, p. 498), which may be deemed to too closely replicate one of the key means by which group singing is likely to benefit its members. Alternatively, group exercise classes often include background music, which again dilutes the differentiation from the group singing intervention. A review conducted by Karageorghis and Priest (2012) reports that, when used with exercise, pre-task music can elevate arousal, and that self-selected music that is considered both motivating and stimulating can improve mood, reduce a sense of exertion, improve energy levels, and increase length of workout. It is to be expected, then, that the presence of music, provided it is pleasant to group members, would improve mood in both choir and exercise settings.

Stewart and Lonsdale (2016) provide an insightful study, comparing choral members to both solo singers and members of sports teams. Both choir members and sports team members reported significantly higher psychological well-being than solo singers; additionally, both choir and team members reported high levels of social bonding, although choir members were more likely to describe these social bonds as more meaningful. The authors suggest these findings may point to the importance of the group experience for socio-emotional wellbeing rather than the act of singing.

In summary, while group singing conditions appear to have a positive impact on affective state and social connection, comparison studies provide mixed results. Results from the children's game designed by Kirschner and Tomasello (2010) indicate that group singing may promote sociability in groups in unique ways. However, in other findings changes in affect or social connection between music and non-music activities, when reported, are not always significantly different. It may be that the experiences between the groups are not identical, particularly concerning social processes. In particular, reports from Pearce and colleagues (Pearce et al., 2015, 2017) indicate that the singing groups in their study both bonded more rapidly and created bonds to the group as an entity, distinct from the strength of individual relationships that were formed across the length of the study. Therefore, while all the groups that participated in their study reported increases in social cohesion, both the rapidity and the type of bonds felt by the singing group were different from the others. This is supported by Stewart and Lonsdale (2016), who report that choir members described their group as more coherent and meaningful than those described by members of sport teams. It also appears that comparison groups are generally selected in order to highlight the unique experience of music co-production, but this has left a gap in understanding how more similar social groups may either converge with or diverge from these experiences.

Music engagement. Studies that compare different methods of musical engagement are helpful to determine whether there are differences in the effects on wellbeing, for example between reception (that is, listening to music) and production (that is, singing or playing). Background music can have a positive impact on social interactions, including increasing a sense of "liking" in initial meetings (Stratton & Zalanowski, 1984b), increasing verbal exchange in social settings (Dubé, Chebat, & Morin, 1995; Stratton & Zalanowski, 1984a), and increasing positive assessment of an individual during an initial meeting (Ortiz, 1997). While there is ample evidence that music listening impacts on wellbeing (Croom, 2015; Juslin & Sloboda, 2010; MacDonald, 2013), including for older adults (Groarke & Hogan, 2015; Laukka, 2007), it is also becoming clear that musical preference is a key component; the music must be liked. Salimpoor, Benovoy, Longo, Cooperstock, and Zatorre (2009) examined this specifically with people who listened to both self-selected pleasurable and neutral musical pieces. They found that mood was elevated, with accompanying physiological responses, only when *liked* music was played. Thompson, Schellenberg, and Husain (2001) also found that listening to Mozart improved performance on a spatial task, but only when the listener found the music pleasurable, thus increasing both PA and arousal.

Therefore, the benefits of music listening are linked to how positively engaged listeners are with the music, which incorporates heightened arousal. While there are numerous music listening studies that measure changes in arousal (Grewe, Kopiez, & Altenmüüller, 2009; Grewe, Nagel, Kopiez, & Altenmüller, 2007; Guhn, Hamm, & Zentner, 2007; Hirokawa, 2004; Rickard, 2004; Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011) it has seldom been measured in settings where music is being actively produced. One study reports that arousal increases were greater for individuals singing or tapping along to music, while these conditions as well as playing on a keyboard also decreased tiredness compared with a listening condition (Lim, 2008), indicating that active music production increases arousal. Contrary to these results, however, Grewe, Kopiez, and Altenmüüller (2009) report no differences in physiological responses in a passive vs. active (singing along) condition to familiar music. These studies were conducted with individuals; the authors are unaware of studies which measure arousal in a group setting. This is another gap in the research, since elevations in arousal may signal engagement with the music, and appears to also facilitate changes in mood (Chanda & Levitin, 2013; Salimpoor, Benovoy, Longo, Cooperstock, & Zatorre, 2009; van der Zwaag, Westerink, & van den Broek, 2011).

While it is known that music listening assists with affect regulation and influences social bonding (Dubé et al., 1995; Ortiz, 1997; Ziv, Granot, Hai, Dassa, & Haimov, 2007), there are few studies directly addressing the question of whether music production may provide greater benefits than a listening condition alone. However, there are indications that this may be the case. For example, when Kreutz, Bongard, Rohrmann, Hodapp, and Grebe (2004) compared the same choir at different times on both a singing and a listening condition, members reported significant increases in PA for both conditions, while NA dropped significantly for the singing condition, but rose for listening. A comparison of listening and singing effects on 5-year-old Japanese children found that they drew for longer and the drawings were judged as higher quality and more creative after singing familiar songs compared with a listening condition. Differences were also reported in the listening condition, with more proficient drawings produced after listening to children's songs than after listening to classical selections (Schellenberg, Nakata, Hunter, & Tamoto, 2007). Baird et al. (2015) reported that singing both familiar and unfamiliar songs improved PA significantly compared with a non-musical condition for people with Parkinson's disease.

In one of the few studies designed to explore differences between active music creation and listening, Dunbar, Kaskatis, MacDonald, and Barra (2012) found that a drumming group exhibited greater pain tolerance than a listening condition, additionally suggesting that the drumming condition facilitated group bonding more so than the listening condition through endorphin release. It is worth noting, however, that the listening condition was passive listening (in an office environment) rather than active, preferred listening. This was followed up with an active listening condition (fast vs. slow tempo music), which registered no increase in pain tolerance. The researchers conducted the same experiment comparing a choral or instrumental group with a dancing condition and found that the music groups outperformed the dancing condition in pain tolerance. These findings point to active music production, rather than either listening or coordinated movement, as the pathway for increased social bonding as measured through changes in pain tolerance.

In summary, it may be that wellbeing effects for music differ between listening and production; this topic could be explored through comparing music production with listening conditions in order to control for the effects of production. It has been established that, for listening conditions, benefits are greater for preferred music. Therefore, engagement with the music may be a critical component of wellbeing effects. Music engagement is distinct from training or

Table 1. Putative mechanisms present in each group type.

	Choir	Exercise	Discussion
Social connection	✓	✓	✓
Emotion regulation	✓	✓	×
Music listening	✓	✓	×
Music production	✓	×	×

competence, referring rather to an individual's emotional or intellectual commitment to a task (Chin & Rickard, 2012). Musically speaking, engagement can be present in a listening condition or absent in a production condition.

Aims of the current study

This study explores the effect of group-based leisure activities on social connectedness and emotion state measures of wellbeing for an older population in a natural setting. It seeks to differentiate whether effects are shared by each of the tested leisure groups, or whether there is a hierarchy of wellbeing effects depending on the level of music engagement: production, passive listening, or no music. To this end, non-auditioned choirs were compared with exercise groups which include music listening, and discussion groups that do not include music. This selection of groups was designed to provide insight into the potential mechanisms contributing to any benefits observed in the choir group, as several features of the group singing condition were shared by the control conditions (see Table 1).

In addition to changes in mood and social connection, this study also includes a measure of energy levels, since engagement with music has been shown to facilitate changes in arousal and may be linked to the emotional changes that individuals report. This current study is focused on short-term effects, pre- to post-session, as there are indications that the pathway to improved wellbeing may differ between musical and non-musical social groups. The short-term duration of the current study is an attempt to identify differences in experiences between the comparison groups that occur in the moment, over the course of a session.

Specifically, it was hypothesized that Choir members would report significantly greater increases in positive affect and greater reductions in negative affect pre- to post-session when compared with Exercise and Discussion groups. Choir members were also hypothesized to report similar increases in energy levels pre- to post-session when compared with Exercise groups, with both groups outperforming discussion groups. Finally, it was hypothesized that Choir members would indicate an increased sense of group bonding from pre- to post-session compared with both Exercise and Discussion Groups.

Method

This research included two components. Phase 1 involved completing a survey immediately before and immediately

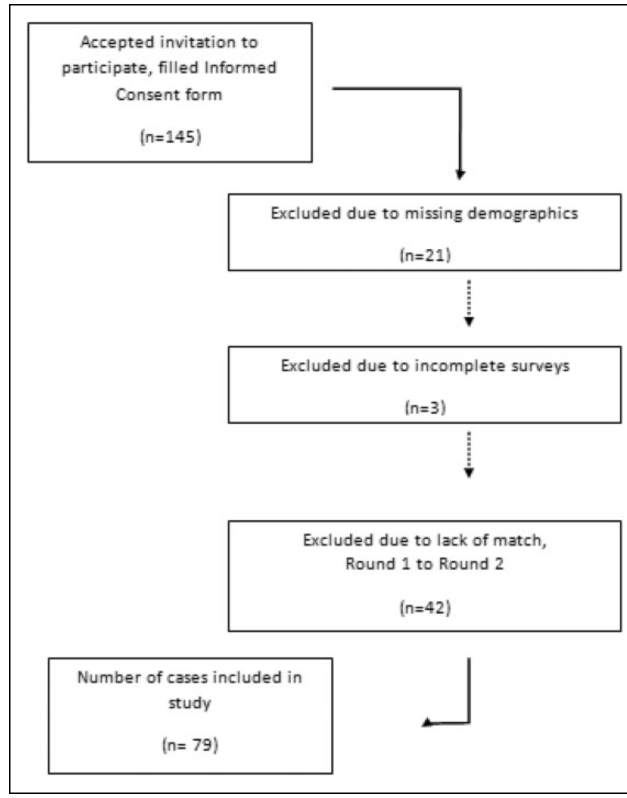

Figure 1. Flowchart of participant attrition.

after a session, reporting on subjective mood, energy, and sense of social connection. Participants also provided basic demographic data. Phase 2 employed an observational matrix which was developed specifically for this research; more details on this are provided under *Phase 2 Materials* and *Procedure*. Both components of this research were approved by the Monash University Human Research Ethics Committee.

Phase 1

Participants. Participants from a sub-set of organized social groups from a larger study were approached to participate; see Figure 1 for flowchart of participant attrition. A power analysis was conducted by reviewing studies with a similar design, timeframe, and measures (Abell et al., 2017; Bartholomew & Miller, 2002; Ekkekakis, Backhouse, Gray, & Lind, 2008; Hirokawa, 2004; Kreutz, Bongard, Rohrmann, Hodapp, & Grebe, 2004; Lim, 2008). Based on the small to medium effects sizes reported in previous research (f =.25, α = .05, and β = .80) and using a power analysis for a mixed measures Analysis of Variance (ANOVA) test, an estimated total sample size of 66, or 22 per group, was required for the short-term study design incorporating 3 groups across 2 timepoints.

Participants were sourced from several groups for each condition; three community non-auditioned choirs (Choir), four exercise (Exercise) groups, and two discussion (Discussion) groups. The exercise groups included medium- to

Table 2. Demographic frequencies, choir, exercise, and control groups.

	Choir		Exercise		Discussion	
	Frequency	%	Frequency	%	Frequency	%
Educational attainment						
No higher than year 10 of high school	2	7.7	9	33.3	3	11.5
Completed high school/VCE	2	7.7	1	3.7	2	7.7
Completed apprenticeship	0	0	0	0	1	3.8
TAFE/College diploma	8	30.8	5	18.5	4	15.4
Undergraduate university degree	6	23.1	5	18.5	5	19.2
Graduate diploma	2	7.7	4	14.8	1	3.8
Post graduate university degree	6	23.1	3	11.1	10	38.5
Employment status						
Unemployed (not studying)	3	11.5	2	7.4	0	0
Studying full time	0	0	1	3.7	0	0
Working part time	4	15.4	1	3.7	0	0
Working full time	4	15.4	0	0	0	0
Retired	15	57.7	21	77.8	26	100
Other			2	7.4		
Socio-Economic Standing (SES)						
Low SES	1	3.8	0	0	0	0
Average SES	18	69.2	24	92.3	19	73.1
Advantaged SES	7	26.9	2	7.4	4	15.4
Music Training (instrument or singing)						
Yes	18	69.2	9	33.3	10	38.5
No	8	30.8	18	66.7	16	61.5
Purposeful music listening						
Several hours/day	5	19.2	7	25.9	4	15.4
About one hour/day	8	30.8	5	18.5	6	23.1
Several times/week	9	34.6	7	25.9	11	42.3
Several times/month	4	15.4	4	14.8	3	11.5
Several times/year	0	0	4	14.8	2	7.7

VCE: Victorian Certificate of Education; TAFE: Technical and Further Education.

low-impact aerobics (listening predominantly to pop and "oldies" songs) and Tai Chi (listening to Chinese relaxation music). The discussion groups were both focused on current events. The majority of the groups were associated with the University of the Third Age (U3A) located in the outskirts of Melbourne, Australia. U3A is a social organization for people aged 55+ years which runs a wide range of groups that are organized and run by the members themselves, on a voluntary basis. All of the exercise and discussion groups in this study were attached to U3A, as well as one of the choirs. To balance numbers, other community, non-auditioned choirs were recruited to the study; this resulted in some demographic differences between the groups. All participants were informed that the study was exploring the possible social and emotional benefits of belonging to social groups, were provided with a printed information sheet, and were told that participation was optional. All participants signed and returned an informed consent form.

The mean age for the Choir group ($N = 26$) was 65.73 (SD: 8.24) years (age range 42–77 years), and the male/female ratio was 3:23. The mean age for the Exercise group ($N = 27$) was slightly older, at 74.08 (SD: 6.97) years (age range 59–90), and the male/female ratio was similar at 2:25. The mean age for the Discussion group ($N = 26$) was 74.39 (SD: 5.04) years (age range 66–84), with a male/female ratio of 6:7. A one-way ANOVA confirmed significant age differences between the groups, $F\,(2, 75) = 13.25, p < .001$, and post-hoc tests revealed that the Choir was significantly younger than both the Exercise and the Discussion groups. A chi-squared test confirmed the differences in the sex ratios between the Discussion and other groups were also significant, $\chi^2(df = 2) = 14.06, p = .001$. Attempts to eliminate the age differential by containing cases to ages 65–80 years were unsuccessful and resulted in reducing the number of cases in the Choir condition to an unacceptable level. Similarly, it was not possible to reduce the gender ratio difference via any method of matching. Therefore, results should be interpreted with these demographic differences in mind. Additional demographic frequencies are displayed in Table 2.

The Discussion group appeared to be slightly more educated than the Choir or Exercise groups, but a chi-square analysis revealed no significant difference in cell frequencies across groups, $\chi^2(df = 12) = 15.99$, $p = .192$. The Choir group appeared to be more engaged in work than the other two groups, and a chi-squared confirmed this was significant: $\chi^2(df = 10) = 25.02$, $p = .005$. Socio-economic standing (SES) differences were not significant across the groups, $\chi^2(df = 4) = 5.80$, $p = .215$. Of those in the Choir group who had music training ($N = 18$), mean years of training were 4.72 (SD = 6.00); those in the Exercise group with music training ($N = 11$) had a higher mean of 6.18 years of music training (SD = 4.69), while those in the Discussion group ($N = 10$) had a mean of 5.11 years of training (SD = 3.44); no significant differences emerged, $F\ (2,35) = 0.28$, $p = .76$.

Table 2 shows the number of trained musicians in each group, and as expected, the Choir group had a significantly higher number of trained musicians, $\chi^2(df = 2) = 6.41$, $p = .041$. Of those who indicated they had musical training across the three groups, the Choir group members practiced an instrument or sang between 1–5 hours/day (mean = 1.37, SD = 1.04) at the peak of their interest, while the Exercise group members with musical training practiced between 1–4 hours/day (mean = 1.35, SD = 1.00), and the Discussion group members practiced between 1–8 hours/day (mean = 2.33, SD = 2.43), with no significant differences emerging, $F\ (2,35) = 1.49$, $p = .239$. Frequencies of deliberate listening to music are displayed in Table 2; a chi-squared test revealed no significant differences across the groups, $\chi^2\ (df = 8) = 6.62$, $p = .578$.

Materials

Demographic information collected included gender, age, postcode (to estimate SES), primary language spoken, handedness, education level, and employment status. Respondents were asked to list other organized social groups with which they were active. Three questions were included to measure music training: "Have you played/do you play a music instrument (includes singing, practice and performance)?", "At the peak of your interest, how many estimated hours per day did you play/practice this primary music instrument (includes singing)?" and "How many years of musical training have you had?" There was also one question to serve as a proxy measure of music engagement; individuals were asked to estimate "On average, how often do you purposely listen to music a day (rather than to music in the environment that you have no control over, e.g., music in cafes, stores)?"

Self-report mood states were measured by the Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellgen, 1988). This widely-used measure of self-report positive and negative affect states was chosen for its reliability as well as its brevity, making it a good choice for the pre- and post- session design. It has been used in similar settings, including studies with choirs (Kreutz et al., 2004) and exercise groups (Bartholomew & Miller, 2002). Participants were prompted to rate a list of 20 adjectives representing mood states on a scale of 1 (very slightly/not at all) to 5 (extremely) to the extent that they were feeling them this way right now, at the present moment. PA is measured by such adjectives as "Interested," "Enthusiastic," and "Attentive" whereas NA is measured by adjectives such as "Distressed," "Upset," and "Ashamed." Cronbach's alpha is reported at .89 for the PA scale, and .85 for the NA scale, with test–retest reliability reported as .79 (PA) and .81 (NA). The two scales are independently analyzed to provide a measure of both PA and NA. In the current study, Cronbach's alpha indicated strong reliability at .94 for PA and .89 for NA (Time 1).

The Short Form Activation-Deactivation Checklist (AD ACL) (Thayer, 1978, 1986) was used to measure changes in energy levels. Similarly to the PANAS, the AD ACL is a widely-used measure that is very quick to complete and therefore was a good fit for the design of this study. The AD ACL has been used in music studies (Hirokawa, 2004; Lim, 2008) and in exercise settings (Ekkekakis et al., 2008). Participants are prompted to rate themselves on a list of 20 adjectives which describe how active and energetic they are feeling right now, on a scale of 1 (definitely do not feel) to 4 (definitely feel). The AD ACL includes four sub-scales: Descriptors for the Energy sub-scale include "Active," "Energetic," and "Full of pep"; examples for the Calmness sub-scale include "Still," "Quiet," and "Placid"; Tiredness adjectives include "Wide awake" (reverse scored), "Drowsy," and "Sleepy"; the Tension sub-scale includes "Jittery," "Fearful," and "Clutched up." Test–retest reliability ranges between .75–.92, while alphas for the subscales range between .89–.92 (Thayer, 1978). Sub-scales were shown to have acceptable reliability, with Time 1 Cronbach's alphas of .92 (Energy), .85 (Calmness), .74 (Tension), and .85 (Tiredness).

A search failed to find a questionnaire designed to measure short-term changes in group cohesion. The Measures of Psychological Climate, Cohesion sub-scale (Koys & DeCotiis, 1991) was adapted for the current study. Published alphas range between .82–.95. Results for the current study demonstrated good internal reliability, with Cronbach's alphas of .9 (Time 1). The sub-scale includes 5 statements with a 7-point scale ranging from 1 (Completely Disagree) to 7 (Strongly Agree); participants were asked to indicate how they feel the group interacts right now. As this scale was originally used to measure group cohesion within a work environment, the 5 statements were slightly modified to refer to a "group" rather than an "organization"; examples of statements include "In this group, people pitch in to help each other out," and "there is a lot of 'team spirit' amongst this group."

Procedure

Participants were tested in the natural environment of their regular session. Groups ranged in size between

Table 3. Results on Phase 1 pre- and post-tests measures, all groups, with time and time × group interaction *p* value.

Measure/ Sub-scale	Choir M (SD)	Choir T2 M (SD)	Exercise M (SD)	Exercise T2 M (SD)	Discussion M (SD)	Discussion T2 M (SD)	Time *p* value	Effect size (Cohen's *d*)	Time x Group Interaction *p* value	Effect size (Cohen's *d*)
PANAS										
PA	3.33 (0.92)	3.7 (0.85)	3.38 (0.86)	3.66 (0.84)	3.08 (0.95)	3.27 (0.85)	.000[a]	1.04	.187	0.29
NA	1.22 (0.53)	1.07 (0.26)	1.20 (0.31)	1.09 (0.26)	1.27 (0.42)	1.27 (0.51)	.074	.57	.270	0.38
AD ACL										
Energy	3.08 (0.77)	3.22 (0.75)	3.25 (0.76)	3.37 (0.67)	2.86 (0.86)	2.89 (0.68)	.152	.33	.784	0.16
Calmness	2.65 (0.59)	2.38 (0.59)	2.35 (0.69)	2.39 (0.73)	2.17 (0.97)	2.19 (0.67)	.423	.18	.302	0.36
Tension	1.38 (0.53)	1.25 (0.42)	1.37 (0.54)	1.29 (0.45)	1.42 (0.49)	1.49 (0.70)	.268	.255	.220	0.40
Tiredness	2.10 (0.74)	2.03 (0.63)	2.06 (0.75)	1.76 (0.48)	1.93 (0.63)	1.76 (0.37)	.012[a]	.059	.382	0.32
Group Cohesion	5.88 (0.78)	6.10 (0.72)	5.81 (0.80)	5.98 (0.73)	5.48 (1.01)	5.46 (1.05)	.047[a]	.46	.236	0.39

[a]The difference in mean values is considered significant at the .05 level.

35–60 people, and for each group between 40–90% agreed to participate in the study. A survey was administered by the researcher just prior to the session, and again immediately following the session. All of the Exercise sessions and two of the Choir sessions ($n = 10$) ran for a duration of 60 minutes. The remaining choir ($n = 16$) ran for a duration of 90 minutes. A two-way mixed measures ANOVA was performed on the Choir groups to check whether the differing length of sessions had an effect on outcomes. Results showed a significant difference for changes in Energy levels, with the 60-minute Choirs reporting a small decrease in energy levels, and the 90-minute choir reporting an increase, $M_{diff} = 0.29$, F (1,22) = 8.67, $p = .008$. No differences arose with any of the other measures. Each of the eight individual groups (three Choir, three Exercise, two Discussion groups) was led by a different facilitator and held in different meeting spaces, at differing times of day (most were held in the morning, but some met in the afternoon and one met in the evening). These unique aspects of delivery were across all group types. All groups were tested at the same time of year to control for seasonal affect changes. Pre- and post-surveys were identical excepting the demographic data, which was included in the post-session questionnaire in order to reduce disruption to the session, since its inclusion extended the survey's length.

Data analysis

All measures were analyzed by a two-way mixed measures ANOVA using SPSS version 24. Twenty-six cells were missing data and were replaced with the sub-scale mean. Three cases were outliers on the Tension subscale of the AD ACL and one on the NA subscale of the PANAS. Since these cases were within range on other measures, the decision was made to Winsorize these cases rather than trim them; this process adjusts the outliers to within 3.29 SD of the mean so that they are less extreme and less likely to skew results. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality of distribution and homogeneity of variance. An alpha level of .05 was used for all statistical tests.

Results

Mean values on all self-reported measures pre- and post-intervention for each of the three groups are shown in Table 3.

The 2 × 3 mixed ANOVAs yielded no significant interaction effects. Despite this lack of statistical significance, a consistent trend was that the Choir group reported slightly greater increases in PA and Cohesion over time than did either the Exercise or Discussion groups. Similarly, the Choir group reported slightly greater decreases in negative outcome measures (i.e., NA and tension) than did the other two groups. The Exercise and Discussion Groups both reported experiencing greater decreases in the Tiredness measure than the Choir Group.

Main effects for time were significant on the measures of PA, NA, Tiredness, and Cohesion. When averaged across groups, PA ratings rose significantly across the two time points, F (2,76) = 20.48, $p = .001$, 95% confidence interval (CI) [–.40, –.16], as did Cohesion ratings: F (2,76) = 4.06, $p = .047$, 95% CI [–.25, –.001]. NA ratings decreased over time, F (2,76) = 6.12, $p = .016$, 95% CI [.02, .16], as did Tiredness: F (2,76) = 6.68, $p = .012$, 95% CI [.04, .32]. There were no main effects of time for Energy, Calmness, or Tension.

Phase 2

The second component of this research utilized an observational methodology for the Choir and Exercise groups only. It was reasoned that if group members were experiencing changes in emotional state, energy levels, and a sense of group cohesion, changes in behavior should reflect this. This study was designed to complement Phase 1, and also

Table 4. Brief description of observed groups.

Group type	Group name	Description	Approx. # of people observed	Frequency and # of observations
Choir	University of the Third Age Choir	This no-audition choir is the only choir in the study associated with the University of the Third Age. It sings a range of mostly popular and musical songs from the 1950s – 1990s. Rehearsals are accompanied by a pianist.	T1*: 28 T2: N/A T3: 25	T1: 305 T2: 0[a] T3: 282
Choir	Open Door Singers	This no-audition community choir meets in the evening for approximately one and a half hours. Song selection tends to be popular songs from a range of styles, and are sung off of an overhead projection, and accompanied by either the director on guitar or by a soundtrack.	T1: 28 T2: 40 T3: 15	T1: 378 T2: 424 T3: 153
Choir	Box Hill Choir	This community choir meets at a community arts center. Of the choirs involved in this study, this choir sang the most musically challenging pieces, primarily written for performance choirs and not in the popular canon.	T1: 10 T2: 15 T3: N/A	T1: 112 T2: 197 T3: 0[b]
Exercise	Moderate Exercise	This group was reasonably fit and flexible. Workouts were done to mostly upbeat music, incorporating aerobics, country dancing, fast walking, and finishing with mat stretching to calming music and dimmed lights.	T1:20 T2: N/A T3: 30	T1: 217 T2: 0[a] T3: 71
Exercise	Tai Chi	This large class meets for 1 hour 30 minutes in the morning with a small break in the middle. The class follows a leader through gentle tai chi moves, accompanied by traditional Chinese music.	T1: 22 T2: 50 T3: 20	T1: 313 T2: 417 T3: 146

*T1 = Pre-session; T2 = mid-session; T3 = post-session.
[a]No break was taken.
[b]Members left immediately.

to test whether behavior changes could be reliably observed and recorded across a large group.

Participants

Phase 2 included the same Choir and Exercise groups that participated in Phase 1, although on a different day. The majority of observation sessions were conducted 2 weeks after the surveys, although for one group it was 2 months later due to scheduling difficulties. A researcher visited the group the week prior to explain the observation session, and then on the day individuals were invited to sign a consent form for being observed and were told if they wished not to be observed to identify themselves to the researchers. All participants provided consent for Study 2 observations. A total of three Exercise and three Choir groups were observed; however, one of the Exercise groups was eliminated from analysis as they started their session early and a baseline observation was therefore not captured. A brief description of each group is provided in Table 4. The approximate number of people observed is provided at each observation time point – that is, prior to the start of the session (Time 1), at the mid-point break if any (Time 2) and after the end of the session (Time 3). This methodology is unique in that it is capturing the number of observations of certain behaviors rather than the number of participants per se, so the number of participants is an estimate only. The number of people observed in a choir setting was approximately 95, while the number of people observed in an exercise class was approximately 80.

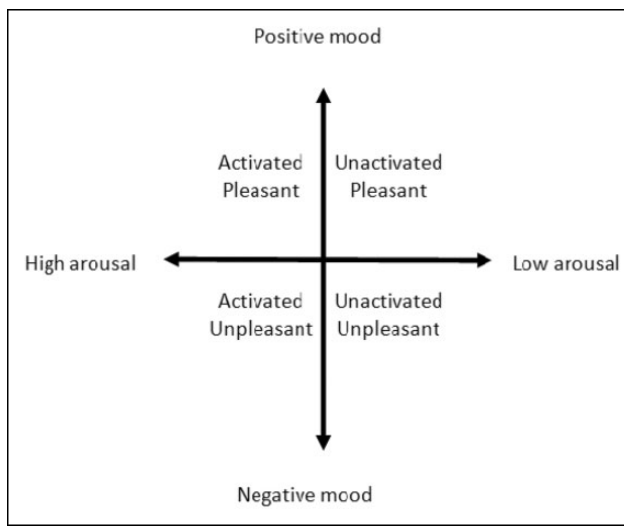

Figure 2. Circumplex model of emotion (Adapted from Russell, 1980).

Materials

This study used an observational checklist which was adapted from that created by Bartel and Saavedra (2000) for use within organizations. The checklist is based on the circumplex model of emotion (Russell, 1980), and identifies specific physical behaviors that can be categorized within one of four quadrants: Activated Pleasant (high arousal, high PA), Unactivated Pleasant (low arousal, high PA), Unactivated Unpleasant (low

Table 5. Observational checklist.

	Activated Pleasant	Unactivated Pleasant	Unactivated unpleasant	Activated unpleasant
Body	Leaning forward Orienting towards others	Relaxed but engaged orientation towards group	Orienting away from group Slouching	Body poised to exclude group members
Movement	Constant body movement	Little movement in torso or limbs	Motionless Resting head on hands	Nervous habits (rocking, biting fingernails)
Physical Contact	High physical contact	Moderate contact	No contact	Avoiding contact
Hands	Exaggerated hand gestures Hands active during speech	Minimal hand movement	Hands inactive during speech Rubbing eyes	Closed fists Hand tremors
Mouth	Smiling with teeth showing Grin (big closed lipped smile)	Mouth turned slightly upwards, open or closed	Yawning Mouth turned downwards	Sneering Clenched teeth
Eyes	High eye contact	Moderate eye contact	Little eye contact Blank stare	Avoiding eye contact

arousal, high NA), and Activated Unpleasant (high arousal, high NA); see Figure 2.

The full checklist with prompts is reproduced above (see Table 5). An eighth row for observing eyebrows was removed as this was too difficult to observe in a large group setting.

Procedure

A primary researcher and two research assistants trialed the tool ahead of time using both video and live observation; a one-page instruction sheet was also created to ensure as much as possible a uniform approach to coding. In each observation, two raters were used – the primary researcher and an assistant. In order to mitigate possible rater bias, the tool was designed to be as objective as possible by recording specific and visible changes in how the body or the face was positioned. The raters observed each group at up to three time points: prior to the start of the session, at the mid-point break (if there was one) and at the end of the session. Each rater recorded their name, the date and time, a short description of what the group was doing (e.g., waiting to start, having a snack), and an estimate of how many people were being observed. Observations were done simultaneously by both raters, scanning the room in the same direction (for example, from left to right) and from the same vantage point in order to provide congruent observations as much as was possible. Each rater observed each person in the room only once, recording all aspects of an individual's body language that could reliably be seen by recording a hash mark in the relevant box. Depending on the number and distribution of people in the room, this took between 2 and 5 minutes. Videotaping sessions was considered, which would have facilitated coding that was more uniform and also allowed for naïve raters to be used. However, there was concern that the taping would be disruptive to the groups, make individuals feel uncomfortable, and would have limited what was observable.

This methodology provided a tally of observations of individuals within the quadrants for Body – Movement – Physical Contact – Hands – Mouth – Eyes. However, not each quadrant was observed for each individual in the room. For example, people who had their back turned to the researchers could be observed for Body, Movement, Physical Contact, and possibly Hands, but not for Mouth or Eyes. In addition, each researcher made independent observations, so while efforts were made to keep observations as congruent as possible, it was not feasible to ensure both were observing the same person at the same time. Therefore, observations of the same person sometimes resulted in differences in the tallies. The same people were not necessarily viewed at the three timepoints, as some arrived late or left early. For example, Table 4 indicates that the fewest observations were taken at Time 3 (after the session ended). This was due to many leaving immediately at the conclusion of the session. Reasons for this were varied, but in some cases was because U3A members had to rush to attend their next class.

Due to the unique challenges of this data set, the group itself is treated as a unit, within which changes of behavior can be observed. It was therefore decided to aggregate the observation tallies from each rater and report the mean. In addition, because there was unequal opportunity for observations at each of the three timepoints, means were standardized across the timepoints as a percentage of the total number of observations for that session. Chi-squared analyses are reported on the changes in frequencies across time, but should be interpreted with caution for these reasons.

Results

Table 6 shows the percentage distribution of observed behaviors across the three timepoints for both the Choir and Exercise Groups, with the expected statistical distribution reported in parentheses. A chi-square goodness of fit analysis shows that both the Choir (χ^2 $(df = 2) = 11.56$,

Table 6. Observed changes in mood and energy, Choir and Exercise groups observational data (expected values in brackets), with goodness of fit calculations across time for each emotion quadrant.

Emotion Quadrant	Time 1	Time 2	Time 3	Chi-square
Choir				
Activated Pleasant	17[a]	23	41	11.56, $p = .003$[b]
(high energy, positive mood)	(27)	(27)	(27)	
Unactivated Pleasant	49	50	39	1.61, $p = .447$
(low energy, positive mood)	(46)	(46)	(46)	
Unactivated Unpleasant	33	24	18	4.56, $p = .102$
(low energy, negative mood)	(25)	(25)	(25)	
Activated Unpleasant	2	2	2	0, $p = 1.0$
(high energy, negative mood)	(2)	(2)	(2)	
Exercise				
Activated Pleasant	12	27	33	9.75, $p = .008$[a]
(high energy, positive mood)	(24)	(24)	(24)	
Unactivated Pleasant	55	51	47	.627, $p = .731$
(low energy, positive mood)	(46)	(46)	(46)	
Unactivated Unpleasant	28	19	16	3.714, $p = .156$
(low energy, negative mood)	(21)	(21)	(21)	
Activated Unpleasant	4	3	5	.5, $p = .779$
(high energy, negative mood)	(4)	(4)	(4)	

[a]There were varying degrees of opportunity to observe across the three sessions, as detailed in Table 4. For example, some groups did not take a mid-session break, and many participants left quickly at the end of sessions to attend to other obligations. Therefore, the observations have been standardized as a proportion of total observations in any one sitting, to control for non-specific effects associated with times.
[b]Indicates changes in this quadrant vary significantly from the expected distribution.

$p = .003$) and Exercise Groups (χ^2 $(df = 2) = 9.75$, $p = .008$) experienced a significant increase of observed behaviors in the Activated Pleasant (positive mood, high energy) quadrant. Changes in the other three quadrants conformed to expected distribution patterns for both groups, with non-significant decreases in the Unactivated Pleasant and Unactivated Unpleasant quadrants and no appreciable change in the Unactivated Unpleasant quadrant.

Discussion

This study explored the short-term (pre- to post-session) effect of group-based leisure activities on social connectedness and emotional state measures of wellbeing, and whether these effects might relate to differing levels of music use. Based on previous research, it was anticipated that there may be a hierarchy of wellbeing effects depending on the level of music engagement: production, passive listening, or no music. To this end, non-auditioned choirs were compared with exercise groups which include music listening, and discussion groups that did not include music, with members drawn from an older population in a natural setting. The use of exercise groups provided a more rigorous comparison than is often used with choirs, since the combination of music listening, movement, and social interaction more closely aligns with non-specific features of choir groups, while the discussion group provided a comparison with a no-music, no-movement but still engaging group condition. By comparing with groups that share more of the non-specific characteristics of a choir experience, it is possible to provide a more systematic test of the wellbeing benefits that are ascribed to group singing, to determine whether they are attributable to that activity per se.

An absence of evidence was obtained in support of the three hypotheses of this study. First, it was predicted that Choir members would report significantly higher increases in PA and reductions in NA pre- to post- session compared with the Exercise and Discussion Groups. This hypothesis was not supported by the self-report scores provided pre- and post-session by participants reported in phase 1, in which increases in PA and sense of group cohesion were experienced across all three groups. Further, while the Choir Group evinced a significant increase in positive mood and increased energy via observable behaviors in phase 2 of this study, these increases were similarly observed in the Exercise Group. The second hypothesis – that the Choir Group and Exercise Group would report similar increases in Energy pre- to post-session while the Discussion Group would not – was not supported. Although both the Choir and Exercise Groups reported small increases in Energy, these changes were not significantly different to those occurring in the Discussion Group. Finally, it was predicted that the Choir Group would report higher Cohesion ratings than both the Exercise and Discussion Groups from pre- to post-test, which was not supported. While the Choir Group rated higher on Cohesion than the comparison groups, the differences were not significant.

Previous research into the wellbeing effects of choir membership indicates that benefits ought to be greater when compared with other groups. More generally, the wellbeing benefits of music listening are well documented; including any kind of music component into a social group setting would generally be expected to increase wellbeing effects, provided music engagement is high (Chin & Rickard, 2012). It is therefore notable that no significant differences across the groups included in this study were observed on the measures of mood, arousal or social cohesion. The current findings raise the possibility that significant short-term benefits of choir participation observed in previous research may also be attributable to characteristics of the activity not specific to choirs, such as group engagement, self-selection, and perhaps music exposure, rather than music production per se. A review of previous research demonstrates this may indeed be the case. A number of studies which report significant benefits did not include a control group (e.g., Abell et al., 2017; Fancourt et al., 2016; Sandgren, 2009), so are unhelpful in exploring this possibility. Several studies which observed significant differences between a choir group and a comparison are open to alternative explanations. For example, it appears that the differences in PA ratings between a choir and control group observed by Sanal and Gorsev (2014) may be attributable to a *decrease* in PA for the control group (who had self-selected to be part of a choir but were prevented from singing on the test day). In contrast, PA remained stable in the choir group pre- to post-singing. Similarly, Pearce et al. (2015) reported increased PA for members of a choir intervention compared with non-singing group activities at a community center; however, these differences are the result of a lower self-report of PA by the choir members in the pre-session measures (Choir Time 1: M = 2.93, SD = 0.97; Choir Time 2: M = 3.58, SD = 1.04) than the control group (Control Time 1: M = 3.5, SD = 0.99; Control Time 2: M = 3.50, SD = 0.99), rather than a significantly higher report of PA at the end of class (3.58 for Singing compared with 3.50 for Control), so it is difficult to exclude external factors present in this group at baseline which may have impacted on PA. Pearce and colleagues also reported on sense of social connection through a self-report and a proxy measure of pain tolerance. While pain tolerance increased pre- to post-session, there were no differences between the groups, while self-reported closeness to the group pre- to post-session was higher for the choir group in two of the three testing sessions. Kreutz et al. (2004) and Kreutz (2014) report on a choir made up of members who had self-selected to join a choir. They were compared with themselves, one week in a singing condition, and one week in either a listening (Kreutz et al., 2004) or a chatting (Kreutz, 2014) condition. While both studies yielded significant differences between the two conditions, it may be that the differences are due to withholding a preferred activity rather than indicating that singing has increased benefits to either of the other activities per se.

In contrast, when appropriate controls have been used, the difference is not convincing. Allpress et al. (2012) recruited a naïve population and randomly allocated them to either a singing or Lego-building activity, with groups switching activities on day 2. No significant difference in measures of mood or cortisol were found between groups. Research conducted by Dingle et al. (2017) also found no differences in mood rating for members of a community choir compared with members of a range of arts-based groups specifically for people with compromised mental health on the day of their activity; importantly, however, this study was not comparing a singing with a non-singing condition, as the "arts-based groups" included both a choir and creative writing classes. Taken together, none of these studies demonstrates convincing evidence that a group singing session may confer more benefits to mood when compared with other kinds of self-selected group activities. The studies which examined short-term changes in group cohesion are fewer but more promising. As part of the study conducted by Kreutz (2014), discussed above, saliva samples were also analyzed for changes in cortisol, oxytocin, and DHEA at the start of each session and again 30 minutes later. Significant time $\times$ condition changes were found in oxytocin levels – a biomarker of bonding with others – with the singing condition experiencing significantly higher levels from pre- to post-condition compared with the chatting condition. This is promising, since one may expect a chatting condition to increase a sense of bonding to others, particularly as this involved sharing personal stories that brought past happiness. However, this may again be explained by participating in a preferred activity compared with having the activity denied. Kirschner and Tomasello (2010) found that preschool children who played a game with a singing and movement component showed greater cooperative and helping behavior than those who played the same game without singing or movement. While this study presents the strongest evidence for a superior effect of a singing activity than no singing activity, it is notable that the control group was also denied movement, which may also have confounded interpretation.

The naturalistic setting maintained in the current study is a strength of this research. Assessing individuals in situ is likely to have achieved greater ecological validity of observed behaviors and may have increased accuracy of self-reports as individuals were not required to recall their emotional state in a different setting. Further, it was an opportunity to explore how wellbeing effects of various leisure activities are experienced in everyday life, where a combination of factors, including motivation and choice, interact to influence wellbeing in ways that are not possible to observe in a more highly controlled environment. However, the natural setting may also explain the absence of significant differences between the groups in this study. First, the groups that were included in this study had been established for some time, which means that relationships had already been formed. This likely reduced the impact of the interventions on all measures, making changes in emotion and social connection more difficult to detect due to a "ceiling effect" of sorts. Second, the members of U3A are part of a larger network of social groups and classes. Most, if not all, of the U3A participants attend multiple sessions throughout the week, and often meet up for coffee or lunch in between sessions. Research indicates that strong social networks are highly protective for the wellbeing of their members (House, Landis, & Umberson, 1988; Steptoe, Shankar, Demakakos, & Wardle, 2013), and again may mean the effects of attending one session in the day may be blunted. Finally, there were differences between the eight individual leisure groups which participated in this research; these included the length of time for sessions (which ranged between 60–90 minutes), time of day, the size of the group, and the personality and leadership style of the leader. It was not possible to control for all of these differences but as these differences were evenly distributed across group types, sampling across several leisure groups may have helped to mitigate their influence on the outcomes.

It is also possible that the demographic differences between the groups influenced the outcomes, possibly masking what would otherwise have been measurable differences. The Discussion group had a more balanced ratio of males to females than the other two groups. It appears from previous research that the benefits of social groups are greater for women than for men (Agahi & Parker, 2008), as are the benefits received from choir participation (Sandgren, 2009). However, these differences would therefore be expected to increase rather than reduce differences between the Discussion group (closely balanced between men and women) and the Choir and Exercise groups (primarily women). The Choir group was also both younger and more engaged in work, while the Exercise and Discussion groups were made up almost exclusively of retired individuals. Amongst other differences, it is likely this resulted in inequalities in overall general health, mobility, and patterns of social engagement, which may have influenced findings. However, as with the differences in gender balance between the groups, this would be expected to magnify rather than diminish differences in wellbeing benefits between the groups. It could be too that, as participants were informed that the study was looking at possible socio-emotional benefits to social group membership, demand characteristics may have impacted more on the Choir groups, since the wellbeing benefits of choir membership are widely publicized.

It could be, however, that the subtle differences between the groups may be more pronounced for other cohorts or in other settings, as has been found in research with more marginalized populations. Although not reaching significance, the Choir group reported slightly higher changes in Cohesion ratings in the pre- to post-session self-report. Research conducted with vulnerable populations and over longer periods of time reports that social connection is a primary benefit identified by choir participants, including choirs for people experiencing homelessness (Bailey & Davidson, 2005, 2013), disability (Bailey & Davidson, 2005, 2013; Dingle et al., 2013), compromised mental health (Clift & Morrison, 2011), and those experiencing adverse life events (Clift & Hancox, 2010; Fancourt et al., 2016; von Lob, Camic, & Clift, 2010). The sample of older adults in the study reported here are generally very well socially connected, as many were members of active social networks through their connection with U3A (members of the non-U3A-related community choirs also indicated in their demographic responses that they were active in a range of other organized social groups). Higher levels of social connectedness may mute any additional effects of choir participation on wellbeing. This aligns with findings reported by Hinshaw, Clift, Hulbert, and Camic (2015), in which young people participating in a choral intervention did not evidence an increase in psychological wellbeing compared with a control group, although the participants did describe a range of benefits from participating. The authors suggest that benefits may be difficult to measure for groups which are already experiencing high levels of wellbeing and social connection.

An alternative explanation is that any social group will confer similar wellbeing benefits to choir membership. It may be that the three groups conferred similar levels of wellbeing because members self-selected into group activities that were of particular interest to them. Self-selection may explain why even the Discussion group, which lacked both music and coordinated movement, still improved overall markers of wellbeing. As demonstrated in the review of short-term comparison studies, withholding of a preferred activity appears to reduce self-reported PA, while comparing across self-selected but differing activities does not yield appreciable differences between activities. This is consistent with Social Determination Theory (SDT), which identifies autonomy, competence, and relatedness (that is, a sense that individual actions contribute to the wellbeing of others and are appreciated) as basic psychological needs of all humans (Deci & Ryan, 2008; Ryan & Deci, 2000). Within this framework, the overriding principle of wellbeing would be an individual's motivation and choice for selecting an activity, rather than the nature of the activity itself. This has also been proposed as a possible explanation for the benefits of singing by Stewart and Lonsdale (2016), and may need further exploration.

The research reported here makes an important contribution to our understanding of music's effects on emotion regulation and social cohesion. The short timeframe of the pre- to post-session design and the observation sessions provide ways to track changes within the group as they happen. In addition, the observation methodology tests a way of recording observable changes in emotion and arousal across a large group. While no appreciable differences were found between the Choir and Exercise groups in this study, this trial of the methodology did confirm that changes in group interactions are observable and can be tracked across time. It would be useful to trial this tool in other settings, perhaps using videotaped footage in order to mitigate possible rater bias. Finally, the use of exercise groups which incorporate music listening and movement provides a strong comparison group from which to gauge whether the positive impacts of singing groups on wellbeing are unique, or whether other groups which incorporate similar processes may deliver the same or greater benefits.

The findings from this study call into question the hypothesis that group singing provides greater support to improved mood and social connection compared with other kinds of group leisure activities within a short timeframe. A reappraisal of previous studies exploring short-term affective and social cohesion changes in a singing condition suggests that claims of any unique effect of singing may be overstated. Future research could seek to identify the key components of the choir experience that are primarily responsible for explaining how group singing improves wellbeing. Identifying the mechanisms that are responsible for wellbeing improvements could lead to a greater understanding of how other, non-musical interventions may provide the same benefits. For example, flow states, which reflect a balance of challenge and ability and is marked by rewarding and enjoyable absorption in an activity (Nakamura & Csikszentmihalyi, 2014) is often reported in music production (Chirico, Serino, Cipresso, Gaggioli, & Riva, 2015; Sinnamon, Moran, & O'Connell, 2012) and appears to be heightened in a group setting (Páez, Rimé, Basabe, Wlodarczyk, & Zumeta, 2015; Walker, 2010). There is also a growing body of evidence that synchronous movement amongst groups both improves mood, facilitates group cohesion, and may support an increase in cooperation and pro-social behaviors (Valdesolo & DeSteno, 2011; Valdesolo, Ouyang, & DeSteno, 2010; Reddish, Bulbulia, & Fischer, 2014; Trainor & Cirelli, 2015). Further, it may be that, rather than either production or listening, musical engagement is the critical mechanism behind improved wellbeing. The concept of engagement is understudied (Chin & Rickard, 2012) and may explain the similarities between the Choir and Exercise Groups, since demographic responses indicate little difference between the two groups in musical engagement. Relatedly, a heightened empathic response is linked to music engagement and emotion contagion (Egermann & McAdams, 2013), and is another possible pathway for wellbeing benefits. Heightened empathy is correlated with an increase in pro-social behaviors, and there is concern that as adults age, they experience reductions in cognitive empathy (the theory-of-mind ability to infer the emotional state of another person), which may in turn erode their social interactions (Sze, Gyurak, Goodkind, & Levenson, 2012). Therefore, finding ways – employing music or other social activities – to retain empathic responses for older adults may assist them to maintain social networks. In the light of this study's findings, however, more research into the role of preference, choice, and agency in selecting leisure group activities may be the most promising direction to pursue. SDT may be a helpful way to frame further research into the links between wellbeing and participation in leisure group activities.

Finally, this study focused on short-term changes across groups on socio-emotional wellbeing. A longer-term study may reveal wellbeing benefits that emerge only over an extended period of time. If music and non-musical groups do bond differently over time, there may also be differences in the way that individuals interact longer-term, both within the group itself as well as more generally. For example, if evolutionary theories are correct, we would predict that members of singing groups would display heightened empathy (Cross et al., 2010; Greenberg, Rentfrow, & Baron-Cohen, 2015) and pro-social behaviors (Koelsch, 2013; Schulkin & Raglan, 2014). There are indications that this may be so. For example, a systematic review indicates that singing programs can assist individuals with dementia to increase social behaviors, encourage participation, and reduce anxiety (Clift, Nicol, Raisbeck, Whitmore, & Morrison, 2010). A longitudinal study of older adults found that those who participated in a choir reported fewer doctor visits, reduced medication, fewer falls, and better overall health than those who participated in self-selected (unspecified) activities; choir members also trended towards increased social participation more generally while the non-choir group reduced their social participation over the same time period (Cohen et al., 2006). A comparison study with school children found that those who participated in a year-long musical interaction group scored higher on an emotional empathy test than those who did not participate (Rabinowitch, Cross, & Burnard, 2013).

A key finding of this research is that all of the groups observed in this study experienced short-term benefits for socio-emotional wellbeing. These findings verify that the short-term effects of membership in both music and non-musical social groups are positive. Practically speaking, this research suggests that providing a broad range of social groups for older adults will result in improved emotion state and sense of social connection. Providing diverse socializing options that cater to a range of interests may be the best protective factor for aging well.

Contributorship

SM and NR both designed the study and collaborated on preparation of the manuscript and analysis of results. SM conducted the study and collected the data, and was the primary writer of the manuscript.

Declaration of conflicting interests

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Chapter 6: An investigation of persistent wellbeing benefits

Preamble

This chapter incorporates a published paper that investigates the longer-term wellbeing benefits derived from choir participation. This research was designed to address the second aim and related research questions addressed by this thesis:

Aim 2: *To assess longer-term changes in wellbeing following participation in a community choir in comparison with other group leisure activities.*

3. *Does group singing provide longer-term wellbeing benefits, specifically increases in emotional and mental wellbeing, empathy and sense of social support?*
4. *Does group singing provide greater longer-term wellbeing benefits than comparison groups?*
5. *Do members of a choir describe wellbeing benefits of their participation qualitatively differently than comparison groups?*

The longer-term timeframe and the more rigorous comparison group contributes to the understanding of how wellbeing effects may – or may not – be embedded over time, transitioning from temporary, short-term benefits (state) to a more positive affective style (trait) and increased pro-social behaviours. Furthermore, this study is distinctive in that open-ended questions concerning wellbeing benefits from group participation were administered to both the intervention and control groups. This allowed for a deeper understanding of how individuals describe the benefits of group participation, and whether there were differences between the groups regarding how people talked about the core activity, emotional benefits, social benefits, and motivation for participating.

The data for this exploratory research was collected concurrently to the short-term study reported in Chapter 5.

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Article

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The Benefits of Participation in a Choir and an Exercise Group on Older Adults' Wellbeing in a Naturalistic Setting

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Abstract

As populations age, it is critical to understand how psycho-social wellbeing supports successful ageing. The health sector is increasingly asking how best to improve social connection and affective state because of their positive influence on overall health. Choral participation has been proposed as a particularly effective way to improve socio-emotional wellbeing, due to benefits of music exposure, social opportunities, and the act of singing. It may be, however, that improvements in wellbeing are also dependent on individual attitudes towards participation, including preference, motivation, and exercising agency. There is a need for studies that account for the influence of choice and preference as they may predict benefits for wellbeing. Findings are presented here from a quasi-experimental study exploring whether choral participation yields greater benefits for wellbeing in the long term (seven months) than does participation in an exercise group that shares some of the nonspecific characteristics of choirs such as social interaction and exposure to music. Emotional wellbeing increased for both groups, while there was a small but significant decrease in mental wellbeing for both groups between the first and second time points; no other statistically significant changes were observed. Analysis of qualitative data indicated that members of choirs found the act of singing to be intrinsically rewarding, while members of exercise groups relied instead on the benefits of social interaction to keep them committed to an exercise regime; however, themes such as the importance of social connection, confidence, improved mental and emotional state, and overall improved wellbeing were common to both groups. Effects on the wellbeing of the members of the two kinds of group did not differ significantly despite differences in their self-reported motivation for joining and participating. No changes were observed in measures of social connection or empathy across the length of the study.

Keywords

choir, exercise, social groups, wellbeing, ageing, social prescribing

Introduction

Globally, the world's population is ageing. The World Health Organization (WHO) reports that people aged over 60 will almost double by 2050, to make up an estimated 22% of the world's population (WHO, 2018), and a growth trend is expected to continue across the century (Lutz

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& KC, 2010). There is, therefore, great interest in how to support 'successful' ageing. While biomedical definitions of successful ageing include absence of disability or chronic disease and maintenance of function and independence, psycho-social definitions include such markers of wellbeing as life satisfaction, happiness, participation in leisure activities, social connection and expansive networks, and personal growth and learning (Bowling & Dieppe, 2005). Increasingly the psycho-social aspects of ageing well are recognised as of value not only for the individual, but also as a viable way to manage the potential expense of larger non-working populations (Cann, 2017). For example, there is a bi-directional relationship between subjective wellbeing, incorporating life satisfaction, hedonic and eudemonic wellbeing, and overall health, whereby higher levels of subjective wellbeing appear to facilitate healthy ageing (Steptoe et al., 2015). Older people experiencing loneliness visit the doctor more often (Ellaway et al., 1999; Vedsted & Christensen, 2005) and have higher levels of morbidity and mortality (Holt-Lunstad et al., 2015). Conversely, high levels of social capital appear to have positive health benefits (Holt-Lunstad et al., 2010), particularly for older people (Elgar et al., 2011). There is therefore an increasing focus on providing appropriate psycho-social responses in lieu of medical interventions, including utilizing the arts in health settings (Fancourt, 2017); social prescribing, in which medical professionals 'prescribe' non-medical interventions such as exercise, art or engaging in social activities (Chatterjee et al., 2018); and exploring the health benefits of connecting isolated individuals with social groups (Haslam et al., 2018).

Choirs and Wellbeing

There has been particular focus on the community choir[1] as an arts-based social group that might uniquely boost wellbeing through its combination of social interaction, music listening and group singing. Numerous studies have indicated that group singing benefits mental health and wellbeing (Clift & Hancox, 2010; Clift & Morrison, 2011; Williams et al., 2018). Short-term studies testing the prediction that participation in choirs improves wellbeing have demonstrated differences between intervention and control groups on a range of measures, including improved affective state, increased sense of social connection, and changes in biomarkers of wellbeing, such as cortisol concentrations, pain tolerance and oxytocin levels (Bullack et al., 2018; Cohen et al., 2006; Coulton et al., 2015; Kirschner & Tomasello, 2010; Kreutz, 2014; Kreutz et al., 2004; Pearce et al., 2015, 2017; Sanal & Gorsev, 2014). The focus on the components of the choir experience may be masking the way that the attitudes that the individual brings to the activity contribute to wellbeing, and as a result the design of these studies may limit the conclusions that can be drawn as to the strength or uniqueness of these effects (Maury & Rickard, 2018). First, several studies have compared singing with non-singing members of a choir (Bullack et al., 2018; Kreutz et al., 2004; Sanal & Gorsev, 2014). In each of these studies, the differences between the groups are attributed to the positive impact of group singing. However, they may equally be explained by the withholding of a preferred activity from the control group – in this case, singing – which could have resulted in a *reduction* in wellbeing for the control group, which better explains the discrepancy between groups. Second, baseline differences between groups may have obscured the meaningfulness of any effect. In a strong research design that included engaging control activities, Pearce et al. (2015) compared people in a choir with people in either a craft or a creative writing group. They reported that the choir members experienced significantly greater boosts to positive affect and sense of social connection than did members of the other groups pre- to post-session. However, this interaction was attributable to *lower* ratings from the choir members prior to the intervention; the post-intervention scores of the two groups did not differ significantly. An uncontrolled external circumstance may have therefore been responsible for suppressed affect scores for choir members before the start of the experiment.

In contrast, there has been limited evidence of superior short-term benefits for choral participation in studies in which groups were equivalent at baseline, and engaging control activities were used. No differences have been reported for benefits experienced by members of choirs and those who took part in collaborative Lego-building (Allpress et al., 2012), exercise and discussion groups (Maury & Rickard, 2018), observers at a choral rehearsal (Unwin et al., 2002) and creative writing workshops (Dingle et al., 2017). One study in which the control group experienced greater benefits than those who sang in a choir (Valentine & Evans, 2001) involved a solo control activity (swimming laps), which raises other potential confounds. A well-controlled study conducted by Kirschner and Tomasello (2010) compared pre-school-aged children who played a game including singing and dancing with their peers who played the same game but without the singing and dancing component. Those who sang and danced demonstrated increased pro-social behaviours compared with their peers, but it is difficult to determine whether singing or dancing (or both) was responsible for the enhanced pro-social behaviours. For example, social bonding benefits have previously been reported for synchronised movements (Hove & Risen, 2009; Tarr et al., 2016), so the difference may have been attributable to some aspect of the dancing.

In studies where an exercise group was used as a control, no differences between groups have been observed (Maury & Rickard, 2018; Stewart & Lonsdale, 2016; Valentine & Evans, 2001). This suggests that coordinated movement may indeed be responsible for some of the benefits. A series of studies conducted systematically by Dunbar et al. (2012) indicates that both physical activity and music creation might contribute to the benefits of music activities. Using a mixed-factorial design, the researchers found in their first experiment that participation in a church service with active singing resulted in greater pain tolerance than participation in a prayer meeting with no singing. In the second experiment active drummers were compared with people listening to background music in an office and people who watched an instructional video with no music. The drummers experienced both greater pain tolerance and positive affect than control groups. In the third experiment dancers were compared with musicians participating in a choir, band or orchestra. The researchers found no differences between the four groups' levels of pain tolerance even though the dancers were more active than the musicians. This study seems to indicate that music creation, and not merely movement, was a significant contributor to higher pain tolerance. However, because so few studies have compared music interventions with physical activity, it is still difficult to distinguish how much of an effect is due to synchronised movement versus singing generally.

It is possible, however, that the benefits of group singing are not immediate, and may require repetition or a sustained effort to yield benefits for wellbeing. Evolutionary theories of group singing posit that the co-creation of music is an adaptive human function through two primary channels: first, joint music-making creates a shared emotional experience that is primarily positive; and, second, this leads to an increased sense of social bonding, which may in turn increase pro-social behaviours (Cross & Morley, 2009; Maury & Rickard, 2016; Mithen, 2009; Tarr et al., 2014). An assumption is that repeated participation in joint music-making activities leads to an accrual of benefits over time. It could therefore be that repeated exposure to group singing, resulting in short-term improvements of mood, may lead to a change in affective style, in which the individual has a more positive emotional outlook generally. The literature comparing the benefits of participation in choirs over a longer time frame is nonetheless mixed.

Exploring the longer-term impact of participating in community singing groups on mental health, Coulton et al. (2015) randomly assigned 258 older adults to either a group singing or a usual-activities condition. The singing group reported significant improvements on measures of quality of life, anxiety and depression at both three and six months after baseline. However, it is not known whether similar outcomes would have been achieved if the control group had also participated in a social group of some kind, or if the intervention had been a non-music-based group, so it is not possible to conclude that the effects are attributable to group singing per se. Pearce et al. (2015) compared participants in a group singing condition with a control group of participants in a crafts or creative writing group on measures of affect and social connection to the group at three time points. Changes in positive affect were greater for the singing condition across the seven months of the study. However, the singing group reported much lower positive affect scores at baseline compared with the control group, and affect scores of the two groups were equivalent at the end of the intervention. Negative affect decreased and pain tolerance increased at similar rates for both groups. There were no significant differences between the social bonding scores of the two groups at the end of the intervention, and although those assigned to the singing condition had higher increases in their measures of social connection, this was again at least partially due to their much lower scores at baseline.

Ecological Validity

The experimental designs used in the studies reviewed above raise issues of ecological validity in that at least some key elements of real-world human experience were precluded (Schmuckler, 2001). In everyday life, individual agency and preference are crucial determinants of whether a person participates in a range of social activities. In previous research evaluating the potential benefits of choral participation for wellbeing, ecological validity was compromised in two ways: first, random allocation to groups and/or the withholding of activity may have reduced participants' sense of agency; and, second, participants' experiences were often captured using either quantitative or qualitative methods, rather than both.

Agency and choice. While there is ample evidence that choir participation improves socio-emotional wellbeing, the underlying mechanisms that are responsible for these changes are poorly understood. Benefits may accrue from the components of the choral experience such as exposure to music, synchronisation of movements, or social opportunities, or they may result from individuals' attitudes to participation including preference, sense of personal agency, and choice. Self Determination Theory (SDT) has been proposed as a framework for understanding wellbeing attributed to participation in choirs (Maury & Rickard, 2018; Stewart & Lonsdale, 2016). In real-world settings it is assumed that people participating in a choir choose to be involved and have a personally meaningful commitment to the activity. Curtailing choice has been found to have profoundly detrimental effects on individual wellbeing and health (Deci & Ryan, 2008; del Mar Salinas-Jiménez et al., 2010; Marcinko, 2015; Ryan & Deci, 2000). Random allocation to intervention or control groups, for example in the context of randomised controlled trials (RCTs), can control for potentially confounding factors, but inherent in this process is the potential loss of participants' preference and feelings of agency. In research on choirs, therefore, the results of studies using research designs that failed to account for individual agency may have been biased, for example, by denying control group choristers their preferred activity (Maury & Rickard, 2018). Researchers undertaking RCTs are required to adopt strict testing regimes, and it is likely that most attempt to mitigate such shortcomings, for example by offering control participants the opportunity to receive the intervention or participate in their preferred activity after the trial has finished. Nevertheless, such 'wait-list' strategies may be inadequate. RCT designs are valuable but their potential lack of ecological validity means that naturalistic studies can provide a useful complementary source of evidence. Two examples illustrate the potential confounding of research results when the factors of preference and choice are not central to the design.

First, Bullack et al. (2018) carried out two studies in which members of a choir were assigned to singing and non-singing conditions during a rehearsal lasting 30 minutes (Study 1) and 60 minutes (Study 2). The non-singers remained embedded in the choir, however, and followed the conductor's instructions, such as sitting up straight and following the music. There were no differences between the two groups' measured levels of cortisol or amylase in either study. In Study 1 the singing group reported increased positive affect and reduced negative affect in comparison with the non-singing group. In Study 2 the singing group demonstrated a decrease in negative affect and increases in positive affect and sense of social connection, while the non-singing group experienced an increase in negative affect and decreases in both positive affect and sense of social connection. While the authors suggest their results were attributable to the unique properties of group singing and its capacity to improve socio-emotional wellbeing, they could equally be due – as predicted by SDT – to preventing those assigned to the non-singing group from participating in a chosen and preferred activity. This would have the effect of reducing positive affect and sense of social connection, and increasing negative affect, as reflected in Study 2.

Second, study designs that allow for self-selection but do not compare experimental activities against other kinds of chosen, preferred, social activities may be measuring the positive impacts of preference and choice for the intervention group, rather than benefits unique to choral participation. For example, Cohen et al. (2006) compared a group of older adults who participated in a choir (intervention) to their peers who went about their normal activities (control). The two groups were matched for level of fitness and number of social activities, and were compared on a range of health measures at baseline and again after 12 months. The choir group reported fewer visits to a doctor, less use of medication and fewer falls, and better physical health, better morale and less loneliness. Further, over the 12-month period, the intervention group increased the overall number of activities in which they participated, while the control group participated in fewer activities. While the results may seem dramatic, allocation of participants to groups was not randomised and participants knew which activities they would be undertaking in advance. The differences between the groups may therefore be the result of the intervention group choosing and enjoying a preferred activity – in this instance, singing – in a social group. The control group, in contrast, expressed a disinclination to participate in a choir. They were not, however, offered alternative activities that may have been more appealing to them and that might have elicited similar improvements in their health and wellbeing. It cannot be determined whether similar results would have been obtained from research involving a non-musical, social, intervention group, or a control group who participated in a different kind of (new) activity.

It may be helpful to study choral participation in naturalistic settings to provide a more nuanced understanding of how people experience improvements to their wellbeing in everyday situations. Quasi-experimental designs in which assignment to intervention and control groups is not random can minimise the confounding effects of removing personal agency by enabling all participants to exercise their agency equally. Such studies should also involve engaging activities that are preferred by participants so as to compare 'like for like'. These approaches will help determine whether choral participation has a greater effect on wellbeing than other kinds of social activity, and answer calls to address the limited ecological validity (Dingle et al., 2019) of research that, while advancing our understanding in many ways, does not answer this core question.

Qualitative studies. The use of qualitative data can enrich quantitative findings and inform a better understanding of participants' experiences. It is therefore one of the key approaches recommended for understanding the links between group singing and wellbeing (Dingle et al., 2019). Qualitative research to date has demonstrated that participants report a range of benefits from group singing. These include emotional benefits, including improved emotion regulation, distraction from or reduction of negative emotions, depression alleviation and experiences of positive emotions (Bailey & Davidson, 2013; Dingle et al., 2013; Hopper et al., 2016; Livesey et al., 2012; Tamplin et al., 2013); social benefits, including increased connection to other members of the choir, increased peer support, improved communication skills, improved interpersonal relationships and increased sense of social confidence more generally (Bailey & Davidson, 2013; Dingle et al., 2013; Hopper et al., 2016; Lamont et al., 2017; Tamplin et al., 2013); psychological and cognitive benefits, including meaningful autobiographical reminiscences, improved self-perception and self-worth, increased motivation, and a sense of meaning, purpose and accomplishment (Davidson et al., 2014; Dingle et al., 2013; Lamont et al., 2017; Livesey et al., 2012; Tamplin et al., 2013); and health and functional outcomes, including pain management and coping with pain, more ordered thinking, increased employment capacity and better overall health (Dingle et al., 2013; Hopper et al., 2016). In each of these studies, qualitative methods were used to explore individual experiences and show how choral participation produced benefits such as improvements in wellbeing; in some studies quotations from participants illustrate insights that could not have been obtained using purely quantitative measures. However, few studies utilise qualitative methods for research involving both choirs and a control activity. An exception is the research by Perkins et al. (2018). Data were gathered in semi-structured focus group interviews with members of two groups of mothers with postnatal depression and their babies. One was a 'standard' playgroup and the other was a playgroup explicitly designed to incorporate singing activities for the mothers. While similar themes emerged from the data gathered from the two groups, including new ideas for interacting with their children, having an enjoyable time together, positive impacts on the baby and a calm and supportive environment, mothers in the singing group identified a wider range of psycho-emotional mechanisms underlying their own wellbeing and supporting mother–child bonding, experiencing singing as an immersive activity from which they gained a sense of achievement and purpose. The rarity of studies providing qualitative insights into both singing and control interventions represents a gap in the literature that limits our understanding of the extent to which choral participation uniquely promotes wellbeing, in comparison with activities involving other kinds of social groups.

The Current Study

The current study aimed to compare the effects of participating in a choir versus an exercise group using a range of socio-emotional measures to assess emotional and mental wellbeing, social support and empathy. The study was designed to contribute to an understanding of the mechanisms underlying potential benefits in three ways. First, the control group was selected to ensure any improvements observed in the choir group's socio-emotional wellbeing could be interpreted appropriately. Another activity was selected so that choral participation was not being compared to a passive or 'no activity' condition, or to a deprivation condition (i.e., choristers asked *to refrain from singing*), all of which can lead to reductions in wellbeing. Exercise groups were selected as the control for a number of reasons. Both group exercise and group singing have been shown to have a positive impact on wellbeing (Clift et al., 2010; Penedo & Dahn, 2005). Group exercise also shares a number of key non-specific characteristics with choral participation, including music listening and social interaction. Exercise in groups and choral singing both incorporate synchronised movements, which are known to facilitate a sense of social bonding (Jackson et al., 2018). Both activities are also known to elicit a neurochemical response with attendant effects on such measures as mood (Basso & Suzuki, 2017; Chanda & Levitin, 2013). This enabled us to infer the mechanisms underlying the potential benefits of choral participation, as effects would either be unique to the intervention group, and therefore attributable to elements of group singing but not exercise, or shared by the control group, and therefore attributable to the non-singing aspects of the choral experience. We do acknowledge that there are differences between exercise groups and choirs; for instance, the former are more active than the latter, and physical activity is known to have positive effects on wellbeing. It was decided, however, that as a quasi-experimental design was being used it was preferable to include an active control known to provide benefits for wellbeing in real-world settings, rather than a passive control likely to confirm prior findings. Second, it was decided to carry out a survey of individuals who had chosen to be members of either a choir or an exercise group in a naturalistic setting, rather than randomly allocating them to one or other group, thus preventing them from engaging in a preferred activity. In this way their agency would be maintained within the scope of the study. Third, responses were solicited over the course of seven months, to track whether changes were measurable over a longer timeframe than is generally employed.

The design of the study was quasi-experimental and longitudinal, and employed both quantitative and qualitative responses, comparing members of choirs and exercise groups who completed surveys self-reporting their socio-emotional wellbeing. Measures were collected at three time points over the course of seven months: at baseline, four months and seven months. Psychometric questionnaires provided a targeted measure of differences in various aspects of socio-emotional wellbeing and were chosen to reflect theories of music's evolutionary utility, including emotional wellbeing (measured by the Positive and Negative Affect Scale) and mental wellbeing (measured by the Warwick-Edinburgh Mental Wellbeing Scale), sense of social support (measured by the Multidimensional Perceived Social Support Scale) and self-report of empathic abilities (measured by the Perceived Empathic Self-Efficacy Scale). Responses to open-ended items allowed individuals from both the intervention and control groups to describe changes in their experiences of wellbeing, providing a deeper understanding of their responses to the psychometric measures. They also enabled us to assess similarities and differences between the two groups' descriptions of their experiences, which we hoped would highlight any differences in mechanisms underlying the socio-emotional benefits of group exercise and choral singing respectively.

It was hypothesised that choir members would report increases in quantitative measures of their emotional and mental wellbeing, empathy and sense of social support over a seven-month period, and that these increases would be greater than those experienced by exercise group members. It was also predicted that choir members' qualitative reflections on their membership of the choir would indicate a range of perceived benefits for wellbeing that would be different from those reported by members of an exercise group.

Method

Participants

Individuals ($N = 147$) who were enrolled in organised social groups with a focus on either exercise or singing were invited to participate in this study. Based on the small-to-medium effect sizes reported in previous research (Caprara et al., 2014; Kuyken et al., 2013; Powell et al., 2013; Proctor et al., 2011; Taylor-Piliae et al., 2006) a power analysis for a mixed measures

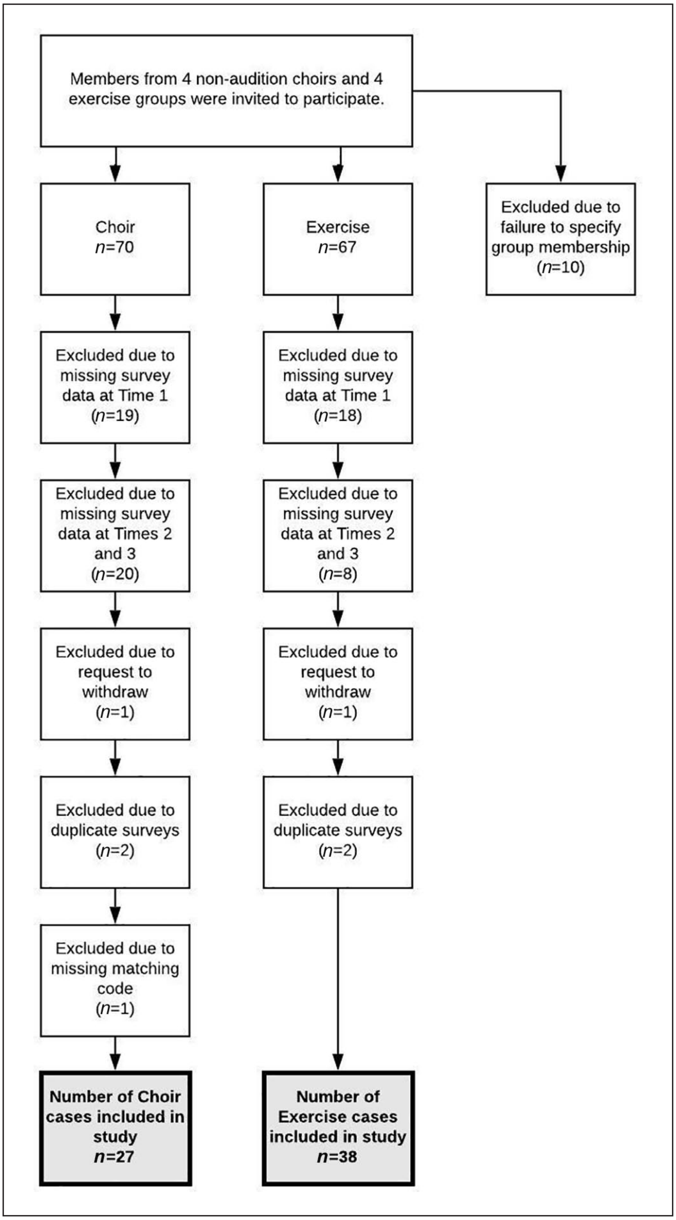

Figure 1. Attrition Subject to Exclusion Criteria for Each Group From Study 1.

ANOVA ($f = 0.25$, $\alpha = 0.05$ $\beta = .8$) yielded a required sample size of 14 in each group (28 in total) at the three time points. Once potential participants had been excluded for a variety of reasons (see Figure 1), the final sample size of 65 exceeded the target number. There were unequal numbers in the two groups due to higher attrition in the Choir group.

Participants were recruited from choirs and exercise groups, primarily associated with the University of the Third Age (U3A), located on the outskirts of Melbourne, Australia. U3A is a social organisation for people aged 55+ that runs a wide range of groups that are organised and run by its members on a voluntary basis. All the exercise groups were associated with U3A and included two gently to moderately active groups exercising predominantly to 'oldies' and pop songs, and two tai chi classes conducted to Chinese relaxation music. Participants were also recruited from four community choirs, of which two were attached to U3A. None auditions its members, who sing mostly well-known 'oldies', pop and traditional songs, and songs from musicals. All the exercise groups and choirs had been running for three years or more, although there may have been changes in leadership from one year to the next in the case of those associated with U3A.

The mean age for the Choir group (n = 27, female = 18) was 66.26 years (SD = 8.84; age range 42–80 years) and the male-to-female ratio was 1:2. The Exercise group (n = 38, female = 36) was slightly older, on average (M = 74.42, SD = 6.22; age range 62–86 years) and the male-to-female ratio was lower at 1:18. The Exercise group was significantly older than the Choir group (t [63] = −4.37, p = .001) and the male-to-female ratio was associated with group membership (X^2 [df = 1] = 8.84, p = .003), with fewer males in the Exercise group than in the Choir group. It was not possible to match the participants by age and sex ratio without reducing the Choir group to an unacceptably low number of cases. Therefore, additional analyses were carried out to determine whether sex or age were determinants of differing outcomes for our measures. As shown in Table 1, the Choir group spent more time deliberately listening to music (X^2 [df = 65] = 19.98, p = .001). There were no differences between measures of the groups' educational level, socio-economic status or employment status.

Materials

Demographic information collected included sex, age, postcode (to estimate socio-economic status), education level and employment status. Music engagement was measured by the question: 'On average, how often do you purposely listen to music a day (rather than to music in the environment that you have no control over, e.g., music in cafes, stores)?', with responses ranging from one (several hours each day) to six (less than once a year). These questions were asked in the first survey only. The psychometric questionnaires listed below were presented in all three surveys. Participants were asked to respond to each item in a way that indicated to what extent they had felt this way generally, over the past two weeks.

Emotional wellbeing was measured by the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988). Participants rated 20 adjectives representing mood states on a scale of 1 (very slightly/not at all) to 5 (extremely). Positive Affect (PA) is measured by such adjectives as Interested, Enthusiastic and Attentive, while Negative Affect (NA) is measured by adjectives such as Distressed, Upset and Ashamed. Cronbach's alpha is reported at .89 for the PA scale, and .85 for the NA scale, with test–retest reliability reported as .79 (PA) and .81 (NA). In the current study, Cronbach's alpha indicated strong reliability at .90 for PA and .87 for NA (Time 1). An overall emotional wellbeing score was calculated by subtracting the negative affect score from the positive affect score, as recommended by Koydemir and colleagues (Koydemir & Schütz, 2012; Koydemir et al., 2013).

The Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS) (Stewart-Brown et al., 2011; Tennant et al., 2007) was used to measure self-reported mental wellbeing, which includes affective, cognitive and psychological functioning components. Seven positive statements are rated on a 5-point Likert scale with options ranging from 1 (*none of the time*) to 5 (*all of the time*). Examples of states include 'I've been feeling relaxed' and 'I have been thinking clearly'. The Warwick-Edinburgh Mental Well-being Scale, with 14 statements, has a published reliability coefficient of .89. The correlation between the SWEMWBS and the long form is .95.

Table 1. *Demographic Frequencies, Choir and Exercise Groups.*

	Choir		Exercise	
	Frequency	%	Frequency	%
Educational attainment				
No higher than year 10 of high school	3	11.1	10	27
Completed high school/VCE[a]	3	11.1	4	10.8
Completed apprenticeship[b]	0	0	1	2.7
TAFE/College diploma	3	11.1	9	24.3
Undergraduate university degree	1	3.7	4	10.8
Graduate diploma	7	25.9	6	16.2
Postgraduate university degree	10	37	3	8.1
Employment status				
Unemployed (not studying)	2	7.4	6	15.8
Studying full time	0	0	1	2.6
Working part time (not studying)	5	18.5	1	2.6
Working full time (not studying)	5	18.5	0	0
Retired	13	48.1	27	71.1
Other	2	7.4	3	7.9
Socio-economic status (SES)				
Average SES	21	77.8	35	94.6
Above-average SES	6	22.2	2	5.4
Deliberate music listening				
Several hours/day	5	18.5	7	18.4
About one hour/day	7	25.9	5	13.2
Several times/week	14	51.9	6	15.8
Several times/month	0	0	11	28.9
Several times/year	1	3.7	9	23.7

Note. VCE = Victorian Certificate of Education; TAFE = Technical and Further Education.
[a]Victorian Certificate of Education
[b]Technical and Further Study

For the current study, scale reliability for Time 1 was .89. Prior to analysis, the scale was transformed as instructed by the creators of the scale (Warwick Medical School, 2019).

Social connection was measured with the Multidimensional Scale of Perceived Social Support (MSPSS) (Zimet et al., 1988). This is a 12-item measure with sub-scales of Family, Friends and Significant Other. Participants responded to statements on a 7-point Likert scale, ranging from 1 (Very strongly disagree) to 7 (Very strongly agree). Examples of statements include 'My family really tries to help me' and 'I can talk about my problems with my friends'. The published reliability coefficients range between .89 and .93. This study found Time 1 scale reliabilities of .95 (entire scale).

The Perceived Empathic Self-Efficacy Scale (PESE) (Di Giunta et al., 2010) uses a six-item scale to assess an individual's belief in their ability to respond empathically to others. Sample questions include 'How well can you recognize whether a person is annoyed with you?' and 'How well can you recognise when a companion needs your help?' Responses are made on a 5-point Likert scale, ranging from 1 (No confidence at all) to 5 (Complete confidence). Reported coefficient alphas range between .78 and .81. For this study, scale reliability was .85 at Time 1.

At the end of the psychometric questionnaires two open-ended items were included that participants could choose to answer. The first survey contained the questions 'What interested you in joining this group?' and 'What benefits do you hope to get from joining this group?' The second and third surveys contained the questions 'What benefits, if any, are you experiencing as a result of participating in this group?' and 'Can you identify changes you've experienced in your life generally – that is, external to this group – as a result of your participation?'

Procedure

Participants were informed that the study was exploring the possible social and emotional benefits of belonging to social groups, provided with an information sheet, told that participation was optional, and that participation could cease at any time. All participants signed and returned an informed consent form. They were prompted to create a unique code that was subsequently used to re-match surveys to group and time point while protecting their identity. It took participants between 15 and 30 minutes to complete the surveys in a place of their own convenience at three time points over the course of seven months: in February when sessions re-started after the extended break from mid-December, mid-year in June and towards the end of the year in September. Because the lead researcher visited the groups at the start of the year to explain the research and provide written information, data collection at Time 1 did not take place until each group had already met once or twice. Surveys were distributed in three ways: online (via Qualtrics), by post and in person. A link to the online surveys was sent to participants providing an email address with two reminder emails sent out one week and two weeks later. Paper copies of the surveys were posted to participants providing a postal address, with a stamped self-addressed envelope. Paper copies were given by the lead researcher, who attended each class, to participants who did not wish to provide either an email or a postal address. All aspects of this research were approved by the Monash University Human Research Ethics Committee.

Data Analysis

There were 44 cases of missing individual responses randomly spread throughout the quantitative data that were replaced with the sub-scale mean. Four outliers were identified on the MSPSS scale. These values were Winsorised (adjusted to within 3.29 *SD* of the mean so that they are less extreme and less likely to skew results). As the groups were not equivalent on age, sex or deliberate music listening variables, preliminary analyses were performed to determine if any of these demographics were associated with the wellbeing measures. Independent t-tests were performed for sex and for deliberate music listening, dichotomised to 'frequent' listening (several times a week or more) and 'infrequent' listening (several times per month or less). Pearson's correlations were performed for the age variable.

Many participants completed the surveys at only two of the three time points. An omnibus analysis of variance (ANOVA) including all three time points would have been underpowered so, to maximize sample sizes, two separate analyses were conducted: the first for the sub-sample who completed the surveys at Time 1 and Time 2 but not Time 3, and the second for the sub-sample who completed the surveys at Time 1 and Time 3 but not Time 2. In all cases two-way mixed-measures ANOVAs were performed using SPSS version 24, with an alpha level of .05.

A thematic analysis of the open-ended responses was conducted using Braun and Clarke (2006) as a guide. A deductive model was used since we were interested in how they might shed light on the quantitative findings. All responses were typed into an Excel spreadsheet and read several times to ensure familiarity with the data. First, NVivo Pro Version 11 was used to code the data by generating a list of most-used words. Second, the list was refined by relating the most-used words to four main themes: (a) attitudes towards the key activity, whether singing or exercise; (b) perceived emotional benefits; (c) perceived social benefits; and (d) motivation for joining and/or continuing with the group. Third, quotations were reviewed carefully in context. Through this process, similarities and differences between the two groups' reports emerged. A summary of the main themes, illustrated by sample quotations, is presented below, organised by group. Many participants referred to the complex interplay of benefits, so this is included as a fifth theme.

Results

Psychometric Measures

Assumption testing revealed that all measures were normally distributed, and homogeneity of variances between groups was met at all time points for all measures. Preliminary checks for age, sex and deliberate music listening revealed that none of these factors was associated with the wellbeing outcome measures (all $p > .05$).

Table 2 presents results for the sub-samples of Choir and Exercise groups who returned the surveys at both Time 1 and Time 2.

Table 3 presents results for the sub-samples of Choir and Exercise groups who returned the surveys at both Time 1 and Time 3.

There were no main effects of group on social support or empathic ability, or interactions between group and time. There were, however, significant effects of time on emotional wellbeing for both groups, in that it increased from Time 1 to Time 3 (F [1, 48] = 8.39, p = .006, d = .837), and also on mental wellbeing, in that it decreased from Time 1 to Time 2 (F [1, 53] = 5.38, p = .024, d = 0.637).

While not statistically significant, two results of interest approached significance. From Time 1 to Time 2, emotional wellbeing increased for both groups (F [1, 52] = 3.66, p = .061), but with a greater increase for the Choir group (F [1, 52] = 2.84, p = .098. Social connection also increased from Time 1 to Time 2 in the Choir group while it decreased in the Exercise group (F [1, 53] = 3.34, p = .073).

Open-Ended Items

A total of 120 open-ended responses were made on at least one of the three surveys by members of the Choir group, and 163 by the Exercise group. Key themes are presented by group and illustrated by quotations in Table 4.

Choir Members

Motivation to Join. Many Choir members identified the opportunity to sing as their primary motivation to join the group, with some indicating that they joined to learn how to sing and others mentioning the opportunity to meet other people, as the following representative quotations indicate. 'The love of singing. Having sung for most of my life, I wanted it to continue' (Abigail, age 80).[2] 'I enjoy singing with others in a relaxed environment' (Barbara, age 60). 'I joined this group as I am new to the community and want to feel connected, want to enjoy myself and want to get to know some local people' (Connie, age 55). 'To learn about singing and to build confidence in singing in social situations' (Dinah, age 61).

The Activity: Singing. They described the experience of singing as intrinsically rewarding – that is, an activity that provides pleasure and satisfaction (Guay et al., 2000). They used a variant of the word 'enjoy' (enjoyed, enjoyment, enjoying) 11 times to describe singing with others,

Table 2. *Means (and Standard Deviations) for Choir Participation Group (n = 20) and Exercise Participation Group (n = 35) at Both Time 1 (Baseline) and Time 2 (4 Months Post-Baseline).*

Measure/ sub-scale	Choir T1 M(*SD*)	Choir T2 M(*SD*)	Exercise T1 M(*SD*)	Exercise T2 M(*SD*)	Combined T1	Combined T2	Time main effect *p* value	Time x group interaction *p* value
Emotional wellbeing	18.45 (11.38)	22.6 (11.18)	17.18 (11.61)	17.44 (11.72)	17.65 (11.43)	19.35 (11.69)	.061	.098
Mental wellbeing	24.94 (4.17)	24.34 (4.34)	24.28 (4.47)	22.93 (3.66)	24.53 (4.34)	23.44 (3.73)	.024*	.372
Empathic response	3.83 (0.59)	3.73 (0.53)	3.54 (0.62)	3.62 (0.52)	3.65 (.62)	3.66 (.52)	.896	.115
Social connection	5.64 (1.14)	5.75 (1.02)	5.43 (1.18)	5.31 (1.16)	5.51 (1.16)	5.47 (1.19)	.931	.073

*Significant $p < .05$.

Table 3. Means (and Standard Deviations) Choir Participation Group (n = 21) and Exercise Participation Group (n = 31) at Both Time 1 (Baseline) and Time 3 (7 Months Post-Baseline).

Measure/ sub-scale	Choir T1 M(*SD*)	Choir T3 M(*SD*)	Exercise T1 M(*SD*)	Exercise T3 M(*SD*)	Combined T1	Combined T3	Time main effect *p* value	Time x group interaction *p* value
Emotional wellbeing	16.52 (11.44)	21.95 (8.58)	16.66 (11.80)	19.07 (12.79)	16.60 (11.53)	20.28 (11.20)	.006**	.271
Mental wellbeing	24.12 (4.15)	23.69 (3.13)	23.80 (4.21)	22.99 (4.22)	23.93 (4.15)	23.28 (3.79)	.234	.709
Empathic response	3.69 (0.66)	3.6 (0.62)	3.55 (0.6)	3.61 (0.62)	3.60 (.620)	3.60 (.70)	.821	.279
Social connection	5.49 (1.24)	5.49 (1.11)	5.26 (1.23)	5.11 (1.36)	5.35 (1.23)	5.26 (1.26)	.427	.427

**Significant $p < .01$.

Table 4. Comparison of Choir and Exercise Group Qualitative Responses.

Focus	Selected quotes from Choir members	Selected quotes from Exercise group members
Motivation to join	'Remembering how much I loved music and singing as a student' (Gillian, 42) 'My love of singing, and being part of a group of like-minded people' (Ingrid, 73) 'I love to sing' (Kelly, 64) 'I love to sing in parts in a group' (Jacquie, 67)	'I like to interact with people for socialization' (Sarah, 78) 'Gentle physical activity. An organized group keeps me disciplined' (Theresa, 75) 'I wanted to do some exercise, and it is easier to do in a group' (Ursula, 81) 'Companionship, keeping fit and active' (Patty, 82) 'I recognized that I needed to be more active physically' (Katrina, 69)
The activity: singing / exercise	'Singing as part of a group is also an intellectual exercise, that I find challenging and rewarding when it works for me' (Marie, 71) 'I am re-acquainted with my enjoyment of choral singing (I used to do it years ago)' (Bill, 52) 'To improve my musical literacy. To expand my appreciation and knowledge of more genres of music' (Dinah, 61) '[I] often go to hear choirs now and am able to appreciate what they do' (Darren, 76)	'I find it fairly to very relaxing, and I find the more exercise I can get the better in a group setting. I find it hard to get time to discipline myself to more exercise other than with my group activities, so it all helps a lot both physically and emotionally' (Adam, 68) 'I do exercise with this group to keep fit and stay healthy' (Ursula, 81) 'Necessity for exercise after retiring from playing bowls. Also meeting new people. By committing to a group keeps you attending' (Ines, 78)
Emotional benefits	'The meetings lift me out of my negative feelings and this carries over to the next day or so' (Laura, 69) 'Emotional release. . . Choir is [an] emotional outlet' (Opal, 64) '[I have a] greater feeling of self-confidence. [I am] less stressed and anxious' (Bill, 52) 'I like singing. Singing makes me happy. I like challenging my brain. People are friendly. It is good fun' (Nancy, 73)	'I often arrive at the group feeling half asleep and without much focus. By the end of the session I feel happier and more engaged' (Gloria, 65) 'Feeling better for having done it. I feel proud of myself' (Katrina, 69) 'The joys of friendship, participation, sociability, belonging, learning' (Rita, 85) 'Feeling happier to attend as it is beneficial to my wellbeing' (Veronica, 71)

(Continued)

Table 4. (Continued)

Focus	Selected quotes from Choir members	Selected quotes from Exercise group members
Social benefits	'Joining in with others and achieving more through group effort' (Darren, 76) 'Socialising with a diverse group of people' (Gillian, 42) 'I was experiencing a time of change and difficulty in my life and I've found singing in a choir helpful at similar times before. I'd recently retired from work and had extra energy to bring to singing' (Hannah, 74)	'Meeting new people, having fun, socialising, getting fit' (Betty, 62) 'Getting to know people better. Coffee chats afterwards. . . I don't like to miss classes. Learning people's names, not just faces' (Olivia, 76) 'I like attending this group as I get to speak to many different people, male and female, listening to how they are and how the week has been for them' (Veronica, 71)
Complex benefits	'[I] enjoy the time. Something to do and look forward to! Learn to sing in tune all the time. Improve memory. Make new acquaintances. Keep my memory active. Feed the brain. Keep Alzheimer's away!' (Nancy, 73) '[I experience] fun, happiness, challenges and brain stretching with new songs, socialising with a diverse group of people' (Gillian, 42) 'I've been more confident in talking about myself in retirement that is, contributing somehow by joining a class or doing volunteer activities as well. Also meeting the challenges of new material (for singing) and performance (which I've been reluctant about)' (Marie, 71)	'I feel the exercise is beneficial to improving flexibility, the accompanying music is very relaxing, and chatting with other senior people makes me feel more connected' (Gloria, 65) 'When everyone is synchronized with the movement it looks wonderful and the feeling can be one of peace. I enjoy the gossip breaks too, which enables us to catch up a bit with others close by. The other wonderful benefit is that a small group of us goes to a nearby coffee shop after the session. We share with each other what is happening in our lives. . . I find it life-giving' (Madeline, 76)

five times to describe learning new songs and three times to describe singing. Additionally, they used the word 'love' or 'loved' 11 times to describe their attitude towards singing or music. For many, their enjoyment had begun when they were very young. 'I wanted to enjoy singing in a group after five decades of not singing (Alvin, age 68)'. 'I love music and have always enjoyed singing' (Elaine, age 74). 'Music has always been a part of my life in keeping balance. . . Somehow this has slipped from my life often because of financial reasons so finding this choir has just boosted my soul' (Franny, age 61).

Many participants also referred to the satisfaction of becoming 'more musical' through exposure to a wider variety of music and improving their singing, which led to more confidence in their musical abilities. '[I am] feeling and being more musical in general. Being confident enough to tell people I sing in a choir!' (Gillian, age 42). '[I am] learning new voice repertoire, feeling positive about belonging, hearing my voice improve with regular exercise, enjoying hearing lovely sounds made in a group' (Hannah, age 74). 'It has deepened my interest in different types of music that I hadn't listened to previously' (Ingrid, age 73).

Emotional Benefits. Many participants mentioned greater general confidence or emotional benefits such as increased positive affect. 'I have more confidence in myself and am able to voice my opinions more comfortably. . .. I feel happy and challenged for the 2 hours at choir, and it's something I look forward to each week' (Jacquie, age 67). 'I have an outlet for stress release from participating. I leave feeling very relaxed and UP' (Kelly, age 64). 'Feeling happier, more optimistic and more confident' (Bill, age 52).

Social Benefits. They also highlighted the social aspects of the choir. It was a good way to meet people and find support, particularly at difficult times. 'This experience has given me a sense of inclusiveness. I have made new friends and shared occasions with others that has given me joyful times' (Kelly, age 64). 'Making new friends. . . Getting to know the name of most group members. . . A feeling of belonging. People say they missed me if I'm not there' (Hannah, age 74). 'I found this choir after my wife died. It helped me during a time of grief and it still does' (Charles, age 77).

Complex Benefits. Many responses from members of the Choir group reflected a complex interplay of benefits. 'Friendship, a sense of satisfaction in being part of a group that sings a song well, general well-being from singing' (Doug, age 74). 'Re-discovering my love of music. Building connections with people with different life experiences and learning from them. Having a weekly musical mood boost!' (Gillian, age 42). 'Getting out of the house, meeting people with a shared interest, physical benefit of singing and breathing deeply, keeping my mind active, just being part of a group with a common goal' (Laura, age 69).

Exercise Group Members

Motivation to Join. The primary motivation for Exercise group members to join was, like that of the Choir group, the core activity – exercise. Like the Choir group, several also mentioned social opportunities. The affordability of the U3A classes was also mentioned by several individuals who had had to terminate gym memberships or stop doing other costly forms of exercise. 'I retired and saw the opportunity to exercise and meet people' (Alice, age 70). 'Exercise, social and cost' (Betty, age 62). 'Keeping fit, social contact with people in the local area' (Claire, age 66). 'Due to the GFC [Global Financial Crisis] I had to cancel my gym membership, so I needed another physical activity' (Danielle, age 78).

The Activity: Exercise. Most participants identified exercise as something that was a good thing to do in order to remain fit and healthy, but only four explicitly referred to enjoying it. However, several members of the tai chi classes mentioned the enjoyable nature of this gentle and relaxed form of exercise. 'Active exercise is keeping me supple and able to bend and stretch' (Eleanor, age 76). 'I feel fitter with this gentle form of exercise [tai chi]. It is very pleasant and the music is very relaxing' (Florence, age 80). 'I enjoy doing vigorous exercise generally. And I enjoy exercising in a group' (Gloria, age 65).

For the participants in the Exercise group, the social aspect was an important motivator to attend class and keep fit, with several reporting that they did not have the discipline to keep up exercise on their own. This reflects a form of extrinsic motivation known as identified regulation – that is, the value of the activity is in the outcome; it is a means to an end (Guay et al., 2000). 'I need to exercise for health reasons. Everyone is friendly, so the necessity is pleasant' (Helen, age 75). 'To gain more exercise as I'm not very motivated to do exercises at home' (Adam, age 68). 'My general lack of exercise commitment. . . requires I attend' (Ines, age 78). 'Have got to know a couple of girls that we do exercise together, smile and joke together, and feel it does me good. The exercise and company. If I did not go I would not exercise by myself' (Joyce, age 73).

Emotional Benefits. Perceived effects on wellbeing included improved mood, a sense of achievement and social inclusion. These effects were attributed to the exercise itself, to the social opportunities afforded by the class, or their interplay. '[I am] feeling more at ease chatting to new people. The sense of enjoyment. [What] I feel at the group, carries on for days' (Gloria, age 65). '[I enjoy] getting to know people at a deeper level, more in-depth conversations, more fun and enjoyment in the group classes' (Claire, age 66).

> I take pride in myself because I am better physically than most in the group. I look forward to going because I know I will feel happier when I leave. Being shy, I get a thrill when people acknowledge me. (Katrina, age 69)

> Good anticipation for each attendance. Enjoy the interaction with familiar people despite that interactions being only superficial. I recognise that I am 'better off' and healthier for continuing this discipline and activity. It fills some hours in my week, and forces me to look beyond myself. (Lynn, age 79)

Social Benefits. Unlike the Choir group, the Exercise group did not use the word 'love' to describe any experience associated with the class. Like the Choir group, however, the Exercise group strongly identified the positive benefits of socialising with other people, during and outside classes, using 'enjoy' or its variants 10 times. 'Enjoying coffee with fellow members. Maintaining physical fitness' (Eleanor, age 76). 'Socially, the company is really good when we have our "gossip" time, exchanging thoughts with others and having a laugh' (Madeline, age 76). 'The social contact helps me to feel connected to other people, so the group reduces the isolation of living alone' (Gloria, age 65).

> My principal reason for joining this group is to be fitter – and more shapely! – but I much enjoy meeting the other participants and getting to know them – their families, what makes them tick, their family origins, knowing what they've done in their lives. (Nora, age 84)

Complex Benefits. Participants in the Exercise group, like those in the Choir group, indicated that they experienced benefits due to a complex interplay of factors, including the exercise itself, improved mood, and social interactions. 'Improvement in physical health and fitness. Feeling more relaxed. Feeling more secure as I enjoy the company of the other people. An increased sense of belonging to a community' (Gloria, age 65). 'Friendship, confidence in belonging to a group, exercise I would not do alone, wanting to continue, not miss classes. . . sharing in many conversations over coffee afterwards' (Olivia, age 76). 'Exercise, getting out and about, friendships, coffee get-togethers, using one's brain' (Patty, age 82). 'The joys of friendship, participation, sociability, belonging, learning' (Rita, age 85).

Open-Ended Responses: Similarities and Differences. There were many similarities between the open-ended responses of the Choir and Exercise groups. Themes such as the importance of social connection, confidence, improved mental and emotional state and overall improved wellbeing were common to both groups. As would be expected, the Exercise group referred more to their increased fitness and flexibility while the Choir group members referred more to their increased 'musicality'. A key difference was that the Choir group were primarily attracted by the activity, and the social benefits were a secondary but welcome bonus. Conversely, the Exercise group discussed exercise as a necessity, and the social aspects of group membership as central to their motivation for attending. Choir members used the word 'love' 11 times to describe singing or music. They used 'enjoy' or a derivative 21 times to describe aspects of singing, but only three times to describe social interactions within the group. Exercise group members did not use the word 'love' at all in relation to classes, although they used 'enjoy' 12 times to describe the social aspects and only four times to describe the exercise itself. There were thus different motivations for the two activities: singing was intrinsically rewarding for the Choir group, while exercise was a means to an end for the Exercise group.

General Discussion

The current study explored the impact of group singing on socio-emotional wellbeing, including emotional wellbeing, mental wellbeing, social connection and empathy, measured using psychometric questionnaires at three time points over seven months. Members of exercise classes formed a control group. Both groups also responded to open-ended questions designed to find out if they described the impact of group participation on wellbeing differently. In this way the research sought to identify whether the experience of singing in a choir has unique effects on wellbeing or if another preferred activity (group exercise in this instance) that shares some but not all features of choral singing has similar effects. Inclusion of open-ended questions was also anticipated to provide some insight into the mechanisms underlying any observed differences.

There was no interaction between group and time; rather, emotional wellbeing for both groups improved significantly between Time 1 and Time 3. There was, by contrast, a small but significant decrease in the mental wellbeing of both groups from Time 1 to Time 2. There were no changes in empathic response or sense of social connection. The hypothesis that choir members would report increases in their emotional and mental wellbeing, empathy and sense of social support over a seven-month period was therefore only partially supported, since only emotional wellbeing increased, while mental wellbeing decreased between Time 1 and Time 2. The hypothesis that the Choir group would experience greater increases than the Exercise group was not supported, since there were no statistically significant differences between the increases experienced by the two groups. While the Choir group reported greater increases in emotional wellbeing and social connection than the Exercise group from Time 1 to Time 2, these differences can only be considered trends since they did not reach significance. The significant but small decrease in mental wellbeing between Time 1 and Time 2 (but not Time 3) could be explained by normal variations across the year. For example, it may be attributable to a slight reduction in excitement at the start of the year as tasks become more challenging, with a return to baseline measures at the end of the year reflecting a sense of accomplishment. It may also reflect normal seasonal fluctuations since the Time 2 measures were taken in the middle of winter, when weather is cold and days are shorter; such seasonal dips in wellbeing measures are common, and appear to be more prevalent in females (Oginska & Oginska- Bruchal, 2014). These findings challenge the conclusion that group singing provides benefits for wellbeing superior to those obtained by participating in other kinds of non-musical social activity, even over a seven-month period of time.

It was also predicted that choir members' reflections on their membership of the choir would indicate a range of perceived benefits for wellbeing that would be different from those reported by members of an exercise group. This was not the case, since the wellbeing benefits described by both groups were very similar. An interesting difference, however, was that members of a choir were more likely to indicate that enjoyment or love of singing drew them to the group, while the exercise group members indicated that social aspects helped them maintain their commitment to exercise. Although there were no significant differences between the increases in the two groups' levels of subjective wellbeing, analysis of open-ended responses shows that choir members expressed intrinsic motivation for singing while the exercise groups had extrinsic motivation in the form of identified regulation, relying on positive social interactions to keep them committed to an exercise regime that provides other rewards (such as improved fitness).

The use of a quasi-experimental design and naturalistic setting within which to explore effects on wellbeing strengthens the findings of the current study, in comparison with previous research in which control group participants were prevented from choosing to engage in preferred activities and therefore lacked motivation to undertake them, thus potentially confounding results. They complement the findings of RCTs, population studies and pre-post within-subjects studies without control groups. While the discrepancy between the limited findings from the analysis of quantitative data reported above and those of previous studies may be attributable to the use of intervention and control groups that had some similarities, in that they shared the characteristics of social interaction and exposure to music, results from previous studies undermine this hypothesis. For example, the research conducted by Bullack et al. (2018) used members of a choir as a non-singing control group who retained both music exposure and social interactions and still experienced a *decline* in mood state and sense of social connection. Kreutz et al. (2004) reported similar findings: increased negative affect scores were obtained from a choir that forwent practice to listen to music, thereby retaining both music listening and socialising. The lack of differences between the intervention and control groups in the current study may be attributable to each group having chosen to participate in their preferred activity.

The analysis of open-ended responses for both the intervention and control groups provides useful insights into participants' views on why and how preferred and engaging social activities influence their wellbeing. There were similarities between the two groups, with common themes of social connection, confidence, improved mental and emotional state and overall improved wellbeing. Participants referred to the benefits of the core activity – increased 'musicality' for choir members and increased fitness and flexibility for the exercise group members. They differed, however, in their motivation, which was intrinsic for the former and extrinsic for the latter – but, importantly, a form of extrinsic motivation known as identified regulation, which incorporates participant choice. This underscores the importance of ensuring that participants' preferences are taken into account in research on choirs, since the data suggest that people join choirs primarily to sing while social benefits are described as a positive secondary outcome. It may also be worth considering potential differences in motivation, preference and sense of agency when encouraging individuals to join other kinds of social groups, and determining the kinds of social group that should be offered in school or retirement settings, for example.

The participants in the current study were older Australians with no major physical or mental limitations. They were socially active, many taking part in several group activities every week. It is important to carry out research with such participants as, unlike studies of choirs involving samples representing populations with compromised physical or mental health, it describes the wellbeing of individuals who do not lack social opportunities. Some previous studies (Abell et al., 2017; Bailey & Davidson, 2005; Dingle et al., 2013; Fancourt et al., 2016) may inadvertently have measured effects that would have resulted from *any* kind of engaging social intervention, and their findings may therefore not be specific to choirs. This interpretation is strengthened by the findings of Dingle et al. (2017), which reported that adults with chronic mental health conditions experienced similar improvements in emotion regulation, whether they took part in a choir or a creative writing class.

A critical review of the literature has indicated that the uniqueness of the benefits conferred by group singing may have been overstated when compared to those conferred by other social leisure activities, particularly those chosen by the individuals who take part in them. Indeed, no differences were observed between the increases in wellbeing reported by members of both choirs and exercise groups at the end of seven months in the current study. It may therefore be that one or more of the features shared by the two kinds of group – such as coordinated movement, listening to music and social contact – was responsible for these changes. Another explanation could be that individual choice and preference underlie improvements in wellbeing, rather than the characteristics of the activity per se. It is also possible that it is an interaction between the characteristics of group activity and individual choice that contributes to changes.

Previous research indicates that both quality and quantity of social connections correlate with improved wellbeing across the lifespan (Cacioppo & Cacioppo, 2014; Carmichael et al., 2015; Umberson & Karas Montez, 2010); perhaps the nature of the group activity is of little importance, provided the individual engages in it from choice (Greaves & Farbus, 2006) and enjoys it. Self Determination Theory (SDT) can be used to predict when a particular activity will increase wellbeing and has been proposed in the past as a useful framework for understanding changes in the wellbeing of choral singers (Maury & Rickard, 2018; Stewart & Lonsdale, 2016), and as a model for successful social prescribing (Hanlon et al., 2019), music education (Evans, 2015) and participation in sport for leisure (Bagøien et al., 2010), for example. Future research could use the SDT framework to find out if wellbeing increases when participants exercise preference and choice, or if it decreases when preference and choice are withheld, regardless of type of activity.

While emotional wellbeing improved across the seven months of the study, the findings do not support the hypothesis that group singing would increase social connection and empathy. One explanation may be that, although baseline measures had been taken at the start of the year following a six-week break, the wellbeing of participants, many of whom had been involved in their group for some time, had already stabilized at a high level. Another explanation is that the effects of group singing on social connection – and possibly other kinds of group activity as well – have, like the uniqueness of the benefits conferred by singing, been overstated in the literature and are largely limited to short-term changes (Fancourt et al., 2016; Maury & Rickard, 2018; Sandgren, 2009). The slight decrease observed in mental wellbeing between Time 1 and Time 2 could support this interpretation. While evolutionary theories provide explanations for the benefits of group singing, which may include the promotion of social connection and prosocial behaviours, it is possible that these benefits no longer operate in modern society. Musical interactions are likely to have played an important role in emotion regulation, social bonding and the development of pro-social behaviours in earlier stages of human development, but in the current environment there are also many other options for achieving the same outcomes through non-musical activities with similar characteristics. It is also possible that such benefits are more pronounced for populations with social deficits such as young children who are still developing their social skills.

Limitations and Future Research

While efforts were made to standardise procedures in this quasi-experiment, conclusions should be treated with caution, as the study had several limitations. First, there was a higher attrition rate in the choirs than the exercise groups. Second, there were more men in the choirs, whose members were also younger, on average, and more likely to be employed. While these limitations were addressed as much as possible through secondary analyses, pre-existing differences may have influenced outcomes. For example, employees may have scored higher on social scales because they had more interaction with other people outside rehearsals or classes, or lower because they had fewer opportunities to take part in leisure activities. Choir members who were employed may have experienced a bigger boost to their mood than members of the exercise group because they had chosen to spend their more limited leisure time on an activity that they felt would provide them with the greatest benefit. It is also possible that the men in the choir groups scored lower on measures of positive affect, since previous research indicates that women rate their mood higher than men following participation in a choir (Sandgren, 2009).

An inevitable limitation of research in naturalistic settings is the difficulty controlling for all differences between groups. For example, each group had a different facilitator, which may have had an impact on members' experiences of wellbeing. The exercise groups were not uniform, but included moderate- and low-intensity aerobic exercise and tai chi. There were also differences between the extent to which the two groups reported listening to music deliberately, in that members of choirs appear to have had higher levels of engagement with music. This was expected, as music engagement reflects the core activity of choirs. In this study, however, music engagement was unlikely to have confounded the results, as the levels of wellbeing of participants who did and did not often listen to music did not differ significantly.

As the benefits of group singing for wellbeing reported in this article are few, and participants experienced a slight decrease in mental wellbeing between Time 1 and Time 2, it is essential that further research be conducted to understand how and why group activities improve wellbeing over time. Preliminary findings from a large population study in the UK (BBC, 2019) indicate that the effects of group activity on wellbeing taper off after 10 years' participation in the same group, implying that novelty is an important mediator. The next focus for research on promoting wellbeing through choirs and other social groups should be participation. Possible avenues to be explored include level of enjoyment and engagement in the activity, experiences of flow, the role of preference, achieving autonomy, competence and relatedness as defined by SDT, and positive and affirming social interactions.

As this article has been in the course of preparation, the spread of COVID-19 means that social group attendance has ceased in many communities, and for an unknown but likely to be extended period of time. Considering the findings from this research under current conditions, there is a unique opportunity to consider how social group participation *maintains* wellbeing across time, which is unlikely to be captured even in a study spanning seven months. With the cessation of many social opportunities, and others moving onto online platforms enabling physical distancing to be maintained, there is an opportunity to measure how individual wellbeing changes as a result, particularly for older adults who may have limited access to technology.

It may be that music and group singing is currently playing a bigger role in both maintaining wellbeing and providing an increased sense of social connection despite physical distancing measures, compared to times when social opportunities are more numerous and take many forms. Exploratory research conducted by Schäfer and Eerola (2018) found that individuals use music listening, watching television and reading fiction as forms of what they term social surrogacy – that is, to help individuals feel socially connected even when alone. Furthermore, they suggest that music listening has unique qualities in that it activates personal memories. Others have reported that music-induced memories are common, vivid and generally positive (Jakubowski & Ghosh, 2019) and that music has more power than photographs to enable people with Alzheimer's disease to recall autobiographical memories (Baird et al., 2018). Additionally, there is evidence that virtual choirs provide a greater sense of social connection than traditional choirs (Fancourt & Steptoe, 2019), which may indicate that music has a unique role in creating or maintaining social connection at times and in places where physical proximity is not possible.

Conclusion

The research reported here indicates that group singing has a positive effect on emotional wellbeing over time, but so does group exercise. Contrary to evolutionary theories, group singing had no other effects on mental wellbeing, social connection or prosocial behaviours, although there were non- significant trends indicating an increase in sense of social connection between Time 1 and Time 2. There is therefore no evidence to suggest that choral participation makes a *unique* contribution to socio-emotional wellbeing. It may be that participation in any kind of social activity, whether or not it incorporates aspects of the choral experience such as listening to music, boosts wellbeing if preference and choice have been exercised. This conclusion is consistent with the findings of other studies incorporating a control group: choirs may not provide superior benefits to other types of social groups. However, it is possible that choir membership provides important protective factors for maintaining wellbeing across longer periods of time. It may also be that in unique situations, such as that created by social distancing during the spread of COVID-19, choirs and other music-centred activities may be better able to improve wellbeing and sense of social connection than other social options available.

As global populations age, it is critical to understand how interaction with the arts and various kinds of social activities influence wellbeing and help people to age well. There is a particular gap in understanding the effects on wellbeing of long-term participation in various kinds of social groups. There has been interest in choirs because of what is perceived as a layering of components that improve wellbeing, including music, coordinated movement, and social opportunities. However, the findings of this research, in the context of our review of previous studies, indicate that choirs may not be uniquely positioned to improve psycho-social wellbeing. The efficacy of social prescribing is dependent on understanding the mechanisms that may underlie increases in affective state and social connection. It is recommended that, in future, frameworks which incorporate both the components of the choir experience and the attitude towards participation that motivates individuals to engage with it are employed to understand how participation in choirs and other social groups may have a positive impact on wellbeing.

Authors' Note

All data are available for review by contacting the first author at Susan.Maury@monash.edu.

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Ethical Approval

This research was approved by Monash University Human Research Ethics Committee on 31 May 2013, Project Number CF13/909-2013000427.

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Notes

1. References to choirs throughout this paper are to non-audition community choirs, categorised as a leisure activity social group.
2. All names are pseudonyms.

Chapter 7: A investigation of the proposed mechanisms of activity components and individual mindset

Preamble

This chapter incorporates a paper (submitted and currently undergoing peer review) that explored potential mechanisms for changes in wellbeing, including contributions of individual attitudes and motivations as well as the core elements of the group activity itself.

This research was designed to address the third aim and related research questions addressed by this thesis:

***Aim 3:** To identify mechanisms underlying changes in wellbeing following participation in a community choir in comparison with other group leisure activities.*

6. *What mechanisms explain wellbeing benefits for choirs? Are they similar to other kinds of social group wellbeing mechanisms?*
    a. *What is the role of the activity's characteristics? Specifically, this thesis examines the role of music engagement, movement, and social interactions.*
    b. *What is the role of individual mindset towards participation? Specifically, this thesis examines the role of motivation, experiences of flow, autonomy, competence and relatedness.*

This chapter clarifies whether the wellbeing improvements reported by choir members are facilitated by unique mechanisms, or whether they are shared by other types of social groups. Its exploration of both core elements of the activity and individual attitudes and motivation has not, to the author's knowledge, been considered within the scope of one study; this allowed a more holistic approach to be taken in understanding the mechanisms behind wellbeing changes. Furthermore, understanding the role of the selected components or individual attitudes expands the examination of choir participation so that wellbeing changes can be understood within the context of leisure group activities more generally. This provides more useful information for practitioners to understand how wellbeing changes may be effected through participating in different kinds of social groups, and whether certain kinds of activities provide enhanced outcomes.

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Socio-emotional benefits associated with choir participation for older adults related to both activity characteristics and motivation factors

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Abstract:	Community choirs can contribute to health and wellbeing, but there is less clarity about the mechanisms through which choir participation promotes positive change. This research explores two possible types of mechanism: Mechanisms relating to the activity experience, which include music, movement and social opportunities; and mechanisms relating to individual characteristics pertaining to mindset and motivation, including experiences of flow, competence, autonomy and relatedness. In Study 1, members of choirs, exercise groups and other kinds of social groups (N=190) completed surveys on their experience of emotional, social and mental wellbeing (outcomes) pertaining to their group activity as well as experiences of motivation, flow and the components of self-determination theory (potential mediators). Multiple regression analyses revealed that participation in both Choir or Exercise groups predicted positive emotional wellbeing, but not social cohesion. Underlying mechanisms differed, with improved positive affect mediated by intrinsic motivation for Choir members, and by intrinsic motivation, identified regulation and flow for Exercise Group members.; Mental wellbeing improved only for exercise group members and was mediated by flow. Study 2 used an experience sampling methodology conducted with a sub-group from Study 1 (N=59), which asked daily questions about wellbeing (mood, sense of social connection and energy levels) and participation in activities (music engagement, singing and exercise either alone or with others). Repeated-measures t-tests revealed that participants were more likely to report higher levels of social connection on days in which they participated in music activities than on days that they did not engage in music activities. Engaging in exercise or group activities was also associated with a greater sense of social connection, as well as higher levels of mood and energy. In sum, the activity experience and individual characteristics of motivation and mindset towards participation contributed to changes in wellbeing, reflecting an ecological model of person-activity fit. Findings are discussed in terms of social prescribing and other settings where social opportunities are organised.

Socio-emotional benefits associated with choir participation for older adults related to both activity characteristics and motivation factors

Abstract

Community choirs can contribute to health and wellbeing, but there is less clarity about the mechanisms through which choir participation promotes positive change. This research explores two possible types of mechanism: Mechanisms relating to the activity experience, which include music, movement and social opportunities; and mechanisms relating to individual characteristics pertaining to mindset and motivation, including experiences of flow, competence, autonomy and relatedness. In Study 1, members of choirs, exercise groups and other kinds of social groups (N=190) completed surveys on their experience of emotional, social and mental wellbeing (outcomes) pertaining to their group activity as well as experiences of motivation, flow and the components of self-determination theory (potential mediators). Multiple regression analyses revealed that participation in both Choir or Exercise groups predicted positive emotional wellbeing, but not social cohesion. Underlying mechanisms differed, with improved positive affect mediated by intrinsic motivation for Choir members, and by intrinsic motivation, identified regulation and flow for Exercise Group members.; Mental wellbeing improved only for exercise group members and was mediated by flow. Study 2 used an experience sampling methodology conducted with a sub-group from Study 1 (N=59), which asked daily questions about wellbeing (mood, sense of social connection and energy levels) and participation in activities (music engagement, singing and exercise either alone or with others). Repeated-measures t-tests revealed that participants were more likely to report higher levels of social connection on days in which they participated in music activities than on days that they did not engage in music activities. Engaging in exercise or group activities was also associated with a greater sense of social connection, as well as higher levels of mood and energy. In sum, the activity experience and individual characteristics of motivation and mindset towards participation contributed to changes in wellbeing, reflecting an ecological model of person-activity fit. Findings are discussed in terms of social prescribing and other settings where social opportunities are organised.

Key words: Leisure activities, choirs, exercise, music, wellbeing, motivation, flow, self determination theory, social connection, affect

Introduction

Evolutionary theories suggest that the longevity and universality of group singing may be attributable to its capacity to create shared positive emotional states and increase social cohesion (Harvey, 2018; MacDonald & East, 2012; Schulkin & Raglan, 2014; Weinstein et al., 2015). There has, therefore, been growing interest in community choir membership as an effective way to improve social and emotional wellbeing (Clift et al., 2010; Dingle et al., 2019; Maury & Rickard, 2016; Williams et al., 2018). Many studies have reported superior benefits for participation in choirs than for control conditions, including studies that compare singing to a non-singing condition (Bullack et al., 2018; Kreutz, 2014; Sanal & Gorsev, 2014) or to another activity (Johnson et al., 2017; Kirschner & Tomasello, 2010). However, other studies that use similarly engaging leisure group activities as controls report comparable benefits for wellbeing for both singing and non-singing conditions, including cooperative Lego-building (Allpress et al., 2012), creative writing classes (Dingle et al., 2017), exercise (Maury & Rickard, 2018, 2020; Valentine & Evans, 2001), and solo or group music and sporting activities (Lonsdale & Day, 2020). Given the diversity of physical and mental activity involved in these different activities, it may be that leisure group activities benefit wellbeing through characteristics that are shared by all, such as social interaction and engagement. While comparing choir participation with control activities that are equally engaging is an important first step, ensuring comparisons share some activity components, such as music exposure, movement and social opportunities, will further elucidate the mechanisms that sit behind wellbeing changes.

An understanding of the mechanisms underlying benefits of group singing may help to clarify whether there is anything unique about this particular leisure activity with regard to its impact on wellbeing. Identifying the features of choir participation which are responsible for its effects on wellbeing could also optimise the efficacy of social-based interventions, such as social prescribing initiatives (Bickerdike et al., 2017). Social prescribing provides a non-medical response to address social determinants of health (Drinkwater et al., 2019), and can include ‘prescriptions’ for activities such as arts engagement, outdoor walks, or participating in a social group (Chatterjee et al., 2018). Equally, the information could be useful for those who provide leisure activities in settings such as retirement communities, schools, or community hubs. Not least, individuals, who are tasked with managing their own health and wellbeing maintenance, could use this information to self-manage their wellbeing more effectively. This is particularly true for older adults who sometimes struggle to look after their wellbeing following such events as retirement or relocation.

Social interaction, health and wellbeing in older adults

Interpersonal relationships are a significant determinant of physical and mental health (Ong et al., 2016). A large population study of older adults found that not smoking and being socially active were the two primary predictors of healthy older age with few chronic diseases (Barak et al., 2020). A meta-analysis revealed that people with stronger social relationships increased their likelihood of survival by 50%, and that these effects were greatest for people with strong social networks (Holt-Lunstad et al., 2010). The loss of social opportunities and roles provided by employment can be a key contributor to reductions in health and wellbeing for older adults who are no longer working (Heybroek et al., 2015). For example, a longitudinal study of retirees found that those who maintained activity in at least two social groups had a 2% risk of death in the first six years of retirement compared with a 12% risk for those who ceased social group activity, while also recording a 10 per cent drop in quality of life scores for each social group that they lost (Steffens et al., 2016). These changes suggest that organised leisure groups are increasingly important for healthy ageing in older adults, which may require proactive management even while other capabilities (e.g., mobility or cognitive capabilities) may be in decline (Steverink et al., 2005). Older adults also often have more time to invest in leisure activities and socialising (Cornwell et al., 2008), which creates an opportunity for maintaining and improving health and wellbeing.

Organised leisure group activities have been identified as an important facilitator of diverse social networks for older adults (Chang et al., 2014), where "[p]erceptions of positive social relationships were associated with greater involvement in leisure activities, and greater involvement in leisure activities was associated with better health in older age" (p. 516). These findings have been corroborated by Fiori et al. (2006), who report that diverse networks – which include social group attendance – are most predictive of mental wellbeing, while family-intensive networks were least predictive, implying that the breadth of social contact may provide important contributions to improved wellbeing. Particular characteristics of certain leisure groups, and common in community choirs, may also contribute to improved wellbeing by specifically enhancing social connections. For example, creating a shared emotional state, a common experience in joint musical experiences (Egermann & McAdams, 2013; Peltola, 2017), has been shown to increase a sense of social bonding (Páez et al., 2015). Indeed, music engagement has been linked to an increased sense of social cohesion (Cross, 2007; Loersch & Arbuckle, 2013; Schäfer & Eerola, 2018) and empathy (Fukui & Toyoshima, 2014; Greenberg et al., 2015). Social interaction is therefore likely to be a key component of wellbeing benefits from choir membership. Several empirical studies corroborate the claim that choir participation increases social cohesion. Dunbar et al. (2012) demonstrated that active music co-creation, including group singing, increased pain tolerance to a similar level to that experienced with a dance condition, while passive music listening did not. Pain tolerance is often used as a proxy measure of oxytocin levels, since elevated levels of oxytocin are implicated in both increased pain tolerance and sense of social bonding (Johnson & Dunbar, 2016). Weinstein et al. (2015) reported that singing in both small community choirs and a larger combined choir increased pain tolerance and self-reported ratings of social bonding. Coordinated movement is another aspect of group singing (Himberg & Thompson, 2009; Müller & Lindenberger, 2011; Phillips-Silver & Keller, 2012) known to increase a sense of social cohesion (Codrons et al., 2014; Jackson et al., 2018; Müller & Lindenberger, 2011; Valdesolo & DeSteno, 2011).

Many exercise groups share similar characteristics to choirs, including music exposure, coordinated movement and social opportunities. Exercise groups have also been found to improve subjective wellbeing and quality of life in older populations (Rennemark et al., 2009), with participation in exercise correlated with reduced depressive symptoms (Lindwall et al., 2007), and overall psychological wellbeing and mood (Hassmen et al., 2000; McIntyre et al., 2020). Similar to choirs, exercise groups have also been found to increase a sense of social cohesion (Dunlop & Beauchamp, 2011; Tunçgenç & Cohen, 2016) and expression of pro social behaviours (Di Bartolomeo & Papa, 2019). There are also indications that group exercise increases oxytocin levels in a similar manner to group singing (Rassovsky et al., 2019), which may therefore be expected to have a similar effect on pro-social behaviours (MacDonald & MacDonald, 2010). Furthermore, while choir participation incorporates a physical activity through the act of singing, exercise classes provide heightened experiences of movement which is often synchronised with other group members. There are also indications that the intensity of exercise may influence these effects (Davis et al., 2015).

Music-based emotion regulation

The use of music for emotion regulation (Juslin & Sloboda, 2010; Moore, 2013; Schäfer et al., 2013; Thoma et al., 2012) could also account for improvements derived from choir participation. Music has a powerful impact on mood (Menon & Levitin, 2005; Rickard, 2012; Schäfer et al., 2013), which appears to be heightened when shared with others (Weinberg & Joseph, 2017). A growing body of evidence indicates that choir participation improves emotional wellbeing (Clift & Hancox, 2010; Daykin et al., 2018; Sandgren, 2009), including for older adults (Coulton et al., 2015; Lamont et al., 2017; Lee et al., 2016). Most exercise classes also incorporate music, which can provide music-related wellbeing effects, provided individuals enjoy and are engaged in the music (Hallam, 2012; Van Den Bosch et al., 2013). A review on the effects of music listening during exercise found that music enhances affect and psychological wellbeing amongst other benefits (Karageorghis & Priest, 2012).

Motivation and flow

While there is great variation in how individual groups are structured, both choirs and exercise groups can offer opportunities for social interaction and cohesion, music-related emotion regulation and coordinated movement, each of which may explain benefits for wellbeing. However, several comparison studies have shown that choir participation does not necessarily yield wellbeing benefits superior to leisure activities that do not comprise these key elements. For example, when choirs have been compared to cooperative Lego building (Allpress et al., 2012), creative writing classes (Dingle et al., 2017), and listening to a choir (Unwin et al., 2002), no discernible differences between groups on wellbeing measures were found. Similarly, a meta-analysis identified similar reductions in perceived stress for both exercise group participants and those who practiced mindfulness (Díaz-Silveira et al., 2020).

Self-determination theory (SDT) argues that perceived autonomy, feeling competent, and a sense of relatedness (that is, that an individual's contribution is meaningful and valued by others) is fundamental to wellbeing across the life course (Ryan, 2009). Employing an SDT frame highlights the critical role that preference and choice may play in wellbeing improvements for an individual. A sense of being 'forced' into participation, or being motivated extrinsically to participate, may undermine a sense of autonomy, competence and relatedness, thereby countering any benefits for wellbeing. Similarly, wellbeing is predicted to be higher when an individual is intrinsically motivated, or at least choosing to engage in an activity (e.g., in cases of identified regulation, in which the outcomes of participation are the motivator), than when extrinsically motivated or not motivated at all (e.g., amotivation) (Deci & Ryan, 2008; Guay et al., 2000).

Intrinsic motivation is also associated with engagement in an activity, and, at its best, can lead to a sense of 'flow', characterised by enjoyment of the activity, intense concentration, a sense of mastery, and a distortion of time passing, which can be particularly positive (Nakamura & Csikszentmihalyi, 2004). Flow has been reported quite regularly by individuals engaged in music production (Chirico et al., 2015; De

Manzano et al., 2010), and this experience has been linked to wellbeing improvements (Fritz & Avsec, 2007). It is also commonly experienced in exercise settings (Jackson et al., 2001; Swann, 2016), and may be enhanced in group settings as opposed to individual endeavours (Decloe et al., 2009; Walker, 2010). It could therefore be that individual motivation for participating in an activity influences wellbeing outcomes, with those who are intrinsically motivated gaining greater benefits. Hence, an individual's disposition towards the activity may be a critical factor for consideration, rather than just the choice of a particular leisure activity (such as 'choir' or 'exercise' group). Comparison of choir members with solo singers, solo instrumentalists, solo exercise, ensemble instrumentalists and members of sports teams found that self-reported wellbeing measures did not differ across any of the activities, but that using a SDT framework highlighted that choir members had lower ratings of autonomy than those participating in other activities (Lonsdale & Day, 2020). The authors suggest that individuals may be willing to forego autonomy when choosing to participate in a social group activity that appeals to them.

A third option is that wellbeing improves when there is a good fit between the activity's characteristics and individual attitudes or motivation. The concept of person-activity fit (Lyubomirsky & Layous, 2013) accounts for both the components of the activity as well as the motivation, engagement and enjoyment experienced by the individual. In this model, wellbeing is not mediated solely by the activity nor by individual attitudes, but rather is dependent on the congruence, or fit, of the two. Person-activity fit was developed to consider specific interventions such as gratitude journals, savouring life's joys and acts of kindness (Thompson et al., 2015), however it may be a useful construct to understand how social group activities and individual motivation interact to improve wellbeing (or not).

The current study

In the current study, we explored mechanisms that might explain improved wellbeing as a result of choir membership, and how these compared to other non-singing social groups. All groups observed were self-selected social leisure groups, with choir participation (Choir group) compared with a similarly social, movement-based leisure group that incorporates music listening (Exercise group), as well as more sedentary, non-musical social leisure groups (Other group). In Study 1, motivational factors were examined as mediators of wellbeing during participation in one of three self-selected types of social group – Choir, Exercise or Other. In Study 2, rather than focusing on the group type, the key features of interest (music, exercise, social interaction) were examined in participants' daily activities independent of any social group affiliation across a two-week period to determine the importance of each element, or combination of elements, to participant wellbeing. It was hypothesised that participation in social leisure group activities (of any type on any given day) would predict increased subjective wellbeing ratings, reflecting changes in emotional state, energy levels and sense of social connection. It was further hypothesised that motivation factors (subjective ratings of sense of intrinsic motivation, identified regulation, experience of flow, autonomy, competence and relatedness) would more strongly predict self-reported wellbeing than would the type of group activity.

Method

All aspects of this research were approved by the REDACTED Human Research Ethics Committee. This research incorporates two components. Study 1 involved completing an online survey concerning experiences in one of three kinds of social groups: A singing group, an exercise group, or another kind of leisure group. An optional Study 2 required responses to two online questions every evening for 14 days.

Study 1

Study 1 examined wellbeing differences by group affiliation (Choir, Exercise or Other) as mediated by differences in motivational factors.

Participants

Social media advertisements (paid) and posts (unpaid) were used to target individuals who belong to and enjoy a range of organised social groups, with a particular focus on choirs and exercise groups. In addition, the researchers directly contacted individuals who were known to participate in social groups, with a request to share the study with others. The study was described as exploring how participation in a social group improves individual wellbeing. Targeted advertising focused on an older demographic (45 years +) in the English-speaking countries of Australia, New Zealand, the United Kingdom and the United States. Individuals who were likely to be a member of a choir (Choir), an exercise group (Exercise), or another kind of social group (Other) were targeted through the social media accounts of various kinds of social groups (specifically choirs, exercise classes and other kinds of groups such as book clubs or knitting groups) or if they had expressed an interest in these activities. Social media posts encouraged people to click on the URL link to read more about the study, which included a plain language description of the research. All cases included in the analysis provided informed consent to participate.

Of a sample of 424 individuals who navigated to the survey page, 273 agreed to participate (see Figure 1 for details of participant attrition). The final number of included cases was 202, which is above the minimum advised by Tabachnick and Fidell (2013) for multiple regression analyses, in which $N > 50 + 8m$ (m=number of variables), totalling 154.

Insert Figure 1 about here.

The mean age for the Choir group was 64.9 (SD = 13.5), for the Exercise group it was 56.2 (SD = 10.0), and for the Other activity group it was 59.0 (SD = 18). A one-way ANOVA showed that there were no significant differences in age between the Exercise and Other groups, but that Choir members were significantly older than both the Exercise and Other groups, F (2, 197) = 5.98, p = .003. The Choir had a total of 64 participants (male = 14), with approximate ratios of female/male of 4:1. The Exercise group also had 64 participants (male = 12), with a female/male ratio of 4:1. The Other activities group had a total of 74 participants (male = 16, non-binary = 2), with female/male/non-binary ratios of 3:1:.05. Chi-square tests indicated the gender ratio was not significantly associated with group. Educational attainment and employment status are displayed in Table 2. A chi-square test indicated the group was not associated with educational attainment level, but was associated with employment level, with Choir members more likely to be retired than other group members, X^2 [df = 10] = 27.6, p = .002.

Insert Table 1 about here.

Because individuals were specifically recruited based on enjoyment of their leisure group activity, all leisure group types were included provided they met the descriptive criteria of 'organised', which was 'a community group of people who meet regularly (e.g., weekly) to participate in a particular activity. This could be an exercise group, a singing group, a book club, a crafting group, a sports club, a discussion group or another activity-focused group.' There were therefore a range of choir types (e.g., community choirs and church choirs) and exercise group types (e.g., aerobics or running clubs). Activities categorised as "Other" (that is, neither Exercise nor Choir) were quite diverse and included church-associated groups, voluntary associations, craft groups, gaming, Pokemon, professional associations, book clubs, acting or dance clubs, meditation, and collector's clubs. For Study 1, participants reporting activities involving strenuous exertion were excluded from the "Other" to avoid overlap with the Exercise group. Eleven cases were removed from analysis, including dance and membership in sports teams. One case was excluded due to identifying both a choir and an exercise group affiliation. Finally, one 'Other' case which identified as a member of a Pilates group was recoded as an Exercise group. This reduced the number in the Other group to 62, which brought it closer in size to the Choir and Exercise groups (n = 64 for each).

Materials, Study 1

Three scales were used to measure the wellbeing constructs of emotional state, mental wellbeing, and social cohesion. Three scales were also used to measure personal motivational attitudes towards group participation, incorporating experiences of flow, the components of self-determination theory (competence, autonomy and relatedness), and type of motivation (intrinsic, extrinsic, identified regulation and amotivation). Further information on all scales is provided in Table 2.

Insert Table 2 about here.

Procedure

A plain language statement explained that the research was interested in how membership in organised social groups may improve wellbeing. Participants were informed that participation was voluntary and that they could withdraw at any time. Only those who provided consent to participate were directed to the surveys. Surveys were administered via the Qualtrics© software platform and were completed at a time and place of the participants' choosing and took an estimated 10 – 15 minutes to complete.

An organised social group was defined as "a community group of people who meet regularly (e.g., weekly) to participate in a particular activity. This could be an exercise group, a singing group, a book club, a crafting group, a sports club, a discussion group or another activity-focused group." Because some participants may belong to more than one organised social group, they were asked at the start of the survey to select the one group that they think improves their overall sense of wellbeing most, and answer the survey with their experiences of that particular group in mind. They were then asked to identify what kind of group this was: a singing group, an exercise group, or another kind of group (specified). They were also asked how often their group generally met: weekly, fortnightly, monthly, or other (specified).

Data Analysis

All analyses were conducted using SPSS version 26. A series of mediated regression analyses were run using the PROCESS version 3.4 add-in (Hayes, 2019), which explored whether: a) any of the wellbeing outcomes - positive affect, negative affect, social cohesion and mental wellbeing - were mediated by any of the proposed mechanisms - motivation and flow; and b) whether the mechanisms differed by group. Due to the nominal nature of the Group Participation variable, three sets of analyses were conducted; the first compared Choir to Exercise, the second compared Choir to Other activity, and the third compared Exercise to Other activity. Comparing both Choir and Exercise groups against the Other group allowed for a contrast of groups that incorporate music listening and movement to groups that are, taken as a whole, more sedentary and less likely to incorporate music and movement as part of the core activity. See Figure 2 for the testing model.

Insert Figure 2 about here.

The analyses tested for the total effect of Group on the outcome variables (wellbeing markers), the direct effect of Group on outcome variables (that is, unmediated) and the indirect effect of Group on outcomes variables (that is, mediated by one of the proposed mechanisms), employing bootstrap confidence intervals. Indirect effect tests also determined whether the mediation was explained by an unidentified mechanism that was not included in the study design. This process aligns with contemporary approaches to testing for mediation effects (Hayes, 2009; Meule, 2019; Zhao et al., 2010).

Results

The data set was checked to ensure the assumptions of multicollinearity were not violated. The independent variables of intrinsic motivation and identified regulation were highly correlated, r=.712, as were autonomy and competence, r=.777. This is below the suggested threshold for multicollinearity of r=.9 (Pallant, 2016), and the Tolerance and Variance Inflation Factor (VIF) were also found to be normally distributed. There were no instances of singularity.

All variables demonstrated normality and linearity with the exception of negative affect, which exhibited non-normal distribution in scatterplots and probability. Attempts to normalise the distribution via logarithmic transformations were unsuccessful (Tabachnick & Fidell, 2013), so the raw data were maintained. While caution should be taken in interpreting results for negative affect, it should be noted that in non-clinical populations, low levels of negative affect are normal (Crawford & Henry, 2004; Diener & Diener, 1996). One case from the Other activity group was found to be an extreme outlier on several measures and exceeded the Mahalanobis distance critical value of 27.9 and was therefore excluded from the analysis. Preliminary checks indicated there was no correlation between any outcome variable and gender, but age was found to correlate with negative affect and mental wellbeing. Age was therefore entered as a covariate for these analyses only.

The mediated regression analysis comparing Choir to Exercise group members showed no direct effect of group on any outcome. When the Choir was compared to the Other group, analysis showed that membership in a Choir predicted changes in emotional wellbeing only, with no effects for either mental wellbeing or social cohesion. There was a significant total effect between choir participation and PA scores, b = 3.199, p = .007, CI [0.876, 5.523], but no direct effect. Choir participation predicted changes in PA through a significant indirect effect of intrinsic motivation, b = .920, CI [0.026, 2.352]. Choir membership also predicted changes in NA, with a significant total effect, b = -1.129, p = .041, CI [-2.13, -0.045]. No significant direct effect of choir membership on NA was observed. The mediated regression analysis revealed no significant indirect effects of choir membership with any of the tested mediators to explain changes in NA. Since the direct effect of choir membership on negative affect was not significant, the significant total effect may be explained by an unidentified mediator which was not measured in this study. There was no mediation through flow, competence, autonomy, relatedness, or identified regulation.

The analyses comparing Exercise group to Other group membership also revealed significant relationships for emotional wellbeing outcomes. The total effect for PA was significant, *b* = 3.5456, *p* = .003, CI [1.228, 5.861]. However, there was no direct effect between Exercise group membership and PA. Exercise group membership predicted changes in PA through a significant indirect effect of flow, *b* = .452, CI [.001, 2.374], intrinsic motivation, *b* = .689, CI [.024, 1.794], and identified regulation, *b*= 0.994, CI [.001, 2.374].

The total effect for Exercise group membership was also significant for NA, *b* = -1.456, *p* = .007, CI [-2.505, -0.406]. There was a significant direct effect of group membership on NA, *b* = -1.193, *p* = .046, CI [-2.661, -0.020]. The mediated regression analysis revealed no significant indirect effects of exercise group membership with any of the tested mediators to explain changes in NA. Some of the change in NA associated with Exercise group membership may therefore be explained by a mediator not contained in our model.

Exercise group membership also predicted changes in mental wellbeing with a significant total effect, *b* = 1.583, SE = .738, *p* = .034, CI [.121, 3.048]. There was no direct effect, but flow mediated this relationship, *b* = .539, CI [.067, 1.30].

No total or direct effects were observed for the other outcome variables or social cohesion. However, when comparing Choir to Other groups, intrinsic motivation was found to negatively predict social cohesion scores, *b* = -.090, SE = .053, CI [-.211, -.009] while autonomy was found to positively predict social cohesion scores, *b* = .108, SE = .069, CI [.000 - .268]. When comparing the Exercise group to Other groups, identified regulation was predictive of social cohesion, *b* = 0.076, SE = .045, CI [.005, .177].These effects did not, however, contribute significantly to overall social cohesion scores for either group.

Figure 3 summarizes the significant outcomes for both Choir (A) and Exercise group (B) membership.

Insert Figure 3 about here.

Study 2

Study 2 examined daily fluctuations in wellbeing as a result of participation in the core activities of interest – music and exercise – as well as whether these activities were done alone or with others. Group affiliation was therefore not a consideration for this study. The ESM enabled wellbeing to be assessed as a function of the activity characteristics for each day as they varied across the 14 day period, considering music (or no music), exercise (or no exercise) and socialising (or no socialising).

Participants

At the completion of the Study 1 surveys, participants were invited to participate in a second study. One hundred people indicated interest and provided an email address. Eligibility for the study required at least three daily responses to be completed, resulting in a sample of 59 participants; 9 males, 49 females, 1 non-binary, mean age 58.95 (SD = 9.94).

Materials

Fourteen individual daily surveys were created for this study. The survey for Day 1 started with only two demographic questions of sex and age. The two survey questions that followed were identical for all 14 days. Question 1 asked about mood using three indices, responding using a drop-down Likert scale: "What's your mood now?" (1 = low, 7 = high): Happy, Socially Connected, Active. The second question asked about activity during the day: "What have you been doing today? Check all that apply (or none)." Options were:

- I've exercised by myself
- I've been singing by myself
- I've listened to or made music by myself (e.g., listening to the radio or practicing an instrument)
- I've attended an exercise class
- I've been singing in a choir

- I’ve listened to or made music with other people (e.g., music was playing in an exercise class or I played an instrument in a band)
- I’ve participated in another kind of group activity (please specify):
- I’ve not done any of these things today.

Procedure

Participants were asked to provide their email address and country of residence. Email addresses were entered into an automated email system on the Qualtrics© platform, grouped by region: Australia/New Zealand (40 participants), United Kingdom (32) and North America (29). Each email address was assigned a number code to anonymise responses. Once a day for two weeks an automated email was sent out to all participants, timed to coincide with early evening for their region (between 4 – 8 pm). Each email contained a link for that day’s survey, available via Qualtrics©. Participants were encouraged to respond to the survey in the evening when all activities were completed, were requested to not respond retrospectively, and told that if they were busy they could skip the day’s survey. Participants were also told in each email that they could opt out at any time, and a link was provided to be removed from the email list. The survey was designed so that it could be completed on a smart phone, to make it easy to quickly respond in the evening.

Data Analysis

Individual daily responses were downloaded and matched using the pre-assigned codes. Due to the optional nature of each daily survey, there was variability in the number of surveys completed across individuals. There were almost twice as many high responders (those who responded for 10 or more days of the 2-week survey) than medium- to low-responders (responses for 9 days or fewer). Since state wellbeing varies by individual, it was important to control for number of responses; otherwise, individuals who were high responders may bias the findings. Therefore, individual ratings were averaged based on the activity or combination of activities that each participant had participated in each day.

Questions of activity covered musical activities, exercise, or another kind of activity. In addition, these activities could be performed alone or with an organised group. On any given day, an individual may participate in multiple activities. Therefore, there was the potential for multiple combinations of activities for any given day. To maximise information generated by these analyses, the categories were combined into three primary activities:

1. Music activities, including any music activity a participant made note of, e.g., music listening, playing an instrument, or singing alone or with others.
2. Exercise activities.
3. Participation in any organised social groups.

Summarising the data in this way allowed for isolating the effect on the wellbeing markers of the three primary activity conditions: music vs. no music, exercise vs. no exercise, and group activity vs. no group activity.

A series of repeated measures t-tests (with two-tailed alpha set at .05) were run to compare "any" versus "none" activity involving music, exercise and group, using SPSS version 26.

Results

Results are presented in Figure 4, displaying the Mean (Standard Deviation) for ratings of Happy, Connected and Active, and the t-test results.

Insert Figure 4 about here.

Days containing any music engagement yielded significantly higher ratings of 'Connected' than days containing no music engagement, t (47) = 2.03, p = .048. No differences were observed in 'Happy' or 'Active' ratings for activities containing or not containing music. Activities containing exercise yielded significantly higher ratings for 'Happy', t (41) = 4.86, p = .000, 'Connected', t (41) = 3.95, p = .000, and 'Active', t (41) = 8.40, p = .000 than did activities not containing exercise. Activities containing group interaction also yielded significantly higher ratings for 'Happy', t (43) = 2.75, p = .009, 'Connected', t (43+ = 3.94, p = .000, and 'Active', t (43) = 4.59, p = .000, than did activities not containing group interaction.

Discussion

This research provides insight into how participation in choirs and other social groups might be associated with improvements in wellbeing, which has implications for how individuals are advised concerning participation in particular types of leisure group activities. We explored two categories of mechanisms that may explain wellbeing changes as a result of choir participation: those related to the group characteristics itself, which included the presence of music, physical movement, and socialising; and those related to individual attitudes towards participation, which included flow, motivation and the components of self-determination theory. Furthermore, choirs were compared to exercise groups, which incorporate some of the same activity characteristics, and other kinds of groups, which were less likely to do so, to determine whether wellbeing benefits were achieved by a range of social group activities through similar mechanisms.

In Study 1, both choir and exercise group participation predicted changes in emotional wellbeing, while exercise group participation also predicted changes in mental wellbeing. No significant changes in social wellbeing were found as a result of membership in either group. Intrinsic motivation was a mediator for changes in positive affect for the Choir group members, while for the Exercise group members positive affect was mediated by flow, intrinsic motivation and identified regulation. Although the mediators differed by group type, the outcome for positive affect was the same. Both groups also registered changes in negative affect, partially explained for the Exercise group by a direct effect. The Exercise group also registered changes in mental wellbeing, mediated by flow. While a direct comparison of Choir and Exercise groups failed to reveal any differences between the two groups, only the Exercise group registered a change in mental wellbeing as a result of group participation. The lack of direct effect by group on any outcome when Choir and Exercise group members were compared directly to one another may reflect the similarity of activity-based mechanisms (social opportunities, music listening and movement) as well as the effects of exercise in general on wellbeing and mental health (De Moor et al., 2006; McAuley et al., 2000; Windle et al., 2010). Surprisingly, intrinsic motivation was the only mediator that explained changes in wellbeing for the Choir group, with no mediation identified through flow, competence or relatedness. Autonomy was a significant contributor to social cohesion although this did not contribute to a significant total effect. Surprisingly, intrinsic motivation was found to be a negatively significant contributor to social cohesion. Study 1 therefore found that Exercise group participation both had wider-reaching positive impacts on wellbeing outcomes and that these outcomes were achieved through a more diverse range of mediators.

In Study 2, participating in activities which included music engagement yielded significantly higher levels of social connection than did activities not containing music engagement. Participating in activities that contained exercise or any kind of social interaction, however, yielded significantly higher levels of social connection, happiness and activation when compared to no exercise or group activity in a day. Taken together, the findings from these studies indicate that changes in wellbeing are influenced by both characteristics of the group activity and individual attitudes towards participation – specifically motivation. Exercise and group interactions appeared to provide broader contributions to improving wellbeing than music engagement. This finding indicates that the primary mechanisms that underlie wellbeing improvements may be shared by a range of social group or exercise activities, rather than being specific to choirs. Changes in wellbeing for choir participation may therefore be mediated more so by individual attitudes towards participation than the components of the activity itself. Our findings point to intrinsic motivation as a primary contributor to wellbeing for Choir members. Taken together, this research supports an ecological model of person-activity fit as proposed by Lyubomirsky and Layous (2013), in which both the motivation and attitude towards participation as well as the characteristics of the activity itself are considered.

The role of social group participation is central to building strong, diverse social networks, which is an important determinant of health. For older adults, who may be losing social opportunities through such changes as retirement or reduced mobility, indications are that organised leisure activities are a core component of healthy social networks (Chang et al., 2014; Fiori et al., 2006; Steffens et al., 2016). With interventions such as social prescribing on the increase, this research provides an important contribution to understanding how individuals receive wellbeing benefits from participation. However, these studies highlight the importance of also considering motivation for an individual to participate in a social group. The research participants who belonged to choirs tended to be intrinsically motivated, finding enjoyment in the activity itself. In contrast, exercise group members were self-motivated to participation through intrinsic motivation and also through identified regulation, by appreciating the outcome achieved from the activity (e.g., better health), which may be linked to goal striving and sense of achievement. Exercise group members also experienced flow while Choir members did not. While there were differences in motivation, self-motivation for participation appears to be a key mediator in wellbeing outcomes of social group participation.

Overlaid with motivation, this research found that providing social opportunities elevated ratings of mood, social connection and energy. Organised leisure groups could therefore be specifically designed to maximise social interactions, rather than focusing exclusively on the core activity. This could include such elements as asking participants to exchange greetings with at least three other people, providing a break time at the mid-point, or providing snacks at some or all meetings. There are also indications from previous research that social ties themselves can keep people committed to leisure group activities in the absence of intrinsic motivation (Beauchamp et al., 2007; Beauchamp et al., 2018; Maury & Rickard, 2020). In settings where the core activity is expected to provide other important benefits, for example, the beneficial impact of exercise on physical health, strengthening social ties may be a strategic avenue for maintaining commitment to the activity in the absence of intrinsic motivation.

Mood, sense of connection and energy levels were also raised on days in which participations reported exercising in this study. Therefore, directing people to activities that provide more rather than less movement and exertion would be recommended, bearing in mind that such exertion needs to be commensurate with individual capabilities. Choirs could also capitalise on this effect through deliberately encouraging increased movement through such additions as hand clapping or swaying during singing sessions. Music engagement provided an elevation in sense of social connection, so, where practical, social opportunities could include music as well. Where music is not a core component of the activity, however, it should be introduced with caution, since benefits of music are directly associated with preference. Playing music that is unpleasant to some group members may have the opposite intended effect (Jezova et al., 2013; Salimpoor et al., 2009).

It was a surprise that Study 1 did not reveal any significant relationship with sense of social connection for Choir members, while conversely in Study 2 it was the only wellbeing marker to register a significant change from music engagement. It is worth noting, however, that Study 2 incorporated music engagement in the broadest sense, rather than being confined to choir experiences. Conversely, the ESM data did not reveal that music engagement was associated with improvement in mood; this is surprising in light of findings in other studies which report that music is primarily used to regulate mood (Moore, 2013; Saarikallio, 2011; Thoma et al., 2012). However, it could be that this finding is due to the focus of this research on social groups. Because we recruited individuals who participated in social group activities, it is possible that the sample was skewed towards people who enjoy social interactions. For this group, it may be that music serves as a proxy for social interactions, and as a result boosted their connectedness scores above the exercise group's scores. This hypothesis is supported by research conducted by Schäfer and Eerola (2018), which indicated that individuals use music listening, watching television and reading fiction as a kind of 'social surrogacy' that serves as a proxy when there are not opportunities to socialise. Furthermore, when an individual feels sadness and loss, listening to affect-congruent music can provide an empathic proxy; listening to sad music resulted in reduced sense of loneliness, a rise in empathy and an improvement in mood (Schäfer et al., 2020). There is, therefore, an emerging understanding of how people may use music to feel socially connected, particularly in times of isolation. For the people in the current study, who enjoyed their social group participation, music use may have become more salient on days when they were not able to attend their group.

Limitations and further research

The Choir sample was older than the Exercise and Other group members, and they were also more likely to be retired. This may have influenced findings, since it may account for differences in valuing social group participation. For example, older people who are retired may place a greater value on leisure activities and social opportunities since they do not benefit from camaraderie in the workplace. It could also be that an older cohort has reduced levels of wellbeing, for example due to chronic illness or restricted mobility. Differences between the groups should therefore be considered with the demographic differences in mind.

This research deliberately recruited individuals who enjoy their social group participation, due to the focus on understanding wellbeing effects. This bias in recruitment means that findings may not be generalisable to individuals with little interest in social opportunities or leisure group participation. It is important to consider findings and implications within this limitation; for social prescribing or enforced participation (e.g., in a school or institutional setting) such considerations are paramount. It could be that strong and diverse social connections are important health and wellbeing protections for people who enjoy such interactions, but not for those who prefer solitude. Because loneliness is the discrepancy between desired and actual social interactions (Ong et al., 2016) rather than a quantifiable amount of time spent alone, understanding the differences between loneliness and solitude could be an important component of successful social prescribing. Furthermore, loneliness can be addressed in a variety of ways; it could be that social group participation does not suit the preferences and motivations of all people who are socially isolated. Many people, including older adults, enjoy episodes of positive solitude, which, in line with the findings from this research, is dependent on individual choice and preference (Ost Mor et al., 2020).

While a wide range of leisure group activities were included in this research, there was not adequate disaggregation of those types which were included in the 'Other' category to understand how participation in social groups that are neither exercise-based nor a choir may improve wellbeing. This research was conducted on the assumption that choir and exercise participation would provide heightened benefits when compared to other groups that may not incorporate music and movement. However, groups that lack these components nevertheless provide important social experiences while also potentially providing opportunities for self-directed motivation that may be linked to experiences of flow, or may provide individuals with a sense of autonomy, competence and relatedness, for example. In addition, previous research on leisure groups emphasise that quantity – the number of leisure activities – is a critical protective factor for health and wellbeing (Chang et al., 2014; Steffens et al., 2016). Further research could focus on how more sedentary social groups contribute to individual wellbeing, and whether the key to improvements is in quantity over quality. Because this research did not consider the quantity of social groups for each participant, this omission could have been a confounding factor in Study 1, which was focused on group affiliation, despite the instructions to respond with one chosen group in mind. For individuals who participate in diverse and multiple groups, wellbeing effects may be heightened with no clear pathway attributable to one individual group.

Findings point to heightened sense of wellbeing on days when individuals exercised when compared to days with music engagement. It therefore appears that movement may be an important contributor to wellbeing. What this research did not consider is what aspect of movement is the primary contributor – physical exertion or synchronicity, both of which have been shown to improve wellbeing measures. Further research could examine how these two components of movement independently contribute to subjective wellbeing, to better under the contributions of each. Better understanding these differences could assist other types of groups to incorporate the appropriate aspects of movement into their activity; for example, choirs could emphasise coordinated movement such as clapping hands or swaying. When considering movement in relation to social groups, individual capacity should be considered as an aspect of person-activity fit. For the older adults who were choir participants, the level of movement afforded in their singing group may have been more appropriate even if the wellbeing effects were reduced.

In Study 1, changes in negative affect were not explained by any of the mediators that were tested. Further research is therefore needed to identify what mediators do explain changes in negative affect – or indeed may also influence other aspects of wellbeing. The dual passion model (Vallerand, 2012), in which harmonious passion – where there is a balanced and intrinsic approach to the activity – improves wellbeing and sense of meaning while obsessive passion – where one is consumed by the activity at the expense of engaging in other valuable life domains – may undermine such benefits, is one possible mechanism that was not explored in this study. Hence, understanding the quality and frequency of involvement in the activity and how it impacts individual life balance is also important. Another possible mechanism is social identity, in which an individual feels a strong sense of affiliation with the group and/or individual members (Haslam et al., 2012; Jetten et al., 2014). Social identity may explain the wellbeing changes for Exercise group members despite the lack of intrinsic motivation, as the commitment to the group may provide a proxy motivation for continued group participation. Such a displacement of commitment from the activity to the group may have important implications for commitment to group activities such as exercise, where there is a value to participation beyond wellbeing effects. There is evidence for both social identity (Haslam et al., 2016; Iyer et al., 2009) and harmonious passion (Philippe et al., 2009; Schellenberg & Bailis, 2015) as mediators of improved wellbeing.

The ESM component of the research returned a rich data set, however it was limited by low rates of choir participation during the data collection timeframe, when many northern hemisphere participants were on break from choir practice. It would be worth replicating this aspect of the research within a timeframe that provided more days of choir participation, in order to allow a more robust direct-comparison data with other kinds of social groups. This data set was also collected prior to the onset of the Coronavirus pandemic; since that time, many leisure groups have been cancelled or moved to an online format. The mechanisms identified in this research may operate differently in an online context, which warrants further exploration.

Conclusion

This study contributes to the current knowledge base in two primary ways. First, it elucidates how wellbeing of older adults is improved by participation in several different types of leisure group activities, and whether any improvements are achieved through similar mechanisms. Second, the findings assists programs such as social prescribing or activities provided in retirement communities or similar settings to effectively direct people to social groups which will be of maximum benefit to them, considering the optimal fit between activity characteristics and personal motivation.

The findings presented here provide an understanding of how social group participation in general, and choir membership in particular, impacts wellbeing. For practitioners, this information is valuable as it demonstrates that the activity characteristics of movement, music and social opportunities are more likely to have a positive impact on emotional wellbeing. However, it is equally critical to understand individual motivation for participation; forcing participation where an individual either does not enjoy or see the personal value of participation is unlikely to result in wellbeing improvements. Person-activity fit, an ecological model that considers both individual motivation and the activity characteristics, therefore best accounts for our findings. This has important implications for both practitioners and social prescribing endeavours when the goal is enhanced wellbeing, pointing to the need for meaningful consultation and access to varied opportunities.

Figure 1

Flowchart of attrition in Study 1 sample. Figure created using Lucid.

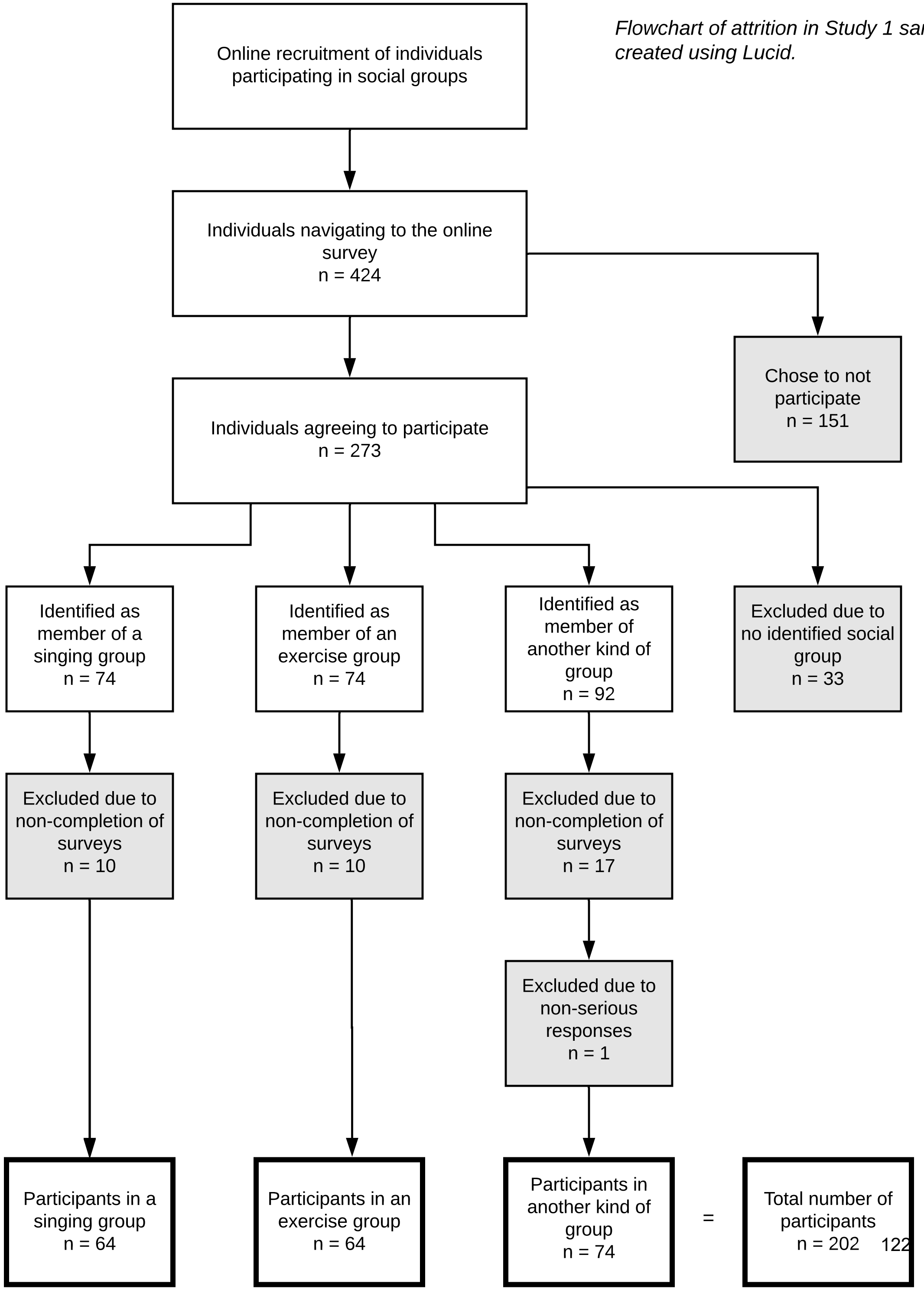

Figure 2

Model for testing mediators of wellbeing outcomes by social group participation type. a = relationship between group participation and mediators; b = relationship between mediators and outcomes, c' = direct effect of group participation on outcomes, and c = total effect (c' + a x b) (Meule, 2019). Figure created using Lucid.

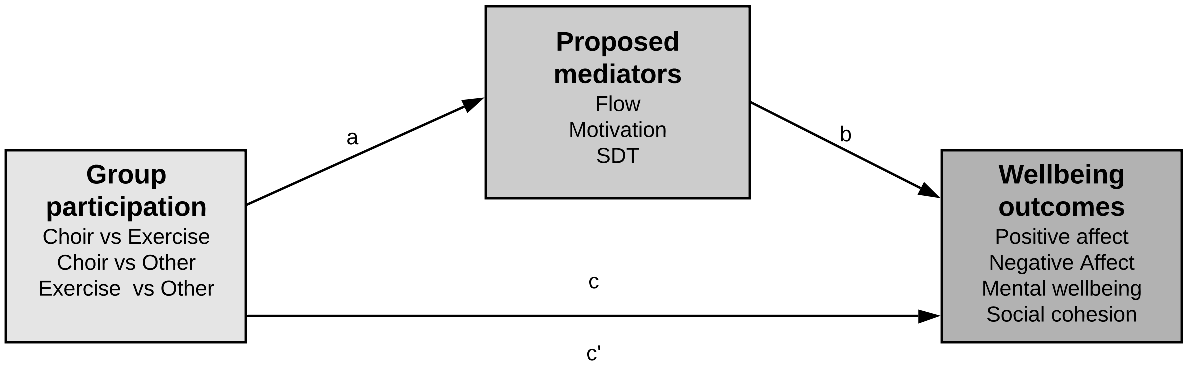

Figure 3

*Significant pathways of mediated wellbeing changes for Choir participation (A) and Exercise Group participation (B). (a) = relationship between group and mediator, (b) = relationship between mediator and outcome variable, (c) = direct effect of group on outcome variable, and (c') = total effect. Coefficients are reported for all significant pathways, with asterisks indicating the strength of significance: *significant at < .05**significant at < .01. Age was included as a covariate for negative affect analyses only, and was a significant contributor only for Exercise group associations. Figure created using Lucid.*

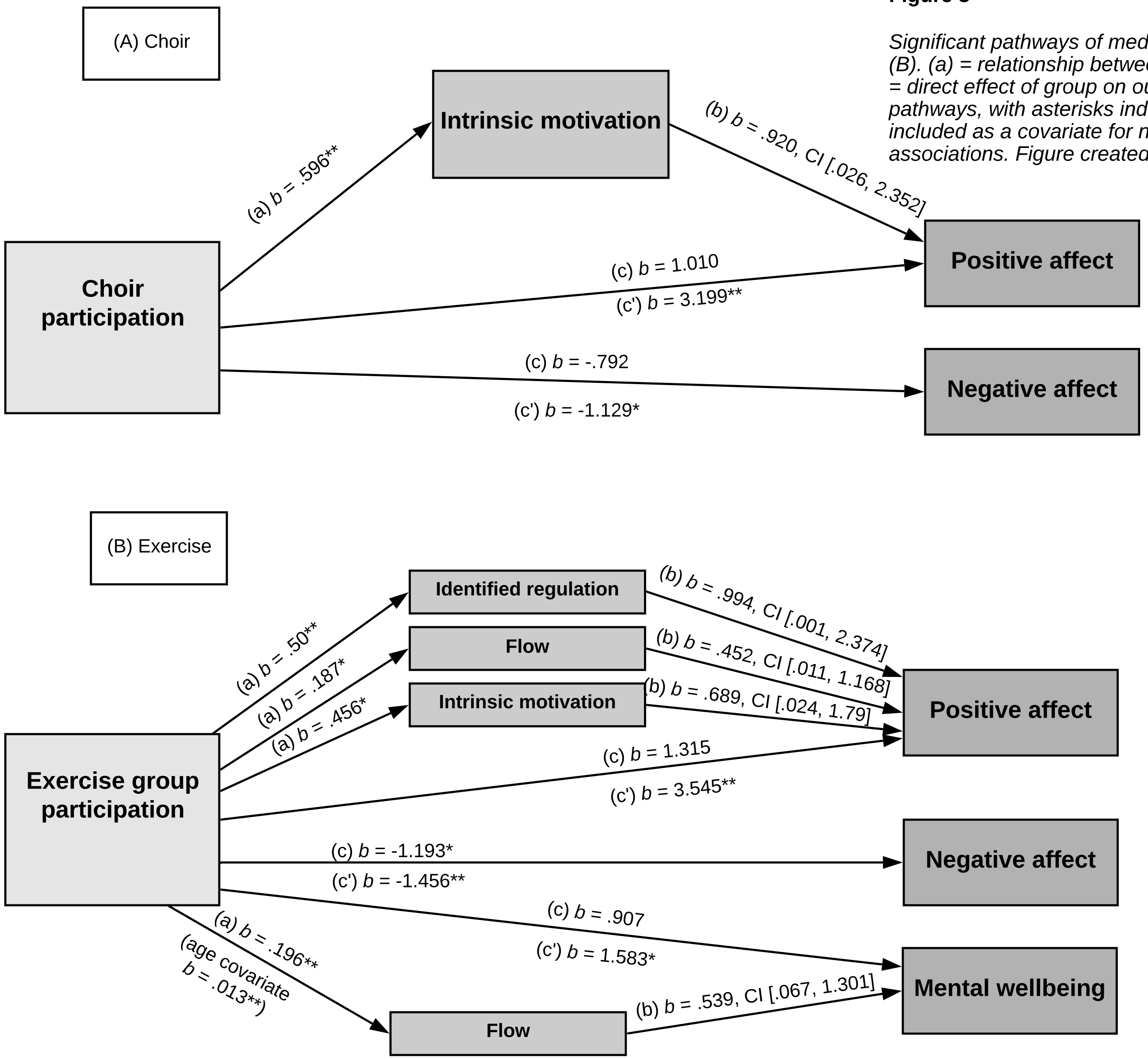

Figure 4

Daily ratings on Happy, Connected, Active with the presence of absence of music (n=44), exercise (n=42) and group (n=44) activities. Graphs creates using Prism.

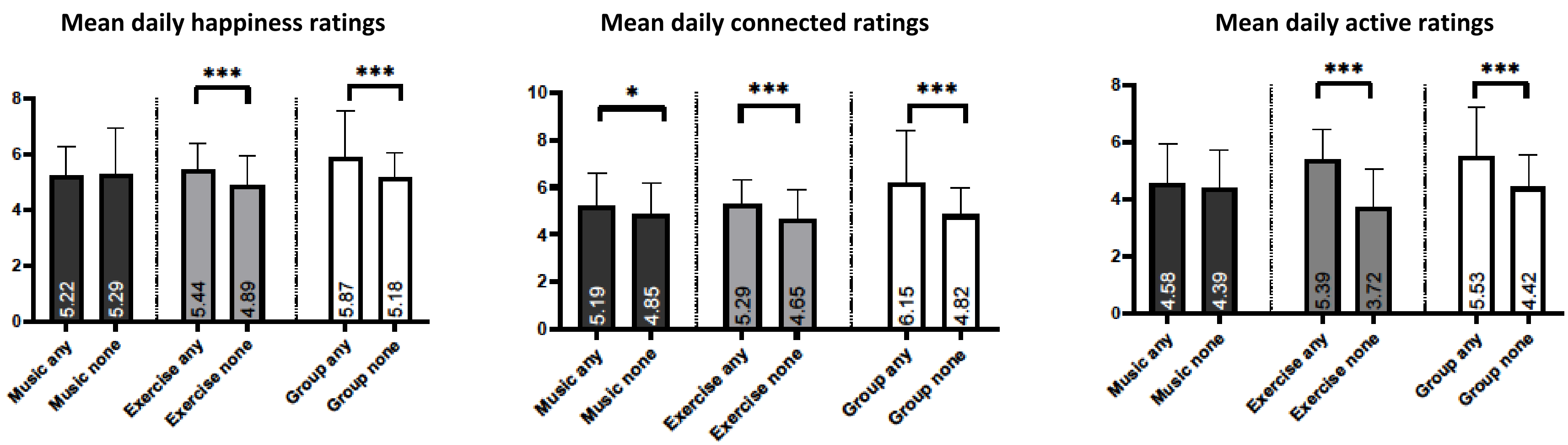

Table 1

Demographic frequencies for Choir, Exercise and Other groups

	Choir		Exercise		Other	
	Frequency	%	Frequency	%	Frequency	%
Educational attainment						
No higher than year 10 of high school	1	1.6	1	1.6	2	2.7
Completed high school/ year 12	4	6.3	4	6.3	4	5.4
Completed apprenticeship	1	1.6	1	1.6	0	0
College diploma/trade qualification	8	12.5	6	9.4	11	14.9
Undergraduate degree (4-year university degree)	19	29.7	20	31.3	17	23
Graduate diploma	9	14.1	7	10.9	9	12.2
Post graduate university degree	22	34.4	25	39.1	31	41.9
Employment status						
Unemployed (not studying)	1	1.6	1	1.6	2	2.7
Studying part-time & working part-time	1	1.6	1	1.6	2	2.7
Working part-time	11	17.2	10	15.6	13	17.6
Working full time	9	14.1	29	45.3	33	44.6
Retired	37	57.8	17	26.6	16	21.6
Other	5	7.8	6	9.4	8	10.8

Table 2

Measures of wellbeing and motivational states

Variable	Questionnaire description	Sample items and instructions	Scale Reliability
Well-being			
Emotional wellbeing	Positive and Negative Affect Scale (PANAS) (Watson et al., 1988) incorporates a list of 20 adjectives which cover both positive and negative moods. The two scales are independently analysed to provide a measure of positive and negative affect.	Positive affect descriptors include "Interested" and "Enthusiastic." Negative affect adjectives include "Distressed" and "Upset". Participants are asked to reflect on their level of mood as experienced generally during and after their social group. Responses are on a Likert scale of 1 (very slightly/not at all) to 5 (extremely).	Watson et al. (1988) report Cronbach's alpha at .89 for the PA scale, and .85 for the NA scale, with test–retest reliability reported as .79 (PA) and .81 (NA). Alphas for this study were .88 (PA) and .80 (NA).
Mental wellbeing	The Short Warwick Edinburgh Mental Well-being Scale (SWEMWBS) (Stewart-Brown et al., 2001; Tennant et al., 2007). This scale consists of seven statements reflecting cognitive, affective and psychological functioning.	"I've been feeling relaxed," and "I've been thinking clearly." Participants are asked to rate each statement based on how they have been feeling generally, over the past 2 weeks. Responses are on a Likert scale of 1 (None of the time) to 5 (All of the time).	The longer Warwick-Edinburgh Mental Well-Being Scale, with 14 statements, has a published reliability coefficient of .89. The correlation between the SWEMWBS and the long form is .95. For this study, Cronbach's alpha was .87. Prior to analysis, the scale was transformed as recommended by the creators of the scale (Warwick Medical School, 2019).

Social cohesion	The Measures of Psychological Climate, Cohesion Sub-Scale (modified) (Koys & DeCotiis, 1991) includes five statements of sense of closeness with a group. This measure was slightly modified to refer to "this group" rather than "this organisation" since it was originally designed to be used with work-based groups.	"In this group, people pitch in to help each other out," and "there is a lot of 'team spirit' amongst this group." Participants are asked to reflect on their sense of cohesion with the other members of their social group. Responses are on a Likert Scale of 1 (Strongly disagree) to 7 (Strongly agree).	Published Cronbach alphas range between .82 - .95. For this study, the alpha was .90.
Motivational state			
Flow	The Short Dispositional Flow Scale (Jackson, Martin & Eklund, 2008; Martin & Jackson, 2008) has nine statements that describe being in a state of flow.	"I am completely focused on the task at hand" and "I am not worried about what others may be thinking about me". Participants are asked to reflect on their level of experience while participating in their social group. Responses are on a Likert scale of 1 (strongly disagree) to 5 (strongly agree).	Published alphas are .82. This study had alphas of .75 for time one.
Competence, autonomy and relatedness	The Basic Psychological Needs in Exercise Scale (BPNES) (modified) (Vlachopoulos, et al., 2010) was used, which includes 11 statements that create subscales for competence, autonomy and relatedness. The statements have been slightly modified so that they are not specific to exercise, but refer to an unspecified 'group activity.'	"I feel that the way I participate in my group activity is the way I want to," and "I feel I have made a lot of progress in relation to the goal I want to achieve in my activity." Responses are on a Likert scale of 1 (I don't agree at all) to 5 (I agree completely).	Published alphas for the sub-scales are .80 (autonomy), .86 (competency) and .83 (relatedness). This study found alphas of .83 (Competence sub-scale), .85 (Autonomy sub-scale), and .85 (Relatedness sub-scale).

Motivation	The Situational Motivation Scale (SIMS) (Guay, Vallerand, and Blanchard, 2000) has 16 statements that make up four subscales to measure four unique types of motivation: Intrinsic, identified regulation, extrinsic and amotivation.	Individuals respond on a 7-point Likert scale to the prompt, “Why are you currently engaged in this activity?” Examples of statement/responses from each of the four sub-scales include, “Because I think this activity is interesting” (intrinsic); “Because I am doing it for my own good” (identified regulation); “Because I am supposed to do it” (extrinsic); and, “There may be good reasons to do this activity, but personally I don’t see any” (amotivation).	Published alphas for the sub-scales range between .87 - .93 (intrinsic) and .67 - .84 (identified regulation). This study reports on intrinsic motivation and identified regulation sub-scales, since the literature indicates that the other types of motivation would not correlate to a sense of wellbeing. Alphas for this study were .87 (Intrinsic sub-scale) and .73 (Identified Regulation sub-scale).

Chapter 8: General discussion

This chapter provides a summary and integrated discussion of the research presented and its broader implications for understanding the wellbeing benefits of group singing in supporting older adults to age well in contemporary society. The research reported in this thesis explored whether community choir participation elicits immediate and persistent benefits for wellbeing in older people, and whether these changes are superior to those experienced by other social groups which share some of the nonspecific characteristics of the choir experience. An attempt was also made to clarify whether the mechanisms underlying any benefits observed are similar across choir and other social leisure group activities, and the relative importance of the activity characteristics (e.g., music, movement, or social connection) to this effect as opposed to individual differences in mindset (e.g., motivation, agency, experiences of flow). Findings are reviewed in light of previous research as well as the evolutionary theories that provide the framework for the studies.

Summary of Findings

The next section provides a summary of findings organized by the three broad research aims. This is followed by a reflection of the findings within the context of previous research.

Immediate effects of choir participation for wellbeing in older adults

The first aim in this thesis was addressed in Chapter 5, which reported on the first empirical studies conducted for this thesis. In Phase 1, members of choirs, exercise groups and discussion groups were compared on changes in positive and negative affect, energy levels and sense of social cohesion just prior to and directly after a session. The exercise groups provided a comparison condition that shared some of the characteristics of the choir experience, such as music listening and movement, while the discussion groups provided a condition that had no music or movement, but nevertheless represented a social activity that individuals preferred and chose to join. Results demonstrated similar changes across all three group types, including significant increases in positive affect and social cohesion and reductions in negative affect and tiredness.

Phase 2 utilised the custom-developed observation checklist, based on the Circumplex Model of Emotion (Russell, 1980), to track observable changes in individual behaviours across time, for example facial expression or physical stance, for the choir and exercise groups at three time points – just prior to the start of the session, at the mid-session break, and post-session. This methodology had the advantage of tracking changes across a group, indicating emotion contagion and/or an increased sense of social bonding, while also providing a potentially more granular method of identifying changes across time than is provided with the psychometric measures. This methodology is a potentially unique contribution to tracking socio-emotional changes across a large group. Most observation methodologies that track changes in interpersonal interactions are designed for small groups – dyads, triads, or small teams. For example, the tool created by Bartel and Saavredra (2000) was used for work groups of not more than eight people. Bartel and Saavreda's tool was adapted for use with much larger groups for the current research, and is therefore helpful for researchers who wish to track socio-emotional changes across a much larger group in real time. Observations using this tool in the current study revealed similar socioemotional changes across both the choir and exercise groups, with a significant increase in the activated pleasant quadrant (high positive affect, high arousal). These findings confirmed the results generated by the psychometric measures, providing greater confidence in the validity of findings.

These studies indicated that group singing provided measurable wellbeing benefits in a short timeframe (pre- to post-session), and this included all areas examined – specifically, increased positive affect, reduced negative affect, a reduction in tiredness (although other energy/arousal measures were not significant), and an increased sense of social connection. However, choir participation did not provide enhanced or unique wellbeing benefits when compared to groups that share some of the non-specific characteristics of the choir, specifically exercise groups, or even when compared to groups that did not include movement or music listening (discussion groups in this case).

When comparing the findings to the short-term studies that employed a pre- to post-session timeframe of a choir to a control group reported in Chapter 3, these outcomes are not surprising. Five researchers used a choir as a refrain-from-singing control group, and these were either the same choir at different timepoints (Kreutz, 2014; Kreutz et al., 2004), one choir but with some members refraining from singing (Bullack et al., 2018), or two separate choirs in which one sings and the other does not (Sanal & Gorsev, 20014). Of these studies, only Kreutz (2014) reported significant increases in the choir condition without commensurate decreases in the refraining-from-singing condition. In designs more similar to the research reported in Chapter 5, four previous studies compared a choir condition to an alternate activity, including a group singing and a listening condition (Unwin et al., 2002), a group singing and Lego building comparison (Allpress et al., 2012), choir singing and solo singing with the same participants (Schladt et al., 2017), and a choir, solo singers and solo swimmers (Valentine & Evans, 2001). Consistent with the findings of the current research, all of these studies reported similar changes in wellbeing markers for *both* the intervention and control conditions, with the exception of Valentine and Evans, who reported significant increases in the solo swimming condition on measures of energetic arousal, hedonic tone and heart rate. The only researchers who reported contrary findings were Pearce et al. (2017), who found that singing groups felt more connected to the group as a whole from pre- to post-session when compared to creative writing and crafting groups. While these findings do not accord with those reported in the current study, it could be that the use of different measurement tools, which reflect different conceptions of social bonding, may explain the difference. While the research reported here conceived of social bonding as sense of cohesion and solidarity with the group, Pearce and colleagues parsed social cohesion into interpersonal relationships and the sense of belonging to the group as a whole. Future research could consider differing conceptions of social bonding to determine whether there is a distinctive contribution made by group singing which the current research failed to identify.

While the current research did not use physiological measures to examine short-term changes in social bonding, the studies which have done so are worth considering here. Comparing a solo singing to a group singing condition with the same participants (Schladt et al., 2017), oxytocin, a hormone implicated in the human bonding process, remained stable during the solo condition but decreased in the choir condition. This is a surprising result, and is contrary to findings reported by Kreutz (2014), although in that instance the low number of participants coupled with high variability in readings suggested cautious interpretation. Schladt et al hypothesise that the level of arousal and stress associated with the group singing condition may have negated the anticipated increases in oxytocin, although it is uncertain whether a group singing condition would be more stressful than a solo condition. There is an assumption that musical activities will increase oxytocin levels (Harvey, 2020), but a paucity of studies means that these physiological changes are not well understood. There may be more variability across musical experiences and settings that requires targeted research before these differences can be explained.

It is also worth noting research conducted by Dingle et al. (2017) which employed a distinctive timeframe for measuring changes in positive and negative affect following a session with a choir or a creative writing class for adults with chronic mental health conditions. Positive affect increased and negative affect decreased from pre- to post-session across both groups, but when the same survey was administered on the evening of the same day, the researchers reported that positive affect increases had dissipated while negative affect reductions were still evident. This design provides an indication about the short-term emotional wellbeing effects of a single session, with potential differences in positive and negative affect changes.

As predicted by evolutionary theories of the utility of music-making, the findings from the short-term study reported in this thesis indicates that group singing does provide immediate wellbeing effects. However, these effects are neither unique nor heightened when compared to other, non-musical group activities. These findings raise a number of important further questions. First, while the outcomes on the wellbeing measures were similar, it could be that the individual self-reporting in psychometric questionnaires is insufficient to detect more nuanced differences in group behaviour. The observation checklist methodology partially mitigated this possibility by employing a complementary process to track changes across the choir and exercise groups. However, it is also possible that differences in wellbeing changes between the groups exist that would not be detected by either short-term methodology. For example, it could be that immediate wellbeing effects are consolidated into persistent effects for choir members but not members of other groups. This possibility was examined in Chapter 6. Furthermore, the similar changes in wellbeing measures experienced by the less active discussion groups may point to a more critical role for individual mindset towards participation in enhancing wellbeing, such as preference, choice and motivation. This possibility was explored in Chapter 7.

Persistent effects of choir participation for wellbeing in older adults

The second broad aim of this thesis was addressed in Chapter 6, which reported research examining whether choir participation yielded longer-term wellbeing benefits. Such findings may indicate that repeated experiences of improved mood are consolidated into a more positive affective outlook, or that increases in social cohesion within the group can facilitate the development of pro-social behaviours that are expressed more generally, outside of the group. While short-term changes may be similar between singing and other kinds of leisure groups, it could be that group singing is unique in its ability to facilitate longer-term changes in individual traits.

Members of community choirs and exercise groups were administered psychometric questionnaires near the start of the year after a break from meeting in their respective social groups (a form of baseline). The questionnaires were then re-administered three months into participation in their social groups and towards the end of the year when sessions ceased (at seven months). Wellbeing measures included positive and negative affect, mental wellbeing, social connection and ratings of empathic capability. Wellbeing improvements across this longer timeframe were found to be limited to the emotional domain, with emotional wellbeing increasing from baseline to the end of the study for both groups. Unexpectedly, mental wellbeing decreased between baseline and the measures taken at midpoint. There were no changes in the social domain. These changes were consistent for both groups, with no group by time changes detected.

The mixed-methods design also embedded open-ended questions within the otherwise quantitative data collected from both choir and exercise group members at each of the timepoints. This provided an opportunity to both triangulate the responses to achieve greater confidence in the validity of findings and to achieve greater insight into participants' perceptions of the benefits of their group activity. Qualitative data revealed a notable similarity in how individuals from each group described benefits, with improved mental and emotional states, social connection, confidence and overall improved wellbeing identified for both choir and exercise group activity. A key difference between the groups, however, related to motivation, with choir group members expressing a love of the core activity – singing – while exercise group members were more likely to describe their motivation as relating to improved health outcomes, while the social connections provided by an exercise group kept them committed to regular attendance.

Participation in both choir and exercise group participation appeared to support the development of a positive affective style across the seven months of this study. This concurs with the findings reported by Pearce et al. (2015) when comparing a choir group to craft or creative writing groups, with similar increases in positive affect and decreases in negative affect for all groups within the testing timeframe, also seven months. While the authors reported that the choir condition experienced greater overall increases in positive affect, this was due to a lower baseline measure.

The findings reported in Chapter 6 do not therefore support the proposition that music-making is evolutionarily adaptive due to its capacity to consolidate a sense of social support or to facilitate pro-social behaviours. The generalizability of these findings is however limited to the scope of the current sample and methods used. Some previous studies indicate that group singing may still facilitate increased pro-social behaviours or a sense of social connection for certain populations who are underdeveloped in their social skills (Dingle et al., 2012; Rabinowitch et al., 2012), while the individuals recruited into the current studies were already very socially active, perhaps leaving little room for further improvements to be achieved. Previous research reviewed in Chapter 3 which identified significant long-term improvements in the social domain employed differing approaches and with more diverse populations. For example, mothers with post-partum depression symptoms expressed a stronger sense of belonging to the group and an increase in the parent-child bond as a result of the singing aspect of the program compared to a playgroup or no-activity condition (Perkins, et al., 2018). Pearce et al. (2015) found a choir intervention bonded faster than control conditions of creative writing and crafting, and that they also felt a stronger identity to the group (Pearce et al., 2017). Disadvantaged adults experienced connectedness both within a therapeutic choir and to the audience, which led to a greater sense of connectedness to the community and increased social functioning (Dingle et al., 2012). Finally, while not a singing intervention, a year-long school-based musical program, specifically designed to incorporate aspects that facilitate pro-social behaviours and focus on interpersonal activities, reported that the participants rated higher on two of three post-intervention empathy measures compared to a no-activity control (Rabinowitch et al., 2012). Therefore, while the outcomes on longer-term measures of consolidated social measures are not conclusive, examining broader findings indicates that musical experiences may facilitate increased pro-social behaviours or sense of social connection, however these effects may be dependent on specific measures (Pearce et al., 2017), specific populations that either have deficits or are developing their social skills (Dingle et al., 2012; Fancourt & Perkins, 2018; Rabinowitch et al., 2012), or on specific musical interventions (Fancourt & Perkins, 2018; Rabinowitch et al., 2012). More targeted research is needed to understand in what circumstances choir participation may enhance expressions of pro-social behaviours more generally.

While similar wellbeing outcomes were observed by participants in the choir group as those in other social leisure groups, the findings from this study raised the possibility that the pathway to wellbeing may differ between groups. That is, the mechanisms that facilitate wellbeing improvements resulting from choir participation may differ from those present in other kinds of social groups. This possibility helped shape the final set of studies addressed in the final Aim and reported in Chapter 7.

Mechanisms underlying effects of choir participation in older adults

Chapter 7 addressed the final Aim of this thesis by providing insight into the respective roles of the group activity characteristics (specifically music exposure, movement and social opportunities) and those of individual mindset towards participation (including motivation, experiences of flow, autonomy, competence and relatedness). Study 1 compared responses from members of choirs, exercise groups and more sedentary activities on outcomes of emotional, social and mental wellbeing pertaining to their group participation as well as their individual mindset towards participation. Participation in both choir and exercise groups predicted positive emotional wellbeing, but this relationship was found to be mediated by different mechanisms; for choir members, positive affect was mediated by intrinsic motivation but for exercise group members it was mediated by intrinsic motivation, identified regulation and flow. Flow was also found to predict changes in mental wellbeing for the exercise group members only. No changes in social wellbeing were detected as a result of participation in either group. This indicates that the role of individual mindset towards participation influences changes in wellbeing, and furthermore that these factors appear to vary by group type.

Motivation emerged as a key function of wellbeing across both group types. Intrinsic motivation reflects an inherent enjoyment in the activity, which Ryan and Deci (2000) describe as exploratory, incorporating novelty, curiosity and learning, even when there are no tangible rewards. Identified regulation, which was salient in the exercise group only, is the commitment to an activity because the outcome is valued even if the activity itself is unpleasant (Guay, et al., 2000). Importantly, both forms of motivation are self-directed, making them distinct from extrinsic motivation (applied by an external source) or amotivation (not motivated). This confirms the importance of retaining choice and agency when researching wellbeing outcomes. It also signifies the importance of providing a range of engaging options for organized leisure activities in community settings.

Because music engagement has been shown to facilitate flow states (Chirico et al., 2015), it is a surprising finding that choir members did not benefit from flow in the same ways that exercise group members did. Dunbar et al. (2012) hypothesized that practice sessions limit flow experiences. The frequent interruptions of music-making that are a normal part of choir rehearsals (along with other forms of group music-making in a rehearsal setting) may deprive participants of flow experiences, which depend on full engagement and immersion. This may explain why flow did not predict wellbeing changes for choir members, since the practice setting leads to constant interruptions; it seems likely that such interruptions are less frequent in exercise settings. The research reported in Chapter 7 found that flow, along with a direct effect, explained improvements in mental wellbeing for exercise group members and was also a contributor to improvements in positive affect. It could therefore be that lack of flow experiences may be depriving community choir participants of wellbeing improvements.

Study 2 utilised an experience sampling methodology via a daily diary which a sub-set of the participants from Study 1 completed each evening for 14 days, responding to questions of wellbeing and activity. While engaging in music activities resulted in higher levels of social connection compared to days without music activities, exercise or social activities were associated with increases in all three wellbeing outcomes of social connection, mood and energy.

It therefore appears that both salient activity characteristics as well as individual mindset towards participation – specifically, motivation and experiences of flow – contribute to improved wellbeing as a result of leisure group participation. Furthermore, there was no evidence that choir participation provided greater benefits than did exercise groups. While emotional wellbeing benefits were facilitated for both groups by intrinsic motivation, the wellbeing benefits arising from exercise appeared to be more complex, mediated also by identified regulation and flow. Furthermore, mental wellbeing benefits were also a positive outcome for exercise group members, but not choir members, suggesting that exercise may provide a broader range of wellbeing benefits than choir participation. Dunbar et al. (2012) demonstrated across a series of experiments that movement might best explain the social bonding effects of joint musical experiences (measured by pain tolerance in this instance), with greater effects for more strenuous activities. If they are correct, then it could be that the musical aspect is in fact not the primary contributor, but rather the movement is, and could explain why the exercise groups in these studies achieved similar (Chapters 5 and 6) or enhanced (Chapter 7) socio-emotional wellbeing outcomes as the choirs. This explanation also concords with the findings reported in Chapter 7 that days including exercise were more likely to have increases in all three measures of wellbeing – mood, energy and sense of social connection – than was experienced by days including music, which only increased sense of connection.

The research reported in Chapter 7 tested a limited number of potential mechanisms for wellbeing linked to motivation, experiences of flow and self-determination theory. However, there are clearly other ways to consider individual mindset to participation which may further elucidate how wellbeing is achieved through social group participation. For example, the level of engagement may explain some of the changes in wellbeing. The short-term studies reported in Chapter 5 measured music engagement; this is a separate construct from musical proficiency and, while under-studied, may explain differences in wellbeing reported in musical settings (Chin & Rickard, 2012), although it did not emerge as a moderating variable in the research reported here. Engagement in the activity itself, not merely music engagement, is also a likely candidate for mediating changes in wellbeing. Smith et al. (2020) reported that, while high levels of activity independently predicted increased wellbeing in an older population, the ability to savour – that is, to attend to and enjoy positive experiences at the time of their occurrence and to employ strategies to heighten positive emotional responses – was independently predictive of all wellbeing measures in the study, and also was found to mediate the relationship between engagement in an activity and wellbeing outcomes on measures of life satisfaction, depression, loneliness and purpose. It could therefore be that, similar to findings in musical settings, attention to and engagement in the activity itself may mediate wellbeing improvements.

Social identity theory may also predict wellbeing changes. Pearce et al. (2017) found that both singing groups and creative writing groups experienced increases in relational bonding – that is, personal connections with individuals in the group – but that only the singing condition yielded an increase in sense of connection to the group as an entity. This attachment to the group as a whole has been shown to improve health and wellbeing outcomes for adults living in a retirement community (Dingle et al., 2020), marginalized individuals (Haslam et al., 2016), people who care for a spouse with Parkinson's Disease (Forbes, 2020), and stroke survivors with aphasia (Tarrant et al., 2016), amongst others. Social identity theory is implicated in the sense of passion national sports team members display when their national anthem is played, and is connected to increased performance (Slater et al., 2018). Williams et al. (2020) reported that strength of social identification with either a choir or a creative writing group explained differences in wellbeing rather than group affiliation; social identity theory may therefore better explain how organised leisure activities improve social wellbeing. However, Draper and Dingle (2021) report that virtual choir participation as a result of the COVID-19 pandemic eroded self-reported levels of group identification when compared to in-person group singing, which may point to a complex interaction of contributing factors in supporting group identification, some of which are compromised in a virtual setting.

The current research did not explore individual personality differences, which is another pathway through which wellbeing is influenced. In a series of meta-analyses, Steel et al. (2008) found that personality differences account for a large portion of the wellbeing effects reported in previous research, with greatest effects for extraversion (positive) and neuroticism (negative). The effect of extroversion in particular is likely to be greater in research that is exploring the wellbeing effects of group activities, since indications are that extroverts enjoy this kind of activity while introverts are more likely to manage their wellbeing in other ways (Hills & Argyle, 2001). Empathy is another possible mediator of wellbeing changes experienced in a choir setting. Those with greater empathy have been found to be more responsive to the emotional content of music and emotion contagion (Eerola et al., 2016; Egermann & McAdams, 2013). It could therefore be that those who rate higher in empathy may be more engaged in musical experiences and benefit from higher levels of wellbeing changes in consequence.

The research reported in Chapter 7 confirmed that choir participation does not provide unique or enhanced wellbeing effects. Rather, exercise participation was found to provide broader wellbeing benefits, and these benefits were explained by a greater number of mechanisms. This research was also novel in that it explored two distinct constructs – characteristics of the choir experience and individual mindset towards social group participation – in seeking to understand how social, emotional and mental wellbeing changes may be explained. While it provides evidence that wellbeing changes are likely best explained by a complex mix of mechanisms, there is more research needed to test other potential mechanisms and better understand how they interact with one another.

Integrated analysis of findings

Taken together, this set of studies is an important contribution to better understanding how evolutionary theories of group singing may manifest in a contemporary context. It provides a corrective to over-stating the benefits of group singing when compared to other forms of leisure group activities that are available, which may be encouraging the promotion of group singing as a one-size-fits-all activity to promote socio-emotional wellbeing. Furthermore, it highlights the central role of preference, choice and motivation for participation – a facilitator of wellbeing that is often overlooked when designing studies, including randomized control trials. This research demonstrated across a series of mixed-methods studies that group exercise provides similar or even greater wellbeing benefits, which may arise from a wider range of mechanisms. Key findings from across the studies are presented here.

Emotional wellbeing was the primary and most consistent wellbeing change across the studies for choir participation, with both immediate and persistent improvements in affect. Changes in positive and negative affect were explained by a direct effect, with changes in positive affect also mediated by intrinsic motivation. Exercise groups experienced similar changes across all studies, with a direct effect explaining changes for both positive and negative affect, but with positive affect changes also mediated by intrinsic motivation, identified regulation and flow. The discussion groups included in the short-term effects reported in Chapter 5 also experienced a similar improvement in emotional state. Group singing experiences were therefore consistent with evolutionary theories concerning both immediate and persistent changes in emotional wellbeing. These benefits were shared by exercise group members for both immediate and persistent effects, and discussion group members (immediate effects only), and were neither unique nor enhanced in comparison. The current findings therefore caution against some of the contemporary commentary on evolutionary theory which appears to suggest choirs yield greater benefits due to the origins of group singing.

Findings for improvements in social wellbeing measures were mixed across the studies, with an increased sense of social bonding reported in the short-term study but no corresponding increase in sense of social support or empathic abilities in the longer-term study. Furthermore, when exploring individual mindset towards participation, sense of social cohesion was not predicted by any of the mechanisms explored for either the choir or the exercise groups. There was therefore limited support for the evolutionary theory that joint music-making supports group bonding and pro-social behaviours, with only short-term effects in evidence across the studies reported here. It could be that such effects are most prominent for populations that are still developing their social skills. For example, in the review of comparison studies reported on in Chapter 3, the research that is most convincing that singing provides an advantage in this area comes from three studies which explored singing activities and pro-social behaviours in children (Beck & Rieser, 2020; Good & Russo, 2016; Kirschner & Tomasello, 2010), with each study demonstrating significant differences in outcomes between the singing and non-singing conditions. It could be that group singing is more likely to facilitate such changes for people, like children, who are still developing their social skills, but that for individuals who already have well developed social skills like those recruited into the current set of studies, such benefits are muted or provide protective rather than a generative support.

Concerning measures of arousal and energy, all groups recorded a similar immediate reduction in tiredness scores; this included the discussion groups which were more sedentary in nature. When considering the contributions of the characteristics of the activities, both exercise and socializing corresponded to significant increases in feeling active on any given day, while music engagement did not. It therefore appears that movement and social opportunities are the primary facilitators of increased energy levels in the current studies. Again, these characteristics are shared across many types of social groups and are not restricted to group singing.

Mental wellbeing was measured in the study on persistent changes, but the only finding in this domain was a reduction between time 1 and time 2 for both choir and exercise groups, with a return to baseline measures at time 3. There is no clear explanation for this, however it could have been associated with seasonal affective changes since these measures were taken in the middle of winter. When exploring mechanisms of wellbeing changes, however, flow predicted improvements in mental wellbeing only for the exercise group. The difference between the exercise and choir group may be explained by fewer interruptions in the exercise group setting when compared to a choir rehearsal, thereby creating enhanced conditions for flow experiences.

The series of studies reported in this thesis provide limited evidence for specific or unique contributions of group singing to emotional or social domains when examined in natural settings, with similarly engaging activities, and across varying timeframes. The natural settings ensured that autonomy, motivation and preference were preserved for both the singing and control groups, providing a more accurate analysis of how community choir participation may enhance wellbeing for older adults in contemporary, everyday settings. Comparing to exercise groups provided an arguably more appropriate control condition than is often utilised in research settings, and challenges previous findings of differences which arise when compared against a no-activity or refrain-from-singing control conditions. In summary, while choir participation provided consistent improvements in emotional wellbeing, impacts on social wellbeing were mixed; more research is needed to establish under what conditions group singing may provide enhanced and consolidated social benefits. Mental wellbeing effects were not in evidence across any of the studies. While participation was described as highly valued and provided important social opportunities and emotional improvements, these benefits were matched and even exceeded by exercise group participants. It therefore appears that theories of group singing's evolutionarily adaptive role in creating a positive and shared emotional state, increasing a sense of social bonding, and facilitating the development of pro-social behaviours may be shared by other equally engaging social group activities, particularly those that incorporate movement, at least for the healthy and socially connected populations that were a part of this set of studies.

Implications for practice

Evidence-based practice relies on research results that are reported appropriately, building up knowledge across time through the synthesis of multiple studies. A key finding from this thesis is that findings may not have been appropriately interpreted, or wellbeing changes properly attributed, due to design considerations. When studies employ designs that remove preference and choice from the control group, significant differences between the intervention and control groups are more likely to be present. This may have led to an over-estimation of the wellbeing effects of group singing, with an assumption that these benefits are both greater than other social activity options, and universally experienced. There is therefore the potential that choirs may be promoted as a panacea response in social prescribing or similar settings. This in turn could lead to lost opportunities to consider the true drivers of wellbeing improvements and achieve a more appropriate person-activity fit.

The current findings therefore provide a number of important implications for practice. First and foremost, for social prescribing initiatives or in settings where activities are provided, preference, choice and motivation must be a key consideration when providing options for individuals. Providing a range of engaging activities and considering individual interests will therefore optimize the potential for wellbeing benefits across a diverse range of individual participants. The concept of person-activity fit is a useful guide for practitioners, as it incorporates the influence of individual motivation, preference and choice alongside the characteristics of the activity. For social prescribing initiatives or providing activities in settings such as retirement communities, considering both the type of activities on offer and the interests of the individual is recommended for improved wellbeing outcomes.

Secondly, because music engagement, movement and social opportunities were all found to have a positive impact on wellbeing, it would be advantageous for social groups to consider how to introduce or augment these aspects into how the group is structured. For example, choirs could deliberately include swaying, clapping hands, or using percussion instruments to increase movement and synchronicity, while introducing a short break at the mid-point of the activity can increase social interactions. For groups which can incorporate music, care could be taken to ensure the pieces selected are enjoyed by the majority of the group's members.

Third, while the exercise groups matched choirs in wellbeing outcomes and may provide a broader spectrum of benefits, group singing is an activity which is highly accessible when exercise and other action-based pursuits must be curtailed. While movement was found to be a contributor to wellbeing, if considered across a spectrum, choir participation can be viewed as an accessible activity for individuals who no longer have the capacity for physical exertion. The links between music and autobiographical memories also supports choir participation as a leisure activity that may have particular salience for people of advanced age (Belfi, et al., 2016).

Finally, the lack of a predictive effect for flow to influence wellbeing measures for the choirs may be indicative of the start-and-stop nature of practice sessions for music-based groups, as proposed by Dunbar et al. (2012). By setting aside time for uninterrupted singing, practitioners may be able to increase experiences of flow for choir participants, resulting in expanded wellbeing benefits.

Limitations and further research

The natural settings that were deliberately employed across the current set of studies are one of its strengths; however, there are also limitations associated with this approach. One question which cannot be answered with this methodology is to what degree do the various activities impact wellbeing for people participating in those activities for the first time. While randomised controlled trials can go some way to answer this question, it is difficult to encourage people to participate in an activity in the absence of some interest in the activity itself. If individuals feel 'forced' to participate, this is likely to reduce wellbeing benefits.

In the absence of ceasing participation across all leisure activities, it is also extremely difficult to identify the role that choir or other forms of social group participation may play in *maintaining* wellbeing. For this reason, it would have been informative to collect comparative data during the lockdown measures associated with COVID-19 to gain insight into what happens to wellbeing when organized social groups are withdrawn. A survey conducted with over 3,000 UK choristers who participated in virtual choirs reported that, while the virtual options were welcome as a way to stay connected, the inability to sing together in person resulted in an overwhelming sense of loss, with the psychological benefits of group singing for maintaining wellbeing not fully understood by participants until they were withdrawn (Daffern, et al., 2021).

The limited changes to wellbeing across the seven months of the study reported in Chapter 6 was surprising. This may have been an artifact of a 'ceiling effect' in which socially active and engaged individuals experience elevated levels of socio-emotional wellbeing – a potential problem for many such studies (Daykin et al., 2018). However, it also highlights the potential role of leisure group activities in *maintaining* wellbeing, above and beyond influencing positive changes. Many of the research participants, and particularly those attached to the University of the Third Age, were socially active across multiple leisure groups; many had also been attached to their social group included in the studies for some time. While an effort was made to record a strong baseline by starting the study after a long end-of-year break, it could be that both the consistency and breadth of social group participation meant that the participants were experiencing a ceiling effect, resulting in little movement on the wellbeing markers across the longer time frame of the study. Predicted influences on pro-social behaviours may also have been less evident for the older populations than they are in children (as reported by Beck & Rieser, 2020; Good & Russo, 2016; Kirschner & Tomasello, 2010) or other populations who are actively developing their social capabilities (Dingle et al., 2012).

While there were no clear indications in the current study that group singing provided heightened wellbeing benefits when compared to other kinds of social group activities, the data were collected prior to the onset of COVID-19 and the ensuring lockdown measures. There is further research required to better understand how group singing and other forms of musical interactions may have salience during times of uncertainty, challenge or stress. The pandemic has required global efforts to maintain social distancing and isolation, which has had a profound negative impact on mental health (Salari et al., 2020; Vindegaard & Benros, 2020). A growing body of research is documenting how people used music to regulate their socio-emotional wellbeing during times of lockdown. For example, Vandenberg et al. (2020) analysed how livestreamed concerts in Europe were a popular way for habitual concert-goers to approximate a sense of group solidarity. Two Spanish studies reported a significant increase in music use (listening, singing, dancing and/or playing an instrument), which assisted with coping with negative affect, regulating mood, providing a distraction, and reducing a sense of loneliness and isolation, including for older populations (Cabedo-Mas et al., 2021; Martín et al., 2021). A global survey of over 5,000 people found that during lockdown, music engagement was used to attain the wellbeing goals of enjoyment, venting negative emotions, self-connection, diversion and a sense of togetherness (Granot et al., 2021). It could be that group singing may provide greater benefits to socio-emotional wellbeing than other forms of leisure activities at times of uncertainty, isolation or upheaval. Several qualitative studies provide some support for this speculation. For example, Clift and Hancox (2010) reported that for people who scored low on a psychological wellbeing scale (n = 85), choir participation provided important benefits, including increasing positive affect and focused attention, breathing deeply, providing social support, providing a cognitive challenge, and requiring regular commitment. Qualitative findings from choristers who had recently experienced a negative life event said that the collective experience, the supportive relationships, a sense of competence and purposefulness, the ability to manage emotions and promote wellbeing, and the sense of creating a meaningful life were all ways that participation assisted them to overcome their personal difficulties (von Lob et al., 2010). Specific to the research conducted as part of this thesis, the finding reported in Chapter 7 that days with music engagement increased a sense of social connection compared to days without may demonstrate the use of music as a social surrogate during times of isolation (Schäfer & Eerola, 2018). This theory is bolstered by research conducted by Fancourt and Steptoe (2019), which found that a virtual choir provided an enhanced sense of social presence compared to a live experience, which may reflect the heightened need for a sense of social connection when isolated.

This research considered the role of movement as a mechanism for improving wellbeing, however it did not consider exertion and synchronicity separately, so it is unknown whether one aspect of movement is more critical for improving wellbeing than the other, or whether they make unique contributions. Synchronous movements have been shown to positively influence wellbeing and social bonding (Loersch & Arbuckle, 2013; Páez et al., 2015; Salimpoor et al., 2011) and is facilitated by musical entrainment (Koelsch, 2011). However, indications are that exertion also provides important socio-emotional benefits (Di Bartolomeo & Papa, 2019; Hogan et al., 2013). One of the few studies to examine synchrony and exertion as independent factors (Tarr et al., 2015) found that both synchronous movements and exertion increased a sense of social bonding and elevated pain thresholds, but with no effects on mood. Further research could elucidate the differential effects of exertion and synchrony, allowing for more targeted use of these elements in organized group activities.

While it is clear that the number of social opportunities, including organized leisure group activities, also plays an important part in supporting health and wellbeing, this research did not consider the potential impacts of expanded social networks. Further research could consider how the number of activities in which an individual participates interacts with activity elements and motivation to influence wellbeing. For example, it could be that as people age and may have to suspend activities that require higher levels of exertion, such as vigorous exercise, participating in social groups that are more sedentary in nature compensates for these losses. However, it is unknown how the various elements of activity components, preference and range of activities interact.

More research is required to understand the wellbeing effects of social group participation on people who are reluctant to participate in organized group activities. It could be that such individuals are missing important contributions to their health and wellbeing; however, because of the role that motivation and preference play in supporting wellbeing changes, it may be that these benefits are only experienced by people who enjoy organized leisure activities – for example, people who are highly social, or who are particularly drawn to the activity. In other words, as the person-activity fit model predicts, social group participation may not be a 'one-size-fits-all' solution for the wellbeing needs of all individuals. There is little research in this area, although there are indications that introverts are more likely to experience flow in solitary settings than in group settings, which was not the case for extroverts (Liu & Csikszentmihalyi, 2020). It could therefore be that some individuals receive equal wellbeing benefits from solitary leisure activities. Conversely, it could be that more needs to be done to make social group activities less daunting or unappealing for a wider range of individuals to participate. If this is the case, identifying and providing options that individuals find intrinsically motivating may be particularly important for introverts or others who are otherwise reluctant to participate in group activities. The finding reported in Chapter 6 that choir members were intrinsically motivated to participate may be an important one that encourages people to move beyond their discomfort of joining group activities.

This research focused on specific socio-emotional measures, but there are other potential benefits for group singing that were not considered. For example, there is both interest in and some exploratory research on the benefits of group singing for physical health (Clift et al., 2009; Cohen et al., 2006; Coulton et al., 2015; Pentikäinen et al., 2021; Wiech et al., 2020) and cognitive health (Galinha et al., 2020; Suttcliffe et al., 2020). For example, a survey of choristers on physical impacts mooted breathing and lung function as a primary benefit (Clift et al., 2009), and while this may be the most demonstrable physical benefit, there have been few trials and findings are currently inconclusive (Lewis et al., 2016). Concerning cognitive benefits, music making has been proposed as a cognitively protective activity for older adults as it may enhance general cognitive function through such pathways as the challenge of learning new things, the diverse activation of multiple cognitive domains, and/or synchronicity and movement (Sutcliffe et al., 2020). It is unknown whether singing, which is more accessible than playing an instrument, may provide cognitive benefits, but researchers are starting to address this question (Galinha et al., 2020). It is also possible that singing also enhances cognitive flexibility, which is known to be facilitated through the pathways of improved mood and positive social interactions (Andreasen & Ramachandran, 2021; Cross, 2001; Subramaniam et al., 2009). Wellbeing is not the only construct through which benefits may be obtained.

Contributions to the field

This body of research adds to the knowledge base on group singing and wellbeing in important ways. First, a review of previous comparison studies suggested that inferred benefits of choir participation may have been overstated due to methodological limitations. This pointed to the need for greater consideration of multiple drivers of wellbeing, including retaining agency, to ensure that wellbeing is neither being eroded by methodological choices for the control group, nor boosted for the intervention group through pathways that are not accounted for in the research design.

Second, suitable control conditions will ensure that wellbeing changes are interpreted appropriately. Comparing against no-activity or cessation-from-singing conditions is common, but as demonstrated here has inflated findings due to other factors. Control conditions that are equally engaging provide comparisons that are more robust and meaningful.

Third, research conducted in natural settings provides a more realistic understanding of how choir participation influences wellbeing in everyday life, alongside other activities and everyday hassles, while also retaining autonomy and preference. While highly controlled studies contribute to the knowledge base in important ways, studies conducted in natural settings provide unique insights and should not be discounted.

Fourth, employing a range of timeframes will assist to understand how wellbeing benefits are consolidated over time, or alternately whether they are only short-term in duration. Understanding the duration of socio-emotional benefits can lead to strategies that facilitate their consolidation from state to trait, with attendant health and wellbeing effects experienced over longer timeframes. Utilising ESM protocols can also provide important insights into how wellbeing benefits both accrue and erode across days or weeks, and potentially identity what factors influence these changes.

Fifth, employing a greater range of theoretical frameworks from the wellbeing literature, such as self determination theory, the literature on motivation, person-activity fit, social identity theory, personality differences and similar will assist in targeting research and interpreting results. An emphasis on the mechanisms that sit behind changes in wellbeing provides an explanatory framework that has been largely missing from the literature.

General conclusion

Music is a ubiquitous and cherished human activity which has puzzling evolutionary foundations. It has been proposed that the emotional response that music elicits may have provided hominids and early humans with rewarding emotional experiences which were shared, leading to an increased sense of group bonding and facilitating the development of pro-social behaviours. These theories have led to increased interest in whether group singing may still provide these benefits today. The research reported here confirmed that community choir participation, with their emphasis on inclusion and enjoyment, provides important socio-emotional benefits. Situating the research within a contemporary understanding of the role of leisure group activities in wellbeing, these benefits do not differ markedly from activities with similar elements, such as exercise groups, and even more sedentary activities, such as discussion groups, can also provide comparable changes in wellbeing. A critique of previous comparison studies found that this is consistent with those which compare against other engaging social activities, while comparisons against a refraining-from-singing condition or a no-activity condition raise methodological concerns about the cause of differences between the groups.

Potential mechanisms for improvements in wellbeing were also explored. Examination of some of the elements present in a choir setting, including music engagement, movement and social opportunities, found that all three elements contribute to changes in wellbeing, but movement and social opportunities appeared to provide greater benefits than music engagement. While intrinsic motivation predicted improvements in emotional wellbeing for choir participants, for exercise group participants emotional wellbeing was facilitated by intrinsic motivation, identified regulation and flow. Moreover, flow predicted changes in mental wellbeing but only for exercise group members.

While group singing provides important wellbeing benefits, it does not appear that these benefits are enhanced when compared to other engaging and preferred group leisure activities. These findings therefore provided inconclusive validation of evolutionary theories for the utility of group singing. Employing other frameworks, however, places group singing activities alongside other, equally engaging activities, where similar outcomes are expected. Considering person-activity fit, in which both the elements of the activity and the preferences and motivation of the individual are considered, is therefore a preferred process for maximizing wellbeing benefits in a community setting.

These findings have implications for social prescribing and other community interventions. Individual preference and choice for social group participation should remain paramount, with a wide range of engaging and enjoyable activities on offer. Additionally, choir participation can provide a more appropriate level of movement for older people who can no longer engage in exercise-based or exertive activities.

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Appendix A: Published version of Chapter 2

Preamble

The published paper that comprises the majority of Chapter 2 (An evolutionary framework linking group singing with wellbeing) was rewritten for this thesis, to align it with the focus on older adults and also to update it in places. It is presented here in its published form.

The original article considered evolutionary theories of music-making as an under-explored option for wellbeing programs provided in school settings.

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Wellbeing in the classroom: How an evolutionary perspective on human musicality can inform music education

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Abstract

Group singing is a common feature of classroom-based music education, and has often been proposed to have benefits that extend beyond acquisition of music skills, primarily in academic achievement. However, potential social and emotional well-being benefits have been under-represented in these discussions. This article proposes that an evolutionary lens provides a helpful framework for understanding how music education can contribute to student well-being. Specifically, group singing may a) create a shared emotional experience which is generally positive; and b) increase group cohesion and pro-social behaviours. It is proposed that, while these changes are generally immediate and short-term, regular participation in group singing may lead to stable, persistent changes in affective style and sociability. The implications for music education are discussed, particularly for improving the social and emotional wellbeing of students.

Key words: music education; singing; wellbeing; emotion; social bonding; evolution.

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Social and emotional wellbeing in the classroom

In recent years, there has been increasing recognition that social-emotional competencies and wellbeing have a significant impact on how students both enjoy school and learn. Schools are places of daily social interaction, and when students feel unable to create bonds with their peers and teachers, they can become disengaged from the school and from learning (Benson, 2006; Blum, Libbey, Bishop, & Bishop, 2004; Klem & Connell, 2004). Disengagement starts in primary school and becomes entrenched in secondary school (Wang & Eccles, 2012; Wang & Fredricks, 2014), is linked to increased risk for mental illness (Wickrama & Vazsonyi, 2011) and anti-social behaviours into adulthood (Henry, Knight, & Thornberry, 2012). Enjoying school and feeling connected, on the other hand, is correlated to both academic attainment and a sense of finding school useful (Denham & Brown, 2010; Neel & Fuligni, 2013). Developing social and emotional competencies for students is therefore a highly protective factor for both the school years and into adulthood (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011).

There are many initiatives and programs for incorporating social and emotional learning into the classroom. This article suggests that participation in joint music creation is an under-studied method for improving social-emotional wellbeing. From an evolutionary perspective, it has been argued that joint music-making was adaptive precisely because it helped individuals to regulate emotions and strengthen bonds. By understanding music as a positive social-emotional activity, its importance in the classroom is augmented. This paper reviews the evidence on group singing for improving wellbeing. While these benefits are likely to be found in any joint music-making activity, the focus is on singing because a) it is accessible to virtually everyone even without training; b) there is no cost associated with participation; and c) from an evolutionary perspective, it would have been the first and primary mode of collective music-making.

Music education and well-being

Music education has rarely been a focus in interventions aimed at improving student well-being. For example, in a meta-analysis of school-based social and emotional interventions, not one study involved music (Durlak et al., 2011). There are some promising studies, however. For example, a 10-week drumming intervention for 30 boys (all approximately 12 years in age) who were considered at high risk for school disengagement produced improvements in self-esteem, school attendance, cooperative behaviour, and a reduction in anti-social behaviours (Faulkner, Wood, Ivery, & Donovan, 2012). In a study tracking 210 kindergarten/grade 1 children and 149 grade 3 students, extra music lessons in the classroom were found to have a protective effect on self-esteem scores compared to control groups (Rickard et al., 2013). When Eerola and Eerola (2014) studied 735 Finish pupils (years 3 and 6), they found that those enrolled in extended music instruction also reported enhanced quality of school life. In a review, Hallam (2010) summarises research which indicates that students participating in music education talk more to parents and teachers (Broh, 2002), develop a positive self-image (Costa-Giomi, 1999; Marshall, 1977; Whitwell, 1977), and experience improved social adjustment and classroom cohesion (Harland et al., 2000; Spychiger, Patry, Lauper, Zimmermann, & Weber, 1993).

However, there are also studies which indicate no effect. In the same study which found protective effects for self-esteem, there were no effects for improved social competence, contrary to expectation (Rickard et al., 2013). Rickard, Bambrick, and Gill (2012) found no cognitive or psychosocial benefits of music education for wellbeing in a study of 127 boys enrolled at a private boys' school (average age 12.67 years), across 6 months; nor with a follow-up study of 115 students in grades 5 and 6 at a mixed-gender school. This finding dovetails with several studies conducted in schools by Schellenberg, where no psychosocial benefits were realized (Schellenberg, 2004, 2006, 2011). It therefore becomes important to understand the mechanisms by which music engagement may increase well-being. Using an evolutionary framework, this paper reviews the theoretical perspective with a view to suggesting more targeted research into this area.

An evolutionary perspective on music

Music is a universal expression in both individuals (with very few exceptions of individuals with amusia) (Blacking, 1973; Koelsch, 2012; Tomlinson, 2013; Trehub, 2001) and societies, throughout history (Brown & Jordania, 2013; Cross, 2003; Titon & Slobin, 1996). While instruments have been dated back 40,000 years (Zatorre & Salimpoor, 2013; Zhang, Harbottle, Wang, & Kong, 1999), Morley (2014) suggests vocal music could extend between 400,000 – 600,000 years ago. The creativity and emotional content associated with music-making appears to be uniquely human, as animal-generated music lacks improvisation while used to communicate specific information (Tomlinson, 2013; Trehub

& Hannon, 2006). Additionally, the significant cognitive resources required to create, decode, and appreciate music suggests it provides valuable human benefits (Warren, 2008).

There is much debate about what role music-making, and singing in particular, may have had in evolutionary terms. Steven Pinker famously mooted that music is nothing more than a spandrel – a by-product of other cognitive and social functions which provided no evolutionary advantage and is in effect a pleasant but accidental curiosity (Pinker, 1997). Many others have suggested that music and language are closely linked, and that proto-music led to the development of language, that language led to the development of music, or that they co-developed (see Mithen, 2005 for overview). Theories linking music and language tend to agree that the most important evolutionary contribution of music is the development of language.

In recent years, an alternate explanation for music's development has been suggested: that music is neither a spandrel, nor does its importance rest solely on its links with language. Rather, music provided very specific and unique benefits to human evolution, through at least two pathways. Specifically, group singing may have created a shared, overwhelmingly positive emotional experience; and it may have increased group cohesion and pro-social behaviours.

For hominids, developing a shared emotional state may have strengthened the group bond while facilitating group decision-making and prioritising, as emotions serve the purpose of prioritising actions (Carver & Sheier, 1998; Cosmides & Tooby, 2000; Lang & Bradley, 2010; Lang & Davis, 2006). Dunbar (1998) proposes that, for primates, the complexity of the brain is directly correlated to social network size; extended cooperative groups enhanced cortical development in hominids. Through its ability to create a shared emotional experience and increase pro-social behaviours, it has been argued that music also facilitated the development of the modern brain (Cross, 2001; Perlovsky, 2011).

Infant musicality

To supplement analysis of the archaeological record, music's role in human development can also be explored through research conducted with newborns. Infants are innately musical. They have a memory for musical performance (Volkova, Trehub, & Schellenberg, 2006), and can process musical patterns in an adult-like manner (Trehub & Hannon, 2006). This is a distinguishing trait from most non-human animals, and should be appreciated as a highly complex skill despite its universality (Trehub & Hannon, 2006). Infants respond with enthrallment when their mothers sing to them, compared to a less intense response for talking (Nakata & Trehub, 2004). Maternal singing has an immediate and profound impact on an infant's arousal and attention, which is often accompanied by physiological changes (Trehub, 2001).

Trehub (2000) points out that mothers innately know what type of singing infants prefer. She also suggests there are benefits to the mother, including an increased sense of wellbeing. McDermott and Hauser (2005) cite evidence that lullabies have universal qualities across cultures and perhaps even through history. Even infant-directed speech is highly prosodic in nature across cultures, and communicates information through its music-like qualities rather than through the language content (Fernald, 1989). Like infant-directed speech, infant-directed music appears to have pre-determined qualities that are innately understood by mothers and others who interact with infants.

Music plays a central role in the first social contact humans experience, by creating and reinforcing parent-child bonds, across cultures (Malloch, 2000; Schulkin & Raglan, 2014). The experience for both child and parent is highly companionable and rewarding.

Group singing and shared emotional experiences

One of the primary uses of music for modern consumers is emotion arousal and regulation (Juslin & Sloboda, 2010; Juslin & Västfjäll, 2008; Salimpoor, Benovoy, Longo, Cooperstock, & Zatorre, 2009; Schäfer, Sedlmeier, Städtler, & Huron, 2013); positive emotional experiences are also identified as a primary benefit of choir membership (Clift & Hancox, 2010). For most people, music elicits emotions which can be very strong, and are sometimes accompanied by physiological arousal, such as chills, increased heart rate, and skin temperature, (Rickard, 2004; Roy, Mailhot, Gosselin, Paquette, & Peretz, 2009; Sammler, Grigutsch, Fritz, & Koelsch, 2007). In addition to the important implications for personal well-being, the link between music and emotion is interesting from an evolutionary perspective for several reasons. First, there is the role that emotions play in decision-making and attentional processes. Second, music's ability to increase positive affect and reduce negative affect may promote pro-social behaviours. Third, the ability to correctly "read" another's emotional state enhances theory-of-mind skills. And finally, facilitating a shared emotional state has implications for the establishment of co-operative groups.

Emotion serves as a psychological motivation for thought or action (Lang & Bradley, 2010; Lang & Davis, 2006). Carver and Sheier (1998) are more specific, identifying emotions as a response to an event that has the capacity to effect goal attainment. Emotions are understood to reduce chaos between competing brain functions by drawing attention to what requires immediate attention, while subsuming attention on less pressing matters (Cosmides & Tooby, 2000). For early hominids, survival may have depended on the ability of the group to share a sense of panic at the approach of a predator, for example. This panic needed to override individual cognitive assessments such as a sense of hunger or a desire to sleep.

Alerting a group to the presence of a predator is a basic survival practice, and is common amongst social animal species, and may even operate across species (Griffin, Savani, Hausmanis, & Lefebvre, 2005; Manser, 2001; Rainey, Zuberbühler, & Slater, 2004; Schmidt, Lee, Ostfeld, & Sieving, 2008). However, it may be that finding ways to share more subtle emotions gave hominid groups an increased sense of social cohesion and an ability to entrain, leading to more sophisticated social and cultural expressions. Cross (2003) suggests that the co-creation of music is a uniquely human trait, and that when early hominid groups made music they also created a shared emotional state. Because emotions serve an attentional function for thought or action, sharing an emotional state may have been pivotal in ensuring group cooperation.

Sharing emotions across the group may have increased empathic responses and helped to develop theory-of-mind abilities (Singer, 2006). There is evidence that decoding music structures and decoding emotion in prosodic phrases is linked, and may also improve the 'reading' of another's emotional state (Thompson, Marin, & Stewart, 2013). The affective messaging of music may have supported these skills to develop in early hominid groups.

Recent research into music anhedonia may also support this analysis. For the majority of people, music activates the reward circuitry of the brain, leading to a pleasure-inducing dopamine release (Menon & Levitin, 2005). Research conducted by Mas-Herrero, Zatorre, Rodriguez-Fornells, and Marco-Pallares (2014) demonstrated that some individuals do not experience activation of their neural reward network in response to music; however, the network was activated in response to a financial stimulus, indicating that the reward network was not damaged. Additionally, the music anhedonics were able to correctly identify the emotion being expressed in the music, despite being unable to experience it.

Clark, Downey, and Warren (2014) argue that music-specific anhedonia which leaves intact the ability to decipher music's emotional content implies that there are music-specific brain reward mechanisms. This in turn implies a biological imperative for music, as there are for other biologically critical functions such as are triggered by food or sex. The authors hypothesise that music's utility is embedded in this emotional response: music is a way of encoding emotions in order to share them with a community. The process of decoding music's emotional text is the same used in decoding emotions in others, and which support the development of theory-of-mind skills. Music is affective messaging.

Emotion is known to spread from person to person, through direct contact (Decety & Ickes, 2011), indirect contact (Coviello et al., 2014), and through music listening (Juslin & Västfjäll, 2008). Successful emotional transfer from person to person is a key indicator of empathy, which is also linked to developing robust theory-of-mind abilities. Sharing the emotions of another is considered a primary factor in the cognitive, affective, and behavioural development of early hominids (Decety & Ickes, 2011). Because music is known to both induce and enhance emotional experiences, it is possible that corporate music experiences would serve the same function, creating a shared emotional experience.

People often experience emotion contagion when listening to music. For example, many athletes use music to put themselves in a mood state which will encourage peak performance (Bishop, Karageorghis, & Loizou, 2007; Lane, Davis, & Devonport, 2011). Adolescents regularly use music as an effective mood regulator (Saarikallio & Erkkilä, 2007). Vuoskoski and Eerola (2012) demonstrate that sad music can transfer a sad emotion state to a listener, particularly if the piece has relevance to the listener. They also found that listeners high in trait empathy were more likely to adopt the sad emotion state, which indicates that an emotional response to music is at least in part a social response.

Music is often used to manipulate emotions in public spaces (Garlin & Owen, 2006; Morrison, Gan, Dubelaar, & Oppewal, 2011; Spence & Shankar, 2010) and public events (Steinberg, 2004; Street, 2013). However, little empirical research has been conducted into whether music may augment emotion contagion amongst individuals. A study with 50 university students found that intentional music listening with a friend or partner increased reports of positive mood states, but not negative states, compared to listening alone (Liljeström, Juslin, & Västfjäll, 2013). However, these findings appear to contradict the findings of an earlier study, which found that 14 members of an orchestra experienced more intense emotional response (as measured by self-report and skin conductance) when listening alone than when listening as a group (Egermann et al., 2011). While both studies focussed on how social context affects emotional responses to music listening, the size differences of the groups (two and 14), the differences in group relationships (a close friend/partner and a larger social/work group), the lab-based nature of the studies, and the focus on listening to rather than creating music may limit their relevance to the current discussion.

Due to the strong links between music and emotions, and the use of group singing in pre-historic and traditional cultures, a positive shared emotional state is likely to be one of the primary benefits of these experiences. Group singing may have provided a rewarding way to create a shared emotional experience. Enjoyable, and therefore repeated, musical experiences would have aided the development of the necessary empathic skills needed for sharing emotions more generally. There is likely therefore to be both short-term and long-term effects: while participation in group singing may lead to a short-term positive emotional state, repeatedly engaging in group singing may lead to persistent long-term changes, including developing a more stable positive affective state and reduction of negative emotional states such as stress or anxiety. A positive affective style is associated with overall thriving (Lyubomirsky, King, & Diener, 2005) and improved health (Pressman & Cohen, 2005) and may create a positive spiral towards overall improved wellbeing (Fredrickson & Joiner, 2002). Positive emotion states are argued to be evolutionarily adaptive, through the benefits of health, improved fertility, creativity, improved planning, more successful mating, and improved sociability (Diener, Kanazawa, Suh, & Oishi, 2014).

Group singing, group cohesion and pro-social behaviours

Music engagement is also strongly linked with social bonding. For example, a range of studies demonstrate that background music can have a positive impact on social interactions, including increasing a sense of 'liking' in initial meetings (Stratton & Zalanowski, 1984b), increasing verbal exchange in social settings (Stratton & Zalanowski, 1984a), and increasing the positive assessment of an individual during an initial meeting (Ortiz, 1997). More recently, Loersch and Arbuckle (2013) demonstrated that music listening enhanced a sense of in-group membership.

Social bonding is reported as one of the primary benefits of choir membership. In a survey of 600 English choral singers (Clift et al., 2007), and a follow-up study of 1124 choir members across England, Australia and Germany (Clift & Hancox, 2010), choir members identified social support as one of six generative mechanisms to improved wellbeing and health (also mentioned was positive affect, focused attention, deep breathing, cognitive stimulation, and regular commitment). This was described both in general terms of participating in a social experience, as well as comments reflecting the focused, unified discipline of co-creating a piece of music. Recent research indicates that singing groups bond faster than other, non-musical social groups (Pearce, Launay, & Dunbar, 2015), which supports the theory that music co-creation has unique social bonding properties.

The impacts of choir membership have been studied on marginalised groups who struggle with making social connections. In a unique longitudinal study looking at the effects of choir membership on older adults (Cohen et al., 2006, 2007), the researchers found that their control group (engaged in self-selected activities) trended towards reduced participation in social events, while the choir members trended towards increased participation. The authors also reported fewer doctor visits, reduced medication, fewer falls, and improved health in the choir cohort compared to the control group.

von Lob, Camic, and Clift (2010) interviewed English members of non-audition singing groups who had also experienced adverse life events, to understand whether and how membership assisted with coping. The social support provided by the singing group was a primary factor, encompassing both building significant relationships within the choir as well as sharing in the collective experience of music making.

A systematic review into the effects of group singing on well-being and health (S. Clift, Nicol, Raisbeck, Whitmore, & Morrison, 2010) indicates that singing programs for individuals with dementia increase social behaviours, encourage participation, and reduce anxiety and agitation. Dingle, Brander, Ballantyne, and Baker (2012) examined the effects of choir membership for adults experiencing a range of disadvantage (chronic mental health problems, physical disabilities and intellectual disability) in a 12-month longitudinal study which coincided with the choir's start-up. A positive social impact was one of three primary benefits identified by the choir members (along with personal impact and personal function). Members identified a strong social connection within the choir, but also with audiences during performances. Several members also mentioned that these effects were apparent in their life separate from the choir; they were more easily able to engage in pro-social behaviours as a matter of course.

Joint music creation may promote pro-social behaviours by promoting empathic responses (Kirschner & Tomasello, 2010; Rabinowitch, Cross, & Burnard, 2013; Sevdalis & Raab, 2014), thereby promoting increased theory-of-mind abilities (Livingstone & Thompson, 2009). Theory-of-mind abilities rely on both affective and cognitive assessments, and empathic abilities have a demonstrable correlation to theory-of-mind skills (Shamay-Tsoory, Tomer, Berger, Goldsher, & Aharon-Peretz, 2005). There is evidence that musical engagement generally, and group singing activities in particular, can promote oxytocin release (Chanda & Levitin, 2013; Grape, Sandgren, Hansson, Ericson, & Theorell, 2002; Kreutz, 2014). Oxytocin is a hormone associated with strong feelings of love and connection, reduced stress, and increased trust amongst individuals (Gimpl & Fahrenholz, 2001; Kosfeld, Heinrichs, Zak, Fischbacher, & Fehr, 2005). Additional studies indicate that group singing also increases the release of endorphins, another hormone implicated in the bonding process, as measured by increased tolerance for pain (Dunbar, Kaskatis, MacDonald, & Barra, 2012; Weinstein, Launay, Pearce, Dunbar, & Stewart, 2015).

While there is some evidence of a link between music and increased pro-social behaviours, the research into this area is limited and exploratory. People high in trait empathy are more responsive to the emotional content in music (Egermann & McAdams, 2013; Vuoskoski & Eerola, 2012). Rabinowitch et al. (2013) found that primary school children who participated in a musical group across the school year showed higher emotional empathy scores than children in the control group. Similarly, Kirschner and Tomasello (2010) found that 4-year-old children who participated in a one-off musical play-based game demonstrated increased pro-social behaviours compared to children who participated in the same game without the musical components.

Implications

Taking an evolutionary perspective on human musicality facilitates an examination of everyday, non-professional, accessible musicality. Music-making has traditionally been an activity that is engaged in by all community members, most often through group singing. While there have been several possible explanations proposed pertaining to music's persistence and value across time, these ideas have not been systematically tested. There are many implications for further research which in turn may inform music education delivery.

First, it may be that level of engagement, rather than level of proficiency, is the most important factor for realizing benefits. This possibility has already been mooted, including the development of a tool for measuring strength of engagement (Chin & Rickard, 2011, 2012). If engagement is the key to increasing well-being, there are implications for how music education is delivered in schools. A British study found that students associate engaging with music outside of school to be for enjoyment and to increase positive moods, while music engagement at school was associated with learning – and therefore less pleasurable (Lamont, Hargreaves, Marshall, & Tarrant, 2003). Because well-being benefits are manifested when the music choice is favoured, both selection of music and how instruction is delivered become important considerations. There are already indications that music education is widening in scope to include both improving technical expertise and to provide opportunities for enjoyable, everyday musical experiences (MacDonald, 2013). This is a positive trend for increasing well-being benefits, which are common in community music settings but often missing from music education.

Second, it would be beneficial to examine other possible benefits of music engagement other than mood regulation – particularly the social benefits. There are already some indications that co-creating music has social benefits for children, disadvantaged populations, and older adults. These studies are exploratory and inconclusive; there is the opportunity to systematically test these theories and build up a robust body of knowledge for the social benefits of music-making. Schools are an excellent place to examine such questions. There are also implications for how music education is delivered in order to encourage group cohesion. If a core evolutionary function of music is to increase social bonding, then the focus for instructors may expand from a goal of excellence in production to including promotion of positive group interactions. Classroom-based music instruction is well-placed to address issues of social isolation, particularly for students who are unable to afford formal music instruction. However, it is important to match how lessons are facilitated to the intended goal.

Third, there is a need to increase the level of research conducted with populations that are co-creating music but without technical expertise. At the moment the vast majority of research is conducted with either trained musicians or music listening. If evolutionary theories of music utility are correct, it is important to include untrained groups co-creating music in the research portfolio. This under-studied group can illuminate ways that everyday, untrained music making may affect individuals and groups. It may well be that music education can fill a gap in promoting active music making into adulthood by untrained, non-musicians, leading to many individual and social benefits.

Fourth, if evolutionary theories are correct, benefits accrue over time. It would therefore be useful to develop more longitudinal studies that track possible changes over time. These should incorporate both individual and group experiences.

Finally, it is likely that there are very specific cognitive benefits which have been hypothesized but are yet to be explored (Cross, 2008; Perlovsky, 2011). Specifically, it has not been tested whether music co-creation may increase cognitive flexibility. Cognitive flexibility is a style of fluid cognitive processing that successfully pairs concepts and ideas that are generally not associated, resulting in creative or insightful thinking. This process is in contrast to applying an inflexible and rule-bound application of information, also known as entrenched thinking (Walker, Liston, Hobson, & Stickgold, 2002). It is already established that high levels of positive affect and low levels of negative affect are positively correlated with increased cognitive flexibility (De Dreu, Baas, & Nijstad, 2008; Isen, 1987; Isen, Daubman, & Nowicki, 1987; Subramaniam, Kounios, Parrish, Jung-Beeman, & Beeman, 2009). There are also indications that positive, empathic social interactions also positively influence cognitive flexibility (Andreasen & Ramchandran, 2012; Ybarra et al., 2008, 2010). It is therefore logical to hypothesise that, if music co-creation improves affective state and increases a sense of social connection, it may also facilitate cognitive flexibility. There is already an understanding that musical creativity relies on high levels of cognitive flexibility (Charyton & Snelbecker, 2007); it is possible that it may be a virtuous cycle, in which music engagement increases cognitive flexibility, which in turn increases music engagement through increased creative expression, and so on. A school-based study conducted by Schellenberg, Nakata, Hunter, and Tamoto (2007) reported that schoolchildren drew for longer periods of time and their drawings were judged as more creative after singing familiar children's songs. This was compared to efforts in a range of listening experiments; creativity and effort was independently judged as highest in the singing intervention, followed by listening to familiar children's songs, listening to upbeat classical music, and lowest when listening to ponderous classical music. This effect indicates that positive music interactions may influence cognitive flexibility, the cognitive process that facilitates creativity.

An evolutionary lens placed over music engagement is useful to illuminate gaps in the current research literature concerning the utility of music co-creation, which has significant implications for music education. Possible avenues for future exploration include an increased focus on untrained music creation, longitudinal studies, and a focus on unexplored affective, social, and cognitive benefits.

Compliance with ethical standards

The authors declare that they have no conflicts of interest. This article does not contain any studies with human participants or animals performed by any of the authors.

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Susan Maury is a PhD candidate in Music Psychology at Monash University, examining the short- and long-term socio-emotional benefits of group singing.

Dr Nikki Rickard is Director of Psychology at Swinburne Online, and holds Honourary positions with the University of Melbourne and Monash University. Her research in music psychology explores emotional processes underlying mental health and well-being, and aims to better understand how everyday listening to music can promote positive functioning and manage emotional distress.

Appendix B: Supporting documents for investigation into immediate benefits (Chapter 5)

This appendix includes supporting documentation on the data collection methods for the short-term study reported in Chapter 5. It includes, in order:

- Participant plain language explanatory statement and consent form
- Demographics questionnaire
- Psychometric questionnaires
- Key data outputs (psychometric questionnaires)
- Observational methodology rater directions and tally sheet
- Observational methodology participant consent form
- Observation data compilation of ratings
- Observational data chi-square analysis

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(Participant plain statement of research and consent forms, including both the short-term study reported in Chapter 5 and longer-term study reported in Chapter 6.)

OCTOBER 2016

Benefits of social group membership for well-being

My name is Susan Maury and I am conducting a research project with Adjunct Associate Professor Nikki Rickard in the School of Psychological Sciences towards a PhD at Monash University. This means that I will be writing a thesis which is the equivalent of a 300 page book. This project has received approval from the Monash University Human Research Ethics Committee. This information sheet is a brief explanation of my research and what is involved for participants. It also has contact information should you have any questions or concerns. Please keep this for future reference.

Participants

We are seeking at least 65 participants 17 years and older, with English as their primary language (or one of their primary languages), and with no chronic (physical or psychological) disorder.

The researchers will not link any identifying information with collected data, and will not directly contact any participant without permission.

The aim/purpose of the research

The purpose of this study is to explore the possible emotional and social benefits of belonging to different social groups – both short-term and longer-term.

Possible benefits

This research will help us understand how membership in organised social groups might impact on well-being over time.

What does the research involve?

Participation will involve completing a short questionnaire (less than 5 minutes) at the very start and at the finish of one of your sessions. These questions are on how you are feeling emotionally and physically, and how you feel about your group.

Inconvenience/discomfort

It is possible that participants may be uncomfortable in answering some of the questions about how happy you are, or about your emotions. Should you become distressed or upset while participating in the study, you are free to discontinue participation at any time, and/or contact the counselling service listed below if you wish.

Lifeline Australia
Lifeline Australia is a 24/7 phone counselling service.
Phone: 13 11 14 Website: http://www.lifeline.org.au/

Can I withdraw from the research?
Being in this study is voluntary and you are under no obligation to consent to participation. However, if you do consent to participate, you may only withdraw prior to completion of the second survey. Any information that is submitted during this time is completely anonymous, and therefore will only be withdrawn if the information is not submitted.

Confidentiality and storage of data

Participants will not be able to be identified because the data will be anonymous. Only aggregate data will be reported, and therefore all individual responses will remain confidential.
If you would like to be informed of the aggregate research findings, please contact Susan via
💻 Susan.maury@monash.edu ☎**044----**

Storage of the data collected will adhere to the University regulations and kept on University premises in a locked cupboard/filing cabinet for 5 years. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

If you would like to contact the researchers about any aspect of this study, please contact the Chief Investigator:	If you have a complaint concerning the manner in which this research CF13/909 - 2013000427 is being conducted, please contact:
A/Prof Nikki Rickard School of Psychological Sciences Monash University Victoria, 3800 Australia. 35 Rainforest Walk, D.432 (Post to 18 Innovation Walk) Email: Nikki.Rickard@monash.edu.au	Executive Officer, Human Research Ethics Monash University Human Research Ethics Committee (MUHREC) 24 Sports Walk, Room 111 Research Office Monash University VIC 3800 Tel: +61 3 9905 2052 Fax: +61 3 9905 3831 Email: muhrec@adm.monash.edu.au

Thank you,

Susan Maury
💻 Susan.maury@monash.edu ☎**044---**

Benefits of social group membership for well-being

Consent form October 2016

Data collected will be used for a Monash University research project titled ‘Benefits of social group membership for well-being’’. The purpose of this study is to explore the possible emotional and social benefits of belonging to different social groups – both short-term and longer-term.

By filling and signing this form, I consent to and understand the following:

I agree to participate in the above research project	Yes ☐	No ☐
The project will be conducted as described in the explanatory statement provided, which I have fully read and understood.	Yes ☐	No ☐
Participation in this study is voluntary, and my consent may be withdrawn at any time.	Yes ☐	No ☐
I will be asked general questions about myself including social activities I participate in, and my mood and well-being.	Yes ☐	No ☐
My answers to these surveys and questionnaires will be truthful and accurate	Yes ☐	No ☐
If any of these tests cause discomfort or distress, consent can be withdrawn and participation can cease.	Yes ☐	No ☐

Signed:________________________ **Date:**__________________________

Please note this form will be kept separate from any data which is collected, so that no data will be identified with any individual.

(Demographics for the short-term research reported in Chapter 5) Before answering the questions, please **create a unique code** which we can use to match up your questionnaire responses. This code will not identify you in any way, but will allow us to keep your results grouped together. To create the code, simply answer the questions below.

Answer here	
	What are the first three letters of your mother's maiden (unmarried) name (e.g., SMI for "Smith")?
	What is your birth month in numbers (e.g., "5" for May)?
	What is your post code's middle 2 numbers (e.g., "15" for 3157)?

Research Participant Basic Information: Please answer the following questions about yourself by ticking the appropriate option or providing information in the space provided.

1. **Are you:** ☐ Male ☐ Female 2. **In what year were you born?** ________ 3. **What is your postcode?** ____ ______

4. **What do you consider your primary language(s)?** _________________________________

5. **For most activities......** ☐ I use my left hand ☐ I use my right hand

6. **What is the highest level of education you have completed at present?**

☐ No higher than Year 10 of high school
☐ Completed High School/ V.C.E.
☐ Completed Apprenticeship
☐ T.A.F.E / College Diploma
☐ Undergraduate University Degree
☐ Graduate Diploma
☐ Post Graduate University Degree

7. **At present which situation best describes you?**

☐ Unemployed (not studying)
☐ Studying full-time
☐ Studying part-time and working part-time
☐ Working part time (not studying)
☐ Working full time (not studying)
☐ If other, please specify: ______________

8. **On average, how often do you <u>purposely</u> listen to music a day (rather than to music in the environment that you have no control over, e.g., music in cafes, stores)?**

☐ For several hours each day
☐ For about an hour a day
☐ Several times a week
☐ Several times a month
☐ Several times a year
☐ Less than once a year

9. **Have you played / do you play a music instrument (includes singing, practice and performance)?**

☐ Yes ***If Yes, answer 10 and 11.*** ☐ No

10. **At the peak of your interest, how many estimated hours per day did you play/practice this primary music instrument (includes singing)?**____________

11. **How many years of musical training have you had?** _________________

12. **What other types of organized social groups do you enjoy?**____

MONASH University

(Psychometric questionnaire used for the research into short-term benefits reported in Chapter 5. The survey used for 'post' was identical. Demographics were collected at Time 2 and are attached separately.)

Benefits of social group membership for well-being

Surveys, 1.1

Thank you for taking part in this research project. Please fill this survey prior to the start of your group activity. It can be completed in less than 5 minutes.

Before answering the questions, please **create a unique code** which we can use to match up your questionnaire responses. This code will not identify you in any way, but will allow us to keep your results grouped together. To create the code, simply answer the questions below.

Answer here	
	What are the first three letters of your mother's maiden (unmarried) name (e.g., SMI for "Smith")?
	What is your birth month in numbers (e.g., "5" for May)?
	What is your post code's middle 2 numbers (e.g., "15" for 3157)?

Please keep this top sheet attached to your responses. The surveys start on the following page.

(Positive and Negative Affect Schedule) This scale consists of a number of words that describe different feelings and emotions. Please read each item and then circle the appropriate number next to the word. Answer in a way that indicates to what extent you feel this way right now, at the present moment.

	Very slightly/ not at all	A little	Moderately	Quite a bit	Extremely
Interested	**1**	**2**	**3**	**4**	**5**
Distressed	**1**	**2**	**3**	**4**	**5**
Excited	**1**	**2**	**3**	**4**	**5**
Upset	**1**	**2**	**3**	**4**	**5**
Strong	**1**	**2**	**3**	**4**	**5**
Guilty	**1**	**2**	**3**	**4**	**5**
Scared	**1**	**2**	**3**	**4**	**5**
Hostile	**1**	**2**	**3**	**4**	**5**
Enthusiastic	**1**	**2**	**3**	**4**	**5**
Proud	**1**	**2**	**3**	**4**	**5**
Irritable	**1**	**2**	**3**	**4**	**5**
Alert	**1**	**2**	**3**	**4**	**5**
Ashamed	**1**	**2**	**3**	**4**	**5**
Inspired	**1**	**2**	**3**	**4**	**5**
Nervous	**1**	**2**	**3**	**4**	**5**
Determined	**1**	**2**	**3**	**4**	**5**
Attentive	**1**	**2**	**3**	**4**	**5**
Jittery	**1**	**2**	**3**	**4**	**5**
Active	**1**	**2**	**3**	**4**	**5**
Afraid	**1**	**2**	**3**	**4**	**5**

(Activation-Deactivation Adjective Check List) Below is a list of words describing how active and energetic you may feel. Circle the number that best describes your present agreement or disagreement with each statement as you feel right now.

	Definitely do not feel	Cannot decide	Feel slightly	Definitely feel
Active	**1**	**2**	**3**	**4**
Energetic	**1**	**2**	**3**	**4**
Vigorous	**1**	**2**	**3**	**4**
Full of pep	**1**	**2**	**3**	**4**
Lively	**1**	**2**	**3**	**4**
Still	**1**	**2**	**3**	**4**
Quiet	**1**	**2**	**3**	**4**
Placid	**1**	**2**	**3**	**4**
Calm	**1**	**2**	**3**	**4**
At rest	**1**	**2**	**3**	**4**
Tense	**1**	**2**	**3**	**4**
Intense	**1**	**2**	**3**	**4**
Clutched up	**1**	**2**	**3**	**4**
Fearful	**1**	**2**	**3**	**4**
Jittery	**1**	**2**	**3**	**4**
Wide awake	**1**	**2**	**3**	**4**
Wakeful	**1**	**2**	**3**	**4**
Sleepy	**1**	**2**	**3**	**4**
Drowsy	**1**	**2**	**3**	**4**
Tired	**1**	**2**	**3**	**4**

(Measures of Psychological Climate, Cohesion Sub-Scale) There are 5 statements below asking your opinion about how this group interacts. Please circle the number that best reflects your opinion right now.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
In this group, people pitch in to help each other out.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
In this group, people tend to get along with each other.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
In this group, people take a personal interest in one another.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
There is a lot of "team spirit" amongst this group.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I feel like I have a lot in common with the people that I know in this group.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Key data outputs: Short-term wellbeing effects (Chapter 5)

Conducted using SPSS version 24

Computation: two-way mixed measures ANOVA

Measures:

Positive affect (PANAS)

Negative affect (PANAS)

Energy (sub-scale of AD-ACL)

Calmness (sub-scale of AD-ACL)

Tension (sub-scale of AD-ACL)

Tiredness (sub-scale of AD-ACL)

Cohesion (Measures of Psychological Climate, Cohesion sub-scale)

1. Positive affect

Descriptive Statistics

	Group type	Mean	Std. Deviation	N
PA1	1.00 Choir	3.3269	.91501	26
	2.00 Exercise	3.3752	.86488	27
	3.00 Control	3.0846	.94855	26
	Total	3.2637	.90686	79
PA2	1.00 Choir	3.7038	.84923	26
	2.00 Exercise	3.6556	.84094	27
	3.00 Control	3.2654	.84803	26
	Total	3.5430	.85795	79

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.212	20.476[b]	1.000	76.000	.000	.212	20.476	.994
	Wilks' Lambda	.788	20.476[b]	1.000	76.000	.000	.212	20.476	.994
	Hotelling's Trace	.269	20.476[b]	1.000	76.000	.000	.212	20.476	.994
	Roy's Largest Root	.269	20.476[b]	1.000	76.000	.000	.212	20.476	.994
Time * Group	Pillai's Trace	.021	.831[b]	2.000	76.000	.440	.021	1.662	.187
	Wilks' Lambda	.979	.831[b]	2.000	76.000	.440	.021	1.662	.187
	Hotelling's Trace	.022	.831[b]	2.000	76.000	.440	.021	1.662	.187
	Roy's Largest Root	.022	.831[b]	2.000	76.000	.440	.021	1.662	.187

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	3.082	1	3.082	20.476	.000	.212	20.476	.994
	Greenhouse-Geisser	3.082	1.000	3.082	20.476	.000	.212	20.476	.994
	Huynh-Feldt	3.082	1.000	3.082	20.476	.000	.212	20.476	.994
	Lower-bound	3.082	1.000	3.082	20.476	.000	.212	20.476	.994
Time * Group	Sphericity Assumed	.250	2	.125	.831	.440	.021	1.662	.187
	Greenhouse-Geisser	.250	2.000	.125	.831	.440	.021	1.662	.187
	Huynh-Feldt	.250	2.000	.125	.831	.440	.021	1.662	.187
	Lower-bound	.250	2.000	.125	.831	.440	.021	1.662	.187
Error(Time)	Sphericity Assumed	11.438	76	.150					
	Greenhouse-Geisser	11.438	76.000	.150					
	Huynh-Feldt	11.438	76.000	.150					
	Lower-bound	11.438	76.000	.150					

a. Computed using alpha = .05

Pairwise Comparisons

Measure: MEASURE_1

(I) Group type	(J) Group type	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1.00 Choir	2.00 Exercise	**.000**	**.229**	**1.000**	**-.457**	**.457**
	3.00 Control	**.340**	**.231**	**.145**	**-.121**	**.801**
2.00 Exercise	1.00 Choir	**.000**	**.229**	**1.000**	**-.457**	**.457**
	3.00 Control	**.340**	**.229**	**.142**	**-.116**	**.797**
3.00 Control	1.00 Choir	**-.340**	**.231**	**.145**	**-.801**	**.121**
	2.00 Exercise	**-.340**	**.229**	**.142**	**-.797**	**.116**

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

2. Negative affect

Descriptive Statistics

	Group type	Mean	Std. Deviation	N
NA1	1.00 Choir	1.2192	.52841	26
	2.00 Exercise	1.2007	.30887	27
	3.00 Control	1.2731	.41527	26
	Total	1.2306	.42133	79
NA2	1.00 Choir	1.0731	.26315	26
	2.00 Exercise	1.0878	.25622	27
	3.00 Control	1.2654	.51299	26
	Total	1.1414	.36891	79

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.074	6.116[b]	1.000	76.000	.016	.074	6.116	.685
	Wilks' Lambda	.926	6.116[b]	1.000	76.000	.016	.074	6.116	.685
	Hotelling's Trace	.080	6.116[b]	1.000	76.000	.016	.074	6.116	.685
	Roy's Largest Root	.080	6.116[b]	1.000	76.000	.016	.074	6.116	.685
Time * Group	Pillai's Trace	.034	1.333[b]	2.000	76.000	.270	.034	2.666	.280
	Wilks' Lambda	.966	1.333[b]	2.000	76.000	.270	.034	2.666	.280
	Hotelling's Trace	.035	1.333[b]	2.000	76.000	.270	.034	2.666	.280
	Roy's Largest Root	.035	1.333[b]	2.000	76.000	.270	.034	2.666	.280

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	.312	1	.312	6.116	.016	.074	6.116	.685
	Greenhouse-Geisser	.312	1.000	.312	6.116	.016	.074	6.116	.685
	Huynh-Feldt	.312	1.000	.312	6.116	.016	.074	6.116	.685
	Lower-bound	.312	1.000	.312	6.116	.016	.074	6.116	.685
Time * Group	Sphericity Assumed	.136	2	.068	1.333	.270	.034	2.666	.280
	Greenhouse-Geisser	.136	2.000	.068	1.333	.270	.034	2.666	.280
	Huynh-Feldt	.136	2.000	.068	1.333	.270	.034	2.666	.280
	Lower-bound	.136	2.000	.068	1.333	.270	.034	2.666	.280
Error(Time)	Sphericity Assumed	3.881	76	.051					
	Greenhouse-Geisser	3.881	76.000	.051					
	Huynh-Feldt	3.881	76.000	.051					
	Lower-bound	3.881	76.000	.051					

a. Computed using alpha = .05

Pairwise Comparisons

Measure: MEASURE_1

(I) Group type	(J) Group type	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1.00 Choir	2.00 Exercise	.002	.099	.985	-.196	.200
	3.00 Control	-.123	.100	.224	-.323	.077
2.00 Exercise	1.00 Choir	-.002	.099	.985	-.200	.196
	3.00 Control	-.125	.099	.213	-.323	.073
3.00 Control	1.00 Choir	.123	.100	.224	-.077	.323
	2.00 Exercise	.125	.099	.213	-.073	.323

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

3. Energy (sub-scale of ADACL)

Descriptive Statistics

	Group type	Mean	Std. Deviation	N
Energy1 ADACL	1.00 Choir	3.0846	.77185	26
	2.00 Exercise	3.2489	.75605	27
	3.00 Control	2.8615	.86491	26
	Total	3.0673	.80428	79
Energy2 ADACL	1.00 Choir	3.2208	.75152	26
	2.00 Exercise	3.3704	.67415	27
	3.00 Control	2.8923	.68406	26
	Total	3.1638	.72313	79

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.027	2.098[b]	1.000	76.000	.152	.027	2.098	.298
	Wilks' Lambda	.973	2.098[b]	1.000	76.000	.152	.027	2.098	.298
	Hotelling's Trace	.028	2.098[b]	1.000	76.000	.152	.027	2.098	.298
	Roy's Largest Root	.028	2.098[b]	1.000	76.000	.152	.027	2.098	.298
Time * Group	Pillai's Trace	.006	.244[b]	2.000	76.000	.784	.006	.489	.087
	Wilks' Lambda	.994	.244[b]	2.000	76.000	.784	.006	.489	.087
	Hotelling's Trace	.006	.244[b]	2.000	76.000	.784	.006	.489	.087
	Roy's Largest Root	.006	.244[b]	2.000	76.000	.784	.006	.489	.087

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	**.365**	**1**	**.365**	**2.098**	**.152**	**.027**	**2.098**	**.298**
	Greenhouse-Geisser	**.365**	**1.000**	**.365**	**2.098**	**.152**	**.027**	**2.098**	**.298**
	Huynh-Feldt	**.365**	**1.000**	**.365**	**2.098**	**.152**	**.027**	**2.098**	**.298**
	Lower-bound	**.365**	**1.000**	**.365**	**2.098**	**.152**	**.027**	**2.098**	**.298**
Time * Group	Sphericity Assumed	**.085**	**2**	**.043**	**.244**	**.784**	**.006**	**.489**	**.087**
	Greenhouse-Geisser	**.085**	**2.000**	**.043**	**.244**	**.784**	**.006**	**.489**	**.087**
	Huynh-Feldt	**.085**	**2.000**	**.043**	**.244**	**.784**	**.006**	**.489**	**.087**
	Lower-bound	**.085**	**2.000**	**.043**	**.244**	**.784**	**.006**	**.489**	**.087**
Error(Time)	Sphericity Assumed	**13.220**	**76**	**.174**					
	Greenhouse-Geisser	**13.220**	**76.000**	**.174**					
	Huynh-Feldt	**13.220**	**76.000**	**.174**					
	Lower-bound	**13.220**	**76.000**	**.174**					

a. Computed using alpha = .05

Pairwise Comparisons

Measure: MEASURE_1

(I) Group type	(J) Group type	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1.00 Choir	2.00 Exercise	**-.157**	**.190**	**.412**	**-.536**	**.222**
	3.00 Control	**.276**	**.192**	**.155**	**-.107**	**.658**
2.00 Exercise	1.00 Choir	**.157**	**.190**	**.412**	**-.222**	**.536**
	3.00 Control	**.433***	**.190**	**.026**	**.054**	**.812**
3.00 Control	1.00 Choir	**-.276**	**.192**	**.155**	**-.658**	**.107**
	2.00 Exercise	**-.433***	**.190**	**.026**	**-.812**	**-.054**

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

4. Calmness (sub-scale of ADACL)

Descriptive Statistics

	Group type	Mean	Std. Deviation	N
Calm1 ADACL	1.00 Choir	**2.6538**	**.59210**	**26**
	2.00 Exercise	**2.3530**	**.69068**	**27**
	3.00 Control	**2.1692**	**.96779**	**26**
	Total	**2.3915**	**.78199**	**79**
Calm2 ADACL	1.00 Choir	**2.3754**	**.58600**	**26**
	2.00 Exercise	**2.3852**	**.72733**	**27**
	3.00 Control	**2.1923**	**.66569**	**26**
	Total	**2.3185**	**.66057**	**79**

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	**.008**	**.649[b]**	**1.000**	**76.000**	**.423**	**.008**	**.649**	**.125**
	Wilks' Lambda	**.992**	**.649[b]**	**1.000**	**76.000**	**.423**	**.008**	**.649**	**.125**
	Hotelling's Trace	**.009**	**.649[b]**	**1.000**	**76.000**	**.423**	**.008**	**.649**	**.125**
	Roy's Largest Root	**.009**	**.649[b]**	**1.000**	**76.000**	**.423**	**.008**	**.649**	**.125**
Time * Group	Pillai's Trace	**.031**	**1.215[b]**	**2.000**	**76.000**	**.302**	**.031**	**2.431**	**.258**
	Wilks' Lambda	**.969**	**1.215[b]**	**2.000**	**76.000**	**.302**	**.031**	**2.431**	**.258**
	Hotelling's Trace	**.032**	**1.215[b]**	**2.000**	**76.000**	**.302**	**.031**	**2.431**	**.258**
	Roy's Largest Root	**.032**	**1.215[b]**	**2.000**	**76.000**	**.302**	**.031**	**2.431**	**.258**

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	.219	1	.219	.649	.423	.008	.649	.125
	Greenhouse-Geisser	.219	1.000	.219	.649	.423	.008	.649	.125
	Huynh-Feldt	.219	1.000	.219	.649	.423	.008	.649	.125
	Lower-bound	.219	1.000	.219	.649	.423	.008	.649	.125
Time * Group	Sphericity Assumed	.818	2	.409	1.215	.302	.031	2.431	.258
	Greenhouse-Geisser	.818	2.000	.409	1.215	.302	.031	2.431	.258
	Huynh-Feldt	.818	2.000	.409	1.215	.302	.031	2.431	.258
	Lower-bound	.818	2.000	.409	1.215	.302	.031	2.431	.258
Error(Time)	Sphericity Assumed	25.583	76	.337					
	Greenhouse-Geisser	25.583	76.000	.337					
	Huynh-Feldt	25.583	76.000	.337					
	Lower-bound	25.583	76.000	.337					

a. Computed using alpha = .05

Pairwise Comparisons

Measure: MEASURE_1

(I) Group type	(J) Group type	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1.00 Choir	2.00 Exercise	.146	.161	.370	-.176	.467
	3.00 Control	.334*	.163	.044	.009	.658
2.00 Exercise	1.00 Choir	-.146	.161	.370	-.467	.176
	3.00 Control	.188	.161	.247	-.133	.510
3.00 Control	1.00 Choir	-.334*	.163	.044	-.658	-.009
	2.00 Exercise	-.188	.161	.247	-.510	.133

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

5. Tension (sub-scale of ADACL)

Descriptive Statistics

	Group type	Mean	Std. Deviation	N
Tension1 ADACL	1.00 Choir	**1.3769**	**.52863**	**26**
	2.00 Exercise	**1.3704**	**.53408**	**27**
	3.00 Control	**1.4231**	**.48769**	**26**
	Total	**1.3899**	**.51131**	**79**
Tension2W ADACL	1.00 Choir	**1.2500**	**.42426**	**26**
	2.00 Exercise	**1.2815**	**.44810**	**27**
	3.00 Control	**1.4846**	**.70467**	**26**
	Total	**1.3380**	**.54280**	**79**

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	**.016**	**1.244[b]**	**1.000**	**76.000**	**.268**	**.016**	**1.244**	**.196**
	Wilks' Lambda	**.984**	**1.244[b]**	**1.000**	**76.000**	**.268**	**.016**	**1.244**	**.196**
	Hotelling's Trace	**.016**	**1.244[b]**	**1.000**	**76.000**	**.268**	**.016**	**1.244**	**.196**
	Roy's Largest Root	**.016**	**1.244[b]**	**1.000**	**76.000**	**.268**	**.016**	**1.244**	**.196**
Time * Group	Pillai's Trace	**.039**	**1.543[b]**	**2.000**	**76.000**	**.220**	**.039**	**3.086**	**.318**
	Wilks' Lambda	**.961**	**1.543[b]**	**2.000**	**76.000**	**.220**	**.039**	**3.086**	**.318**
	Hotelling's Trace	**.041**	**1.543[b]**	**2.000**	**76.000**	**.220**	**.039**	**3.086**	**.318**
	Roy's Largest Root	**.041**	**1.543[b]**	**2.000**	**76.000**	**.220**	**.039**	**3.086**	**.318**

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	.104	1	.104	1.244	.268	.016	1.244	.196
	Greenhouse-Geisser	.104	1.000	.104	1.244	.268	.016	1.244	.196
	Huynh-Feldt	.104	1.000	.104	1.244	.268	.016	1.244	.196
	Lower-bound	.104	1.000	.104	1.244	.268	.016	1.244	.196
Time * Group	Sphericity Assumed	.259	2	.129	1.543	.220	.039	3.086	.318
	Greenhouse-Geisser	.259	2.000	.129	1.543	.220	.039	3.086	.318
	Huynh-Feldt	.259	2.000	.129	1.543	.220	.039	3.086	.318
	Lower-bound	.259	2.000	.129	1.543	.220	.039	3.086	.318
Error(Time)	Sphericity Assumed	6.377	76	.084					
	Greenhouse-Geisser	6.377	76.000	.084					
	Huynh-Feldt	6.377	76.000	.084					
	Lower-bound	6.377	76.000	.084					

a. Computed using alpha = .05

Pairwise Comparisons

Measure: MEASURE_1

(I) Group type	(J) Group type	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a] Lower Bound	Upper Bound
1.00 Choir	2.00 Exercise	-.012	.134	.926	-.279	.254
	3.00 Control	-.140	.135	.302	-.410	.129
2.00 Exercise	1.00 Choir	.012	.134	.926	-.254	.279
	3.00 Control	-.128	.134	.342	-.395	.139
3.00 Control	1.00 Choir	.140	.135	.302	-.129	.410
	2.00 Exercise	.128	.134	.342	-.139	.395

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

6. Tiredness (sub-scale of ADACL)

Descriptive Statistics

	Group type	Mean	Std. Deviation	N
TirednessR1 ADACL	1.00 Choir	2.1000	.74027	26
	2.00 Exercise	2.0641	.75208	27
	3.00 Control	1.9308	.62723	26
	Total	2.0320	.70398	79
Tiredness2R ADACL	1.00 Choir	2.0331	.63414	26
	2.00 Exercise	1.7630	.47729	27
	3.00 Control	1.7638	.36834	26
	Total	1.8522	.51437	79

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.081	6.674[b]	1.000	76.000	.012	.081	6.674	.723
	Wilks' Lambda	.919	6.674[b]	1.000	76.000	.012	.081	6.674	.723
	Hotelling's Trace	.088	6.674[b]	1.000	76.000	.012	.081	6.674	.723
	Roy's Largest Root	.088	6.674[b]	1.000	76.000	.012	.081	6.674	.723
Time * Group	Pillai's Trace	.025	.974[b]	2.000	76.000	.382	.025	1.948	.213
	Wilks' Lambda	.975	.974[b]	2.000	76.000	.382	.025	1.948	.213
	Hotelling's Trace	.026	.974[b]	2.000	76.000	.382	.025	1.948	.213
	Roy's Largest Root	.026	.974[b]	2.000	76.000	.382	.025	1.948	.213

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	1.256	1	1.256	6.674	.012	.081	6.674	.723
	Greenhouse-Geisser	1.256	1.000	1.256	6.674	.012	.081	6.674	.723
	Huynh-Feldt	1.256	1.000	1.256	6.674	.012	.081	6.674	.723
	Lower-bound	1.256	1.000	1.256	6.674	.012	.081	6.674	.723
Time * Group	Sphericity Assumed	.366	2	.183	.974	.382	.025	1.948	.213
	Greenhouse-Geisser	.366	2.000	.183	.974	.382	.025	1.948	.213
	Huynh-Feldt	.366	2.000	.183	.974	.382	.025	1.948	.213
	Lower-bound	.366	2.000	.183	.974	.382	.025	1.948	.213
Error(Time)	Sphericity Assumed	14.298	76	.188					
	Greenhouse-Geisser	14.298	76.000	.188					
	Huynh-Feldt	14.298	76.000	.188					
	Lower-bound	14.298	76.000	.188					

a. Computed using alpha = .05

Pairwise Comparisons

Measure: MEASURE_1

(I) Group type	(J) Group type	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1.00 Choir	2.00 Exercise	.153	.147	.300	-.139	.445
	3.00 Control	.219	.148	.143	-.076	.514
2.00 Exercise	1.00 Choir	-.153	.147	.300	-.445	.139
	3.00 Control	.066	.147	.653	-.226	.358
3.00 Control	1.00 Choir	-.219	.148	.143	-.514	.076
	2.00 Exercise	-.066	.147	.653	-.358	.226

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

7. Cohesion

Descriptive Statistics

	Group type	Mean	Std. Deviation	N
Cohesion1	1.00 Choir	5.8762	.77732	26
	2.00 Exercise	5.8096	.79760	27
	3.00 Control	5.4846	1.01062	26
	Total	5.7246	.87317	79
Cohesion2	1.00 Choir	6.1000	.72056	26
	2.00 Exercise	5.9815	.73434	27
	3.00 Control	5.4615	1.04884	26
	Total	5.8494	.88083	79

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.051	4.064[b]	1.000	76.000	.047	.051	4.064	.512
	Wilks' Lambda	.949	4.064[b]	1.000	76.000	.047	.051	4.064	.512
	Hotelling's Trace	.053	4.064[b]	1.000	76.000	.047	.051	4.064	.512
	Roy's Largest Root	.053	4.064[b]	1.000	76.000	.047	.051	4.064	.512
Time * Group	Pillai's Trace	.037	1.473[b]	2.000	76.000	.236	.037	2.947	.306
	Wilks' Lambda	.963	1.473[b]	2.000	76.000	.236	.037	2.947	.306
	Hotelling's Trace	.039	1.473[b]	2.000	76.000	.236	.037	2.947	.306
	Roy's Largest Root	.039	1.473[b]	2.000	76.000	.236	.037	2.947	.306

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	.609	1	.609	4.064	.047	.051	4.064	.512
	Greenhouse-Geisser	.609	1.000	.609	4.064	.047	.051	4.064	.512
	Huynh-Feldt	.609	1.000	.609	4.064	.047	.051	4.064	.512
	Lower-bound	.609	1.000	.609	4.064	.047	.051	4.064	.512
Time * Group	Sphericity Assumed	.442	2	.221	1.473	.236	.037	2.947	.306
	Greenhouse-Geisser	.442	2.000	.221	1.473	.236	.037	2.947	.306
	Huynh-Feldt	.442	2.000	.221	1.473	.236	.037	2.947	.306
	Lower-bound	.442	2.000	.221	1.473	.236	.037	2.947	.306
Error(Time)	Sphericity Assumed	11.392	76	.150					
	Greenhouse-Geisser	11.392	76.000	.150					
	Huynh-Feldt	11.392	76.000	.150					
	Lower-bound	11.392	76.000	.150					

a. Computed using alpha = .05

Pairwise Comparisons

Measure: MEASURE_1

(I) Group type	(J) Group type	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b] Lower Bound	Upper Bound
1.00 Choir	2.00 Exercise	.093	.223	.680	-.352	.537
	3.00 Control	.515*	.225	.025	.066	.964
2.00 Exercise	1.00 Choir	-.093	.223	.680	-.537	.352
	3.00 Control	.422	.223	.062	-.022	.867
3.00 Control	1.00 Choir	-.515*	.225	.025	-.964	-.066
	2.00 Exercise	-.422	.223	.062	-.867	.022

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

(The directions for the raters and the tally sheet for the observational methodology described in the short-term research reported in Chapter 5 are provided here. The raters also practiced in advance with videos and in a crowded room, with permission from the Monash Human Ethics Research Committee.)

Observation checklist – group interactions

OVERVIEW & GENERAL DESCRIPTION

This observation checklist, adapted from Bartel and Saavedra (2000), is designed to observe the collective mood of a group through their body language. It is based on the circumplex model of emotions, and is divided into four quadrants: Activated pleasant/pleasant, unactivated pleasant, unactivated unpleasant/unpleasant, and activated unpleasant. Within these categories, there are lists of highly visible observations which can be recorded in any group: body, movement, physical contact, and hands. Additionally, there are also low-visibility observations which can be recorded for smaller groups, or individuals in a larger group: mouth, eyes, and eyebrows.

GENERAL INSTRUCTIONS

1. There should be two raters.
2. Fill in the information at the top of the form (name of Group, Size of group, Number included in observation, Date, Time, Rater name).
3. Provide a short description of what the group is doing – are they sitting or standing? Are they waiting for the formal group activities to start, are they enjoying a tea break, are they breaking up for the evening? The form should be filled when the formal group activities are NOT underway, but rather during down-time prior to, after, or during a break.
4. Only record for each person once.
5. This tool is designed to capture a point in time, and should be filled prior to the start of the group's commencement (waiting period). A second form needs to be filled either when the group is at break in the middle of the activity, or at the end, when they have finished.
6. Ideally, the form should capture what each individual in the room is doing with respect to each of the first set of highly visible categories. Therefore, if there are 30 people in the room, there ought to be 30 hash marks across the line marked "Body," for example.
7. Once all of the highly visible items have been filled, go back and fill low-visibility observations as able.
8. If the group is deemed too big, the two raters must agree on how to restrict the group (e.g., a defined sub-group). Note this at the top of the sheet. Attempt to record at least 50 members, and attempt to record the same 50 members pre- and post- the organised group activity.
9. Fill a sheet prior to the start of the organised activity. Fill a second sheet either at the close of the activity, or during a break.

Group:_____________________________ Size: ________# observed:_________ Date:_____________ Time: _______________ Rater: ____________

Is the group primarily sitting or standing? ________________ What is the group doing? (e.g., waiting to start, tea break) _________________________

		Activated pleasant - pleasant	Unactivated pleasant	Unactivated unpleasant - unpleasant	Activated unpleasant
High visibility actions: Fill for each observed individual	Body	Leaning forward Orienting towards others	Relaxed but engaged orientation towards group	Orienting away from group Slouching	Body poised to exclude group members
	Movement	Constant body movement	Little movement in torso or limbs	Motionless Resting head on hands	Nervous habits (rocking, biting fingernails)
	Physical Contact	High physical contact	Moderate contact	No contact	Avoiding contact
	Hands	Exaggerated hand gestures Hands active during speech	Minimal hand movement	Hands inactive during speech Rubbing eyes	Closed fists Hand tremors
Low visibility actions: fill for each observed individual as able	Mouth	Smiling with teeth showing Grin (big closed lipped smile)	Mouth turned slightly upwards, open or closed	Yawning Mouth turned downwards	Sneering Clenched teeth
	Eyes	High eye contact	Moderate eye contact	Little eye contact Blank stare	Avoiding eye contact

MONASH University

(This consent form was used to obtain consent from group members for the observation sessions reported in Chapter 5. This process was also explained to the group verbally the week prior, to ensure they understood the process.)

Benefits of social group membership for well-being

Individual members of this group are participating in the above-named research, being conducted by Susan Maury, PhD candidate at Monash University.

As part of this process, researchers will be passively observing the group's interactions at this session. We will be looking at things such as hand gestures, facial expressions, and body posture. This will be completely uninvasive. Information is tallied using hash marks and is therefore not identified back to any individual.

We would like to observe the group as a whole for this process. Please provide your consent below. If you prefer to not be included in the observation, speak to me directly.

Many thanks,
Susan Maury
044 ----
Susan.maury@monash.edu

I give my permission to be observed during this session.

Observation data compilation of ratings

June 2016

Nunawading U3A choir

NOTE: This group does not take a mid-session break.

U3A Nunawading choir Round 1: pre-session	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	5	6	15	11	10	5	0	1
Movement	4	2	22	15	5	6	0	0
Physical contact	0	2	2	1	27	20	0	0
Hands	6	3	20	13	5	6	0	0
Mouth	4	3	20	13	1	5	0	0
Eyes	2	2	16	15	8	5	0	0
TOTALS	21	18	95	68	56	47	0	1
	39/2 = 20		163/2 = 82		103/2 = 52		1	

U3A Nunawading choir Round 3: post session	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	10	11	6	8	6	5	0	0
Movement	12	6	12	15	0	3	0	0
Physical contact	0	5	1	2	23	17	0	0
Hands	9	4	15	17	0	3	0	0
Mouth	13	5	9	16	1	2	0	0
Eyes	10	10	12	12	1	1	0	0
TOTALS	54	41	55	70	31	31	0	0
	95/2 = 48		125/2 = 63		62/2 = 31		0	

Observational data – Open Door Singers community choir

Open Door Singers Round 1: pre-session	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	6	20	16	9	10	1	0	0
Movement	6	3	14	25	12	2	0	0
Physical contact	3	0	0	0	27	28	0	1
Hands	5	11	15	16	14	3	0	0
Mouth	5	5	15	22	13	3	0	1
Eyes	8	14	17	11	8	6	0	1
TOTALS	33	53	77	83	84	43	0	2
	86/2 = 43		160/2 = 80		127/2 = 64		5/2 = 3	

Open Door Singers Round 2: mid-session break	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	3	20	14	18	4	3	0	0
Movement	10	3	16	38	5	1	0	0
Physical contact	0	1	0	2	31	38	2	0
Hands	9	7	23	33	3	0	0	0
Mouth	8	4	22	30	1	5	0	0
Eyes	14	27	12	10	4	3	0	0
TOTALS	44	62	87	131	48	50	2	0
	106/2 = 52		218/2 = 109		98/2 = 49		2/2 = 1	

Open Door Singers Round 3: post-session	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	4	5	5	3	1	1	0	0
Movement	5	13	7	3	0	0	0	0
Physical contact	1	6	5	3	4	5	0	0
Hands	5	10	7	5	3	0	0	0
Mouth	7	8	3	3	1	3	0	0
Eyes	9	15	2	0	0	0	0	0
TOTALS	31	57	29	17	9	9	0	0
	88/2 = 44		46/2 = 23		19/2 = 9		0	

Observational data – Box Hill Community Arts Centre Choir

BHCAC Choir Round 1: pre-session	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	0	0	9	10	0	0	0	0
Movement	0	0	7	10	2	0	0	0
Physical contact	0	0	0	0	9	10	0	0
Hands	0	0	5	5	4	5	0	0
Mouth	2	2	7	8	0	0	0	0
Eyes	0	9	7	1	0	0	0	0
TOTALS	2	11	35	34	15	15	0	0
	13/2 = 7		69/2 = 35		30/2 = 15		0	

BHCAC Choir Round 2: mid-session break	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	2	7	16	6	2	2	0	0
Movement	4	3	14	12	0	0	0	0
Physical contact	0	0	0	0	18	15	0	0
Hands	6	4	10	7	2	4	0	0
Mouth	1	3	6	13	7	0	0	0
Eyes	2	10	14	3	2	2	0	0
TOTALS	15	27	60	41	31	23	0	0
	42/2 = 21		101/2 = 51		54/2 = 27		0	

The group left quickly at the end of the session, and it was therefore not possible to make a third observation.

Observation data, Tai Chi 3 exercise group

Tai Chi 3 Round 1: pre-session	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	4	2	14	18	4	1	0	3
Movement	4	0	17	20	4	3	0	0
Physical contact	1	0	1	0	28	25	0	0
Hands	2	0	25	25	5	0	0	0
Mouth	2	0	7	13	15	10	0	0
Eyes	15	8	15	15	5	2	0	0
TOTALS	28	10	79	91	61	41	0	0
	38/2 = 19		170/2 = 85		102/2 = 52		0	

Tai Chi 3 Round 2: mid-session break	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	7	13	18	22	2	0	0	0
Movement	6	10	23	25	0	2	0	0
Physical contact	3	0	1	3	30	30	0	0
Hands	11	12	23	30	8	0	0	0
Mouth	3	5	5	35	3	0	0	0
Eyes	20	28	20	12	3	3	0	1
	50	68	90	127	46	35	0	1
	118/2 = 59		217/2 = 109		81/2 = 41		1	

Tai Chi 3 Round 3: post-session	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	10	7	7	2	2	0	0	0
Movement	7	1	9	9	0	0	0	0
Physical contact	4	0	0	1	9	11	0	0
Hands	5	2	4	8	1	0	0	0
Mouth	7	2	7	9	0	0	0	0
Eyes	7	6	4	4	0	1	0	0
	40	18	31	33	12	12	0	0
	58/2 = 29		64/2 = 32		24/2 = 12		0	

Observation data, Moderate Active exercise group

Moderate Active Round 1: pre-session	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	3	4	13	16	1	0	1	0
Movement	1	2	16	13	1	7	0	0
Physical contact	0	0	2	2	15	18	0	0
Hands	2	8	11	12	3	0	0	0
Mouth	3	3	10	13	3	0	0	0
Eyes	4	2	11	11	3	2	0	0
TOTALS	13	19	63	67	26	27	0	0
	32/2 = 16		130/2 = 65		53/2 = 27		0	

NOTE: This group did not take a break mid-session.

Moderate Active Round 3: post session	**Activated pleasant - pleasant**		**Unactivated pleasant**		**Unactivated unpleasant - unpleasant**		**Activated unpleasant**	
	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2	Rater 1	Rater 2
Body	1	5	5	3	2	0	0	0
Movement	2	0	6	5	0	0	0	0
Physical contact	0	2	0	4	6	0	0	0
Hands	2	3	5	2	1	0	0	0
Mouth	0	3	5	3	0	0	0	0
Eyes	0	0	4	0	2	0	0	0
TOTALS	5	13	25	17	11	0	0	0
	18/2 = 9		42/2 = 21		11/2 = 6		0	

Chi-squared analysis, observational data

August 2017

Calculated using means

Activated Pleasant	T1	T2	T3	Totals
Choir	69 67	74 85	92 83	235
Exercise	35 37	59 48	38 47	132
Totals	104	133	130	367

$\chi^2 = (69\text{-}67)^2/67 + (74\text{-}85)^2/85 + (92\text{-}83)^2/83 + (35\text{-}37)^2/37 + (59\text{-}48)^2/48 + (38\text{-}47)^2/47$

$= .06 + 1.42 + .98 + .11 + 2.5 + 1.72$

$= 6.99$, p=.030

Unactivated Pleasant	T1	T2	T3	Totals
Choir	196 203	160 158	86 81	442
Exercise	150 143	109 111	53 58	312
Totals	346	269	139	754

$\chi^2 = (196\text{-}203)^2/203 + (160\text{-}158)^2/158 + (86\text{-}81)^2/81 + (150\text{-}143)^2/143 + (109\text{-}111)^2/111$

$+ (53\text{-}58)^2/58$

$= .241 + .025 + .308 + .342 + .036 + .431$

$= 1.383$, p=.5008

Unactivated Unpleasant	T1	T2	T3	Totals
Choir	130 134	76 75	40 37	246
Exercise	78 74	41 42	18 21	137
Totals	208	117	58	383

χ^2 = $(130\text{-}134)^2/134 + (76\text{-}75)^2/75 + (40\text{-}37)^2/37 + (78\text{-}74)^2/74 + (41\text{-}42)^2/42\ (18\text{-}21)^2/21$

= .118 + .013 + .243 + .216 + .024 + .429

= 1.044, p=.5933

NOT RUN USING THE MEANS – LOW NUMBERS, NO SIGNIFICANT DIFFERENCES BETWEEN RATERS

Activated Unpleasant*	T1	T2	T3	Totals
Choir	9 405	7 314	5 115	21
Exercise	10 286	6 314	5 115	21
Totals	19	13	10	42

** Note that, due to the very low number of observations in the Activated Unpleasant category, +5 was added to each total in order to allow the chi squared analysis to be performed.*

χ^2 = $(9\text{-}10)^2/10 + (7\text{-}7)^2/7 + (5\text{-}5)^2/5 + (10\text{-}10)^2/10 + (6\text{-}7)^2/7 + (5\text{-}5)2/5$

= .1 + 0 + 0 + 0 + .1 + 0

= .2, p=.905

Appendix C: Supporting documents for investigation into persistent wellbeing effects (Chapter 6)

This appendix includes supporting documentation on the data collection methods for the longer-term research reported in Chapter 6. It includes, in order:

- Demographics questionnaire
- Psychometric questionnaires
- Open-ended questions
- Key data outputs (psychometric questionnaires)

MONASH University

(Demographics and psychometric questionnaires used for the longer-term study reported in Chapter 6. The participant plain language statement and consent form was shared with the short-term study (reported in Chapter 5.)

Benefits of social group membership for well-being

Surveys, 2.1

Thank you for taking part in this research project. This survey can be filled in at home and returned at your next social group meeting, mailed using the postage-paid envelope provided, or if you prefer can be filled online at: http://bit.ly/1MiXQEd

This survey can be completed in less than 15 minutes.

Before answering the questions, please **create a unique code** which we can use to match up your questionnaire responses. This code will not identify you in any way, but will allow us to keep your results grouped together. To create the code, simply answer the questions below.

Answer here	
	What are the first three letters of your mother's maiden (unmarried) name (e.g., SMI for "Smith")?
	What is your birth month in numbers (e.g., "5" for May)?
	What is your post code's middle 2 numbers (e.g., "15" for 3157)?

☐ U3A Nunawading choir (Wed 10:45)

☐ U3A Nunawading Tai Chi 3 (Friday 10:45)

☐ U3A Nunawading Gentle (Wed 9:30)

☐ U3A Nunawading Moderate Active 1 (Wed 9:45)

☐ U3A Nunawading Hand and Foot (Wed noon)

☐ U3A Manningham Singing for Pleasure (Friday 10:30)

☐ Box Hill Community Arts Centre Choir

☐ Open Door Singers Diamond Valley

☐ U3A Nunawading Tai Chi 1 (Friday 9:30)

Please keep this top sheet attached to your responses. The surveys start on the following page.

Research Participant Basic Information Sheet

Please answer the following questions about yourself by ticking the appropriate option or providing information in the space provided.

1. **Are you:** ☐ Male ☐ Female

2. **In what year were you born?** ________________

3. **What is your postcode?** _______________

4. **What do you consider your primary language(s)?** ____

5. **For most activities......** ☐ I use my left hand ☐ I use my right hand

6. **What is the highest level of education you have completed at present?**

☐ No higher than Year 10 of high school
☐ Completed High School/ V.C.E.
☐ Completed Apprenticeship
☐ T.A.F.E / College Diploma
☐ Undergraduate University Degree
☐ Graduate Diploma
☐ Post Graduate University Degree

7. **At present which situation best describes you?**

☐ Unemployed (not studying)
☐ Studying full-time
☐ Studying part-time and working part-time
☐ Working part time (not studying)
☐ Working full time (not studying)
☐ If other, please specify:
____

8. **On average, how often do you <u>purposely</u> listen to music a day (rather than to music in the environment that you have no control over, e.g., music in cafes, stores)?**

☐ For several hours each day
☐ For about an hour a day
☐ Several times a week
☐ Several times a month
☐ Several times a year
☐ Less than once a year

9. **Have you played / do you play a music instrument (includes singing, practice and performance)?**
☐ Yes ☐ No
If 9=Yes, answer 10 and 11.

10. **At the peak of your interest, how many estimated hours per day did you play/practice this primary music instrument (includes singing)?**____________

11. **How many years of musical training have you had?** __________________

12. **What other types of organized social groups do you enjoy?**_____________________________________

(Positive and Negative Affect Schedule) This scale consists of a number of words that describe different feelings and emotions. Please read each item and then circle the appropriate answer/number next to the word. Answer in a way that indicates to what extent you feel this way generally, over the past 2 weeks.

	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Interested	**1**	**2**	**3**	**4**	**5**
Distressed	**1**	**2**	**3**	**4**	**5**
Excited	**1**	**2**	**3**	**4**	**5**
Upset	**1**	**2**	**3**	**4**	**5**
Strong	**1**	**2**	**3**	**4**	**5**
Guilty	**1**	**2**	**3**	**4**	**5**
Scared	**1**	**2**	**3**	**4**	**5**
Hostile	**1**	**2**	**3**	**4**	**5**
Enthusiastic	**1**	**2**	**3**	**4**	**5**
Proud	**1**	**2**	**3**	**4**	**5**
Irritable	**1**	**2**	**3**	**4**	**5**
Alert	**1**	**2**	**3**	**4**	**5**
Ashamed	**1**	**2**	**3**	**4**	**5**
Inspired	**1**	**2**	**3**	**4**	**5**
Nervous	**1**	**2**	**3**	**4**	**5**
Determined	**1**	**2**	**3**	**4**	**5**
Attentive	**1**	**2**	**3**	**4**	**5**
Jittery	**1**	**2**	**3**	**4**	**5**
Active	**1**	**2**	**3**	**4**	**5**
Afraid	**1**	**2**	**3**	**4**	**5**

(Warwick-Edinburgh Mental Well-Being Scale) Below are some statements about feelings and thoughts. Please circle the number that best describes your experience of each generally, over the last 2 weeks.

STATEMENTS	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future	**1**	**2**	**3**	**4**	**5**
I've been feeling useful	**1**	**2**	**3**	**4**	**5**
I've been feeling relaxed	**1**	**2**	**3**	**4**	**5**
I've been dealing with problems well	**1**	**2**	**3**	**4**	**5**
I've been thinking clearly	**1**	**2**	**3**	**4**	**5**
I've been feeling close to other people	**1**	**2**	**3**	**4**	**5**
I've been able to make up my own mind about things	**1**	**2**	**3**	**4**	**5**

(Multidimensional Scale of Social Support) Following are 12 statements about relationships. Circle the number that best reflects your experience generally, over the past 2 weeks.

	Strongly disagree	Disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Agree	Strongly agree
There is a special person who is around when I am in need.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
There is a special person whom I can share my joys and sorrows.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
My family really tries to help me.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I get the emotional help and support I need from my family.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I have a special person who is a real source of comfort to me.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
My friends really try to help me.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I can count on my friends when things go wrong.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I can talk about my problems with my family.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I have friends with whom I can share my joys and sorrows.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
There is a special person in my life who cares about my feelings.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
My family is willing to help me make decisions.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I can talk about my problems with my friends.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

(Perceived Empathy Self-Efficacy Scale) Following are 6 statements about identifying another person's state of mind. Circle the number that most reflects your experiences generally, over the past 2 weeks.

How well can you…	Not well at all	Rarely	Some of the time	Often	Very well
Read your friends' needs?	**1**	**2**	**3**	**4**	**5**
Recognise when someone wants comfort and emotional support, even if s/he does not overtly exhibit it?	**1**	**2**	**3**	**4**	**5**
Recognise whether a person is annoyed with you?	**1**	**2**	**3**	**4**	**5**
Recognise when a person is inhibited by fear?	**1**	**2**	**3**	**4**	**5**
Recognise when a companion needs your help?	**1**	**2**	**3**	**4**	**5**
Recognise when a person is experiencing depression?	**1**	**2**	**3**	**4**	**5**

Open-ended questions. Please take a minute to respond to the following questions concerning your experiences with this group. Feel free to use the back of this sheet if you would like more room to reply.

Additional questions added for rounds two and three:

Are you still regularly attending your group? ☐ *YES* ☐ *NO*

If not, how many weeks has it been since you last attended? ________________________________

What interested you in joining this group?
Question for rounds two and three: What benefits, if any, are you experiencing as a result of participating in this group?

What benefits do you hope to get from joining this group?
Question for rounds 2 and 3: Can you identify changes you've experienced in your life generally – that is, external to this group – as a result of your participation?

Key data outputs: Longer-term wellbeing effects (Chapter 6)

Conducted using SPSS version 24

Computation: two-way mixed measures ANOVA

Measures:

Emotional wellbeing (PANAS)

Mental wellbeing (WEMWBS)

Sense of social connection (MSPSS)

Perceived empathic self-efficacy (PESE)

1. Emotional wellbeing - PANAS (Time 1 – Time 3)

Descriptive Statistics

	Group	Mean	Std. Deviation	N
PANAS1T	Choir	18.4500	11.38085	20
	Exercise	17.1765	11.60583	34
	Total	17.6481	11.43176	54
PANAS2T	Choir	22.6000	11.18458	20
	Exercise	17.4412	11.71684	34
	Total	19.3519	11.68963	54

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.066	3.666[b]	1.000	52.000	.061	.066	3.666	.468
	Wilks' Lambda	.934	3.666[b]	1.000	52.000	.061	.066	3.666	.468
	Hotelling's Trace	.071	3.666[b]	1.000	52.000	.061	.066	3.666	.468
	Roy's Largest Root	.071	3.666[b]	1.000	52.000	.061	.066	3.666	.468
Time * Group	Pillai's Trace	.052	2.839[b]	1.000	52.000	.098	.052	2.839	.380
	Wilks' Lambda	.948	2.839[b]	1.000	52.000	.098	.052	2.839	.380
	Hotelling's Trace	.055	2.839[b]	1.000	52.000	.098	.052	2.839	.380
	Roy's Largest Root	.055	2.839[b]	1.000	52.000	.098	.052	2.839	.380

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	122.712	1	122.712	3.666	.061	.066	3.666	.468
	Greenhouse-Geisser	122.712	1.000	122.712	3.666	.061	.066	3.666	.468
	Huynh-Feldt	122.712	1.000	122.712	3.666	.061	.066	3.666	.468
	Lower-bound	122.712	1.000	122.712	3.666	.061	.066	3.666	.468
Time * Group	Sphericity Assumed	95.046	1	95.046	2.839	.098	.052	2.839	.380
	Greenhouse-Geisser	95.046	1.000	95.046	2.839	.098	.052	2.839	.380
	Huynh-Feldt	95.046	1.000	95.046	2.839	.098	.052	2.839	.380
	Lower-bound	95.046	1.000	95.046	2.839	.098	.052	2.839	.380
Error(Time)	Sphericity Assumed	1740.584	52	33.473					
	Greenhouse-Geisser	1740.584	52.000	33.473					
	Huynh-Feldt	1740.584	52.000	33.473					
	Lower-bound	1740.584	52.000	33.473					

a. Computed using alpha = .05

2. Mental wellbeing – WEMWBS (T1 – T2)

Descriptive Statistics

	Group	Mean	Std. Deviation	N
TotalWEMWBS1r	Choir	24.9434	4.16582	20
	Exercise	24.2864	4.47156	35
	Total	24.5253	4.33557	55
TotalWEMWBS2r	Choir	24.3445	3.75160	20
	Exercise	22.9269	3.66375	35
	Total	23.4424	3.72523	55

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.092	5.377[b]	1.000	53.000	.024	.092	5.377	.624
	Wilks' Lambda	.908	5.377[b]	1.000	53.000	.024	.092	5.377	.624
	Hotelling's Trace	.101	5.377[b]	1.000	53.000	.024	.092	5.377	.624
	Roy's Largest Root	.101	5.377[b]	1.000	53.000	.024	.092	5.377	.624
Time * Group	Pillai's Trace	.015	.811[b]	1.000	53.000	.372	.015	.811	.143
	Wilks' Lambda	.985	.811[b]	1.000	53.000	.372	.015	.811	.143
	Hotelling's Trace	.015	.811[b]	1.000	53.000	.372	.015	.811	.143
	Roy's Largest Root	.015	.811[b]	1.000	53.000	.372	.015	.811	.143

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	24.407	1	24.407	5.377	.024	.092	5.377	.624
	Greenhouse-Geisser	24.407	1.000	24.407	5.377	.024	.092	5.377	.624
	Huynh-Feldt	24.407	1.000	24.407	5.377	.024	.092	5.377	.624
	Lower-bound	24.407	1.000	24.407	5.377	.024	.092	5.377	.624
Time * Group	Sphericity Assumed	3.682	1	3.682	.811	.372	.015	.811	.143
	Greenhouse-Geisser	3.682	1.000	3.682	.811	.372	.015	.811	.143
	Huynh-Feldt	3.682	1.000	3.682	.811	.372	.015	.811	.143
	Lower-bound	3.682	1.000	3.682	.811	.372	.015	.811	.143
Error(Time)	Sphericity Assumed	240.560	53	4.539					
	Greenhouse-Geisser	240.560	53.000	4.539					
	Huynh-Feldt	240.560	53.000	4.539					
	Lower-bound	240.560	53.000	4.539					

a. Computed using alpha = .05

3. Sense of social connection – MSPSS (T1 – T2)

Descriptive Statistics

	Group	Mean	Std. Deviation	N
WMSPSSALL1	Choir	5.6375	1.14142	20
	Exercise	5.4292	1.17857	35
	Total	5.5049	1.15897	55
WMSPSSALL2	Choir	5.7458	1.01972	20
	Exercise	5.3100	1.15518	35
	Total	5.4685	1.11841	55

Note: "W" refers to Winsorised (4 cases).

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.000	.008[b]	1.000	53.000	.931	.000	.008	.051
	Wilks' Lambda	1.000	.008[b]	1.000	53.000	.931	.000	.008	.051
	Hotelling's Trace	.000	.008[b]	1.000	53.000	.931	.000	.008	.051
	Roy's Largest Root	.000	.008[b]	1.000	53.000	.931	.000	.008	.051
Time * Group	Pillai's Trace	.059	3.337[b]	1.000	53.000	.073	.059	3.337	.434
	Wilks' Lambda	.941	3.337[b]	1.000	53.000	.073	.059	3.337	.434
	Hotelling's Trace	.063	3.337[b]	1.000	53.000	.073	.059	3.337	.434
	Roy's Largest Root	.063	3.337[b]	1.000	53.000	.073	.059	3.337	.434

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	.001	1	.001	.008	.931	.000	.008	.051
	Greenhouse-Geisser	.001	1.000	.001	.008	.931	.000	.008	.051
	Huynh-Feldt	.001	1.000	.001	.008	.931	.000	.008	.051
	Lower-bound	.001	1.000	.001	.008	.931	.000	.008	.051
Time * Group	Sphericity Assumed	.329	1	.329	3.337	.073	.059	3.337	.434
	Greenhouse-Geisser	.329	1.000	.329	3.337	.073	.059	3.337	.434
	Huynh-Feldt	.329	1.000	.329	3.337	.073	.059	3.337	.434
	Lower-bound	.329	1.000	.329	3.337	.073	.059	3.337	.434
Error(Time)	Sphericity Assumed	5.232	53	.099					
	Greenhouse-Geisser	5.232	53.000	.099					
	Huynh-Feldt	5.232	53.000	.099					
	Lower-bound	5.232	53.000	.099					

a. Computed using alpha = .05

4. Perceived empathic self-efficacy – PESE (T1 – T2)

Descriptive Statistics

	Group	Mean	Std. Deviation	N
TotalPESE1	Choir	3.8333	.59235	20
	Exercise	3.5390	.61975	35
	Total	3.6460	.62106	55
TotalPESE2	Choir	3.7333	.53092	20
	Exercise	3.6238	.52447	35
	Total	3.6636	.52459	55

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.000	.017[b]	1.000	53.000	.896	.000	.017	.052
	Wilks' Lambda	1.000	.017[b]	1.000	53.000	.896	.000	.017	.052
	Hotelling's Trace	.000	.017[b]	1.000	53.000	.896	.000	.017	.052
	Roy's Largest Root	.000	.017[b]	1.000	53.000	.896	.000	.017	.052
Time * Group	Pillai's Trace	.046	2.572[b]	1.000	53.000	.115	.046	2.572	.350
	Wilks' Lambda	.954	2.572[b]	1.000	53.000	.115	.046	2.572	.350
	Hotelling's Trace	.049	2.572[b]	1.000	53.000	.115	.046	2.572	.350
	Roy's Largest Root	.049	2.572[b]	1.000	53.000	.115	.046	2.572	.350

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	.001	1	.001	.017	.896	.000	.017	.052
	Greenhouse-Geisser	.001	1.000	.001	.017	.896	.000	.017	.052
	Huynh-Feldt	.001	1.000	.001	.017	.896	.000	.017	.052
	Lower-bound	.001	1.000	.001	.017	.896	.000	.017	.052
Time * Group	Sphericity Assumed	.217	1	.217	2.572	.115	.046	2.572	.350
	Greenhouse-Geisser	.217	1.000	.217	2.572	.115	.046	2.572	.350
	Huynh-Feldt	.217	1.000	.217	2.572	.115	.046	2.572	.350
	Lower-bound	.217	1.000	.217	2.572	.115	.046	2.572	.350
Error(Time)	Sphericity Assumed	4.482	53	.085					
	Greenhouse-Geisser	4.482	53.000	.085					
	Huynh-Feldt	4.482	53.000	.085					
	Lower-bound	4.482	53.000	.085					

a. Computed using alpha = .05

5. Emotional wellbeing - PANAS (Time 1 – Time 3)

Descriptive Statistics

	Group	Mean	Std. Deviation	N
PANAS1T	Choir	16.5238	11.43512	21
	Exercise	16.6552	11.79672	29
	Total	16.6000	11.52814	50
PANAS3T	Choir	21.9524	8.57599	21
	Exercise	19.0690	12.78652	29
	Total	20.2800	11.20321	50

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.149	8.393[b]	1.000	48.000	.006	.149	8.393	.810
	Wilks' Lambda	.851	8.393[b]	1.000	48.000	.006	.149	8.393	.810
	Hotelling's Trace	.175	8.393[b]	1.000	48.000	.006	.149	8.393	.810
	Roy's Largest Root	.175	8.393[b]	1.000	48.000	.006	.149	8.393	.810
Time * Group	Pillai's Trace	.025	1.240[b]	1.000	48.000	.271	.025	1.240	.194
	Wilks' Lambda	.975	1.240[b]	1.000	48.000	.271	.025	1.240	.194
	Hotelling's Trace	.026	1.240[b]	1.000	48.000	.271	.025	1.240	.194
	Roy's Largest Root	.026	1.240[b]	1.000	48.000	.271	.025	1.240	.194

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	374.551	1	374.551	8.393	.006	.149	8.393	.810
	Greenhouse-Geisser	374.551	1.000	374.551	8.393	.006	.149	8.393	.810
	Huynh-Feldt	374.551	1.000	374.551	8.393	.006	.149	8.393	.810
	Lower-bound	374.551	1.000	374.551	8.393	.006	.149	8.393	.810
Time * Group	Sphericity Assumed	55.351	1	55.351	1.240	.271	.025	1.240	.194
	Greenhouse-Geisser	55.351	1.000	55.351	1.240	.271	.025	1.240	.194
	Huynh-Feldt	55.351	1.000	55.351	1.240	.271	.025	1.240	.194
	Lower-bound	55.351	1.000	55.351	1.240	.271	.025	1.240	.194
Error(Time)	Sphericity Assumed	2142.089	48	44.627					
	Greenhouse-Geisser	2142.089	48.000	44.627					
	Huynh-Feldt	2142.089	48.000	44.627					
	Lower-bound	2142.089	48.000	44.627					

a. Computed using alpha = .05

6. Mental wellbeing – WEMWBS (Time 1 – Time 3)

Descriptive Statistics

	Group	Mean	Std. Deviation	N
TotalWEMWBS1r	Choir	24.1170	4.15434	21
	Exercise	23.8037	4.21197	30
	Total	23.9327	4.14937	51
TotalWEMWBS3r	Choir	23.6900	3.12782	21
	Exercise	22.9900	4.22127	30
	Total	23.2782	3.79071	51

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.029	1.451[b]	1.000	49.000	.234	.029	1.451	.219
	Wilks' Lambda	.971	1.451[b]	1.000	49.000	.234	.029	1.451	.219
	Hotelling's Trace	.030	1.451[b]	1.000	49.000	.234	.029	1.451	.219
	Roy's Largest Root	.030	1.451[b]	1.000	49.000	.234	.029	1.451	.219
Time * Group	Pillai's Trace	.003	.141[b]	1.000	49.000	.709	.003	.141	.066
	Wilks' Lambda	.997	.141[b]	1.000	49.000	.709	.003	.141	.066
	Hotelling's Trace	.003	.141[b]	1.000	49.000	.709	.003	.141	.066
	Roy's Largest Root	.003	.141[b]	1.000	49.000	.709	.003	.141	.066

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	9.507	1	9.507	1.451	.234	.029	1.451	.219
	Greenhouse-Geisser	9.507	1.000	9.507	1.451	.234	.029	1.451	.219
	Huynh-Feldt	9.507	1.000	9.507	1.451	.234	.029	1.451	.219
	Lower-bound	9.507	1.000	9.507	1.451	.234	.029	1.451	.219
Time * Group	Sphericity Assumed	.923	1	.923	.141	.709	.003	.141	.066
	Greenhouse-Geisser	.923	1.000	.923	.141	.709	.003	.141	.066
	Huynh-Feldt	.923	1.000	.923	.141	.709	.003	.141	.066
	Lower-bound	.923	1.000	.923	.141	.709	.003	.141	.066
Error(Time)	Sphericity Assumed	321.006	49	6.551					
	Greenhouse-Geisser	321.006	49.000	6.551					
	Huynh-Feldt	321.006	49.000	6.551					
	Lower-bound	321.006	49.000	6.551					

a. Computed using alpha = .05

7. Sense of social connection – MSPSS (T1 – T3)

Descriptive Statistics

	Group	Mean	Std. Deviation	N
MSPSSALL1	Choir	5.4921	1.23741	21
	Exercise	5.2135	1.33828	31
	Total	5.3260	1.29346	52
MSPSSALL3	Choir	5.4921	1.10739	21
	Exercise	5.0078	1.57288	31
	Total	5.2034	1.41199	52

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.022	1.102[b]	1.000	50.000	.299	.022	1.102	.178
	Wilks' Lambda	.978	1.102[b]	1.000	50.000	.299	.022	1.102	.178
	Hotelling's Trace	.022	1.102[b]	1.000	50.000	.299	.022	1.102	.178
	Roy's Largest Root	.022	1.102[b]	1.000	50.000	.299	.022	1.102	.178
Time * Group	Pillai's Trace	.022	1.102[b]	1.000	50.000	.299	.022	1.102	.178
	Wilks' Lambda	.978	1.102[b]	1.000	50.000	.299	.022	1.102	.178
	Hotelling's Trace	.022	1.102[b]	1.000	50.000	.299	.022	1.102	.178
	Roy's Largest Root	.022	1.102[b]	1.000	50.000	.299	.022	1.102	.178

a. Design: Intercept + Group
 Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	.265	1	.265	1.102	.299	.022	1.102	.178
	Greenhouse-Geisser	.265	1.000	.265	1.102	.299	.022	1.102	.178
	Huynh-Feldt	.265	1.000	.265	1.102	.299	.022	1.102	.178
	Lower-bound	.265	1.000	.265	1.102	.299	.022	1.102	.178
Time * Group	Sphericity Assumed	.265	1	.265	1.102	.299	.022	1.102	.178
	Greenhouse-Geisser	.265	1.000	.265	1.102	.299	.022	1.102	.178
	Huynh-Feldt	.265	1.000	.265	1.102	.299	.022	1.102	.178
	Lower-bound	.265	1.000	.265	1.102	.299	.022	1.102	.178
Error(Time)	Sphericity Assumed	12.013	50	.240					
	Greenhouse-Geisser	12.013	50.000	.240					
	Huynh-Feldt	12.013	50.000	.240					
	Lower-bound	12.013	50.000	.240					

a. Computed using alpha = .05

8. Perceived empathic self-efficacy – PESE (Time 1 – Time 3)

Descriptive Statistics

	Group	Mean	Std. Deviation	N
TotalPESE1	Choir	3.6917	.65845	20
	Exercise	3.5454	.59677	30
	Total	3.6039	.61977	50
TotalPESE3	Choir	3.6000	.61511	20
	Exercise	3.6056	.70369	30
	Total	3.6033	.66316	50

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Time	Pillai's Trace	.001	.052[b]	1.000	48.000	.821	.001	.052	.056
	Wilks' Lambda	.999	.052[b]	1.000	48.000	.821	.001	.052	.056
	Hotelling's Trace	.001	.052[b]	1.000	48.000	.821	.001	.052	.056
	Roy's Largest Root	.001	.052[b]	1.000	48.000	.821	.001	.052	.056
Time * Group	Pillai's Trace	.024	1.197[b]	1.000	48.000	.279	.024	1.197	.189
	Wilks' Lambda	.976	1.197[b]	1.000	48.000	.279	.024	1.197	.189
	Hotelling's Trace	.025	1.197[b]	1.000	48.000	.279	.024	1.197	.189
	Roy's Largest Root	.025	1.197[b]	1.000	48.000	.279	.024	1.197	.189

a. Design: Intercept + Group

Within Subjects Design: Time

b. Exact statistic

c. Computed using alpha = .05

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Time	Sphericity Assumed	.006	1	.006	.052	.821	.001	.052	.056
	Greenhouse-Geisser	.006	1.000	.006	.052	.821	.001	.052	.056
	Huynh-Feldt	.006	1.000	.006	.052	.821	.001	.052	.056
	Lower-bound	.006	1.000	.006	.052	.821	.001	.052	.056
Time * Group	Sphericity Assumed	.138	1	.138	1.197	.279	.024	1.197	.189
	Greenhouse-Geisser	.138	1.000	.138	1.197	.279	.024	1.197	.189
	Huynh-Feldt	.138	1.000	.138	1.197	.279	.024	1.197	.189
	Lower-bound	.138	1.000	.138	1.197	.279	.024	1.197	.189
Error(Time)	Sphericity Assumed	5.542	48	.115					
	Greenhouse-Geisser	5.542	48.000	.115					
	Huynh-Feldt	5.542	48.000	.115					
	Lower-bound	5.542	48.000	.115					

a. Computed using alpha = .05

Appendix D: Supporting documents for investigation into proposed mechanisms (Chapter 7)

This appendix includes supporting documentation for the research into possible mechanisms for improved wellbeing reported in Chapter 7. It includes, in order:

- Examples of social media tiles used for participant recruitment
- Plain language participant explanatory statement and consent form
- Demographics questionnaire
- Psychometric questionnaires
- Invitation to participate in the experience sampling methodology (ESM)
- Key data outputs (psychometric questionnaires)
- ESM auto-generated email examples
- ESM demographics
- ESM questionnaires
- ESM questionnaires presentation on a smart phone
- Key data outputs (ESM questionnaires)

Examples of social media tiles used for participant recruitment

The research reported in Chapter 7 recruited individuals through paid and unpaid social media placements. Examples of social media tiles, aimed at choir members, exercise groups, and other social activities, are provided here.

Figure A1: Example of social media tile targeting choir members

Figure A2: Example of a social media tile targeting exercise group members

Figure A3: Example of a social media tile targeting members of unspecified social groups

(The online presentation of participant plain language statement, consent form, demographics, psychometric surveys, and opportunity to participate in the ESM study used for the research exploring possible mechanisms reported in Chapter 7.)

Social group membership and mechanisms for improved wellbeing: Research participant information and surveys

Thank you for taking a few minutes to share your experiences as a member of a social group.

Your participation will help us to better understand how belonging to various types of social groups contribute to improving wellbeing.

This survey will probably take around 15 minutes of your time to complete and is completely anonymous.

It includes the following:

1. A detailed explanation of the research, for which we request your consent. You will have the option to opt in or out of the survey.

2. A series of questionnaires which will ask you:
- a few general questions about yourself, and
- questions about how your social group may contribute to improved mood, social connection and wellbeing.

If you're ready to read the detailed explanation, please press on the arrows >> below.

Please read the explanatory statement below and, if you are willing to participate, click "yes." This will direct you to the survey.

Explanatory Statement:

Social group membership and improved well-being

My name is Susan Maury and I am conducting a research project with Adjunct Associate Professor Nikki Rickard in the School of Psychological Sciences towards a PhD at Monash University. This means that I will be writing a thesis which is the equivalent of a 300-page book. This project has received approval from the Monash University Human Research Ethics Committee. This information sheet is a brief explanation of my research and what is involved for participants. It also has contact information should you have any questions or concerns.

Participants

We are seeking participants 17 years and older, with English as their primary language (or one of their primary languages), and with no chronic (physical or psychological) disorder.

The researchers will not link any identifying information with collected data, and will not directly contact any participant.

The aim/purpose of the research

The purpose of this study is to explore how social group membership may improve social and emotional wellbeing for participants.

Possible benefits

This research will help us understand the ways in which membership in organised social groups might improve well-being for participants.

What does the research involve?

Participation will involve completing some short questionnaires (about 15 minutes in total) about how participation in your social group may improve your wellbeing. Some of these questions will ask how you feel, including whether you have feelings of depression and anxiety at times.

Inconvenience/discomfort

It is possible that participants may be uncomfortable in answering some of the questions about how happy you are, or about your emotions. Should you become distressed or upset while filling the surveys, you are free to discontinue participation at any time. We recommend that if you do feel any distress or concern when you are involved in this research, that you contact your doctor or school/university or work’s welfare officer to discuss this, or seek help from help services such as:

Australia	**New Zealand**	**Canada**	**USA**
Lifeline Australia Lifeline is a 24/7 phone and online counselling service. Phone: 13 11 14	Lifeline Aotearoa Service providing a 24/7 helpline and face to face counselling.	Mental Health Helpline Provides information about mental health services in Ontario.	MentalHealth.gov National website providing information on other services.

Can I withdraw from the research?

Being in this study is voluntary and you are under no obligation to consent to participation. However, if you do consent to participate, you may only withdraw prior to completion of the surveys. Any information that is submitted during this time is completely anonymous, and therefore will only be withdrawn if the information is not submitted.

Confidentiality and storage of data

Participants will not be able to be identified because the data will be anonymous. Only aggregate data will be reported, and therefore all individual responses will remain confidential.

If you would like to be informed of the aggregate research findings, please contact Susan via
 Susan.maury@monash.edu 044---

Storage of the data collected will adhere to the University regulations and kept on University premises in a locked cupboard/filing cabinet for 5 years. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

If you would like to contact the researchers about any aspect of this study, please contact the Chief Investigator:	If you have a complaint concerning the manner in which this research, **project number 19544**, is being conducted, please contact:
A/Prof Nikki Rickard School of Psychological Sciences 18 Innovation Walk Monash University Victoria, 3800 Australia. Email: Nikki.Rickard@monash.edu.au	Executive Officer, Human Research Ethics Monash University Human Research Ethics Committee (MUHREC) 24 Sports Walk, Room 111 Research Office Monash University VIC 3800 Tel: +61 3 9905 2052 Fax: +61 3 9905 3831 Email: muhrec@adm.monash.edu.au

Thank you,

Susan Maury

Susan.maury@monash.edu (+61) 449---

Consent to participate

Data collected will be used for a Monash University research project titled 'Social group membership and mechanisms for improved well-being'. The purpose of this study is to explore how emotional and social wellbeing may be improved through membership in social groups.

By checking "Yes", I consent to and understand the following:

- I agree to participate in the above research project.
- The project will be conducted as described in the explanatory statement provided, which I have fully read and understood.
- Participation in this study is voluntary, and my consent may be withdrawn at any time prior to completing the online surveys.
- I will be asked general questions about myself including social activities I participate in, and my mood and well-being.
- My answers to these surveys and questionnaires will be truthful and accurate.
- If any of these tests cause discomfort or distress, consent can be withdrawn and participation can cease.

☐ Yes
☐ No

(If "Yes" is selected, they are directed to the survey; pages following.)

(If "No" is selected, they are directed away from the survey.)

You have been directed away from the survey.

Many thanks for your time and interest in this research project.

Social group membership and mechanisms for improved wellbeing: Demographics and surveys

Research participant basic information

This section asks a few questions about yourself. Please tick the appropriate option or provide information in the space provided.

1. **Are you:**

☐ Male
☐ Female
☐ Non-binary
☐ Prefer not to answer

2. **In what year were you born?** ________

3. **What do you consider your primary language(s)?**

☐ English
☐ Other (please specify): ______________________________

4. **What is the highest level of education you have completed at present?**

☐ No higher than Year 10 of high school
☐ Completed High School/ year 12
☐ Completed Apprenticeship
☐ College Diploma/trade qualification
☐ Undergraduate University Degree
☐ Graduate Diploma
☐ Post Graduate University Degree

5. **At present which situation best describes you?**

☐ Unemployed (not studying)
☐ Studying full-time
☐ Studying part-time and working part-time
☐ Working part time (not studying)
☐ Working full time (not studying)
☐ Retired
☐ If other, please specify: ______________

We are interested in how belonging to an organised social group might be beneficial for your social and emotional wellbeing. By 'organised', we mean a community group of a group of people who meet regularly (for example, weekly) to participate in a particular activity. This could be an exercise group, a singing group, a book club, a crafting group, a sports club, a discussion group or another activity-focussed group.

You may belong to more than one social group. Please select the ONE GROUP that you believe helps to improve your overall sense of wellbeing the most. Answer the survey with your experiences of that particular group in mind.

I am answering this survey concerning my involvement in:

☐ A singing group

☐ An exercise group

☐ Another kind of group (please specify): ___________________________

I generally attend my group:

☐ Weekly

☐ Fortnightly (every 2 weeks)

☐ Monthly

☐ Other (please specify): ______________________________

(Positive and Negative Affect Schedule) This scale consists of a number of words that describe different feelings and emotions. Please read each item and then select the appropriate answer next to the word. Answer in a way that indicates to what extent you feel this way during and directly following your group participation.

	Very slightly/ not at all	A little	Moderately	Quite a bit	Extremely
Interested	**1**	**2**	**3**	**4**	**5**
Distressed	**1**	**2**	**3**	**4**	**5**
Excited	**1**	**2**	**3**	**4**	**5**
Upset	**1**	**2**	**3**	**4**	**5**
Strong	**1**	**2**	**3**	**4**	**5**
Guilty	**1**	**2**	**3**	**4**	**5**
Scared	**1**	**2**	**3**	**4**	**5**
Hostile	**1**	**2**	**3**	**4**	**5**
Enthusiastic	**1**	**2**	**3**	**4**	**5**
Proud	**1**	**2**	**3**	**4**	**5**
Irritable	**1**	**2**	**3**	**4**	**5**
Alert	**1**	**2**	**3**	**4**	**5**
Ashamed	**1**	**2**	**3**	**4**	**5**
Inspired	**1**	**2**	**3**	**4**	**5**
Nervous	**1**	**2**	**3**	**4**	**5**
Determined	**1**	**2**	**3**	**4**	**5**
Attentive	**1**	**2**	**3**	**4**	**5**
Jittery	**1**	**2**	**3**	**4**	**5**
Active	**1**	**2**	**3**	**4**	**5**
Afraid	**1**	**2**	**3**	**4**	**5**

(Short Dispositional Flow Scale) Below are some statements about thoughts and feelings you may experience during your social group activity. There are no right or wrong answers. Think about how you feel during your event/activity generally, then rate your agreement with each statement as it best matches your social group experience generally.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I feel I am competent enough to meet the demands of the situation.	1	2	3	4	5
I do things spontaneously and automatically without having to think.	1	2	3	4	5
I have a strong sense of what I want to do.	1	2	3	4	5
I have a good idea about how well I am doing while I am involved in the activity.	1	2	3	4	5
I am completely focused on the task at hand.	1	2	3	4	5
I have a feeling of total control over what I am doing.	1	2	3	4	5
I am not worried about what others may be thinking of me.	1	2	3	4	5
The way time passes seems to be different from normal.	1	2	3	4	5
I find the experience extremely rewarding.	1	2	3	4	5

(The Situational Motivation Scale) Read each item carefully. Using the scale below, please select the number that best describes the reason why you are currently engaged in this activity where “1” on the scale = “corresponds not at all” and “7” on the scale = “corresponds a lot”

Why are you currently engaged in this activity?	Corresponds…						
	Not at all	A very little	A little	Moderately	Enough	A lot	Exactly
Because I think that this activity is interesting	1	2	3	4	5	6	7
Because I am doing it for my own good	1	2	3	4	5	6	7
Because I am supposed to do it	1	2	3	4	5	6	7
There may be good reasons to do this activity, but personally I don’t see any	1	2	3	4	5	6	7
Because I think that this activity is pleasant	1	2	3	4	5	6	7
Because I think that this activity is good for me	1	2	3	4	5	6	7
Because it is something that I have to do	1	2	3	4	5	6	7
I do this activity but I am not sure if it is worth it	1	2	3	4	5	6	7
Because this activity is fun	1	2	3	4	5	6	7
By personal decision	1	2	3	4	5	6	7
Because I don’t have any choice	1	2	3	4	5	6	7
I don’t know; I don’t see what this activity brings me	1	2	3	4	5	6	7
Because I feel good when doing this activity	1	2	3	4	5	6	7
Because I feel that this activity is important to me	1	2	3	4	5	6	7
Because I feel that I have to do it	1	2	3	4	5	6	7
I do this activity, but I am not sure it is a good thing to pursue it	1	2	3	4	5	6	7

(Basic Psychological Needs in Exercise Scale, modified) The following sentences refer to your overall experiences in terms of your group's core activity (for example, exercise, singing, discussion, craft, etc.) rather than any particular situation. Using the 1-5 scale below, please indicate the extent to which you agree with these statements by choosing one number for each statement.

	I don't agree at all	I agree a little bit	I agree somewhat	I agree a lot	I agree completely
I feel I have made a lot of progress in relation to the goal I want to achieve in my activity.	1	2	3	4	5
The way I participate in my activity is in agreement with my choices and interests.	1	2	3	4	5
I feel I perform successfully the activity of my group.	1	2	3	4	5
My relationships with the people I participate with are very friendly.	1	2	3	4	5
I feel that the way I participate in my group activity is the way I want to.	1	2	3	4	5
I feel this activity is one which I do very well.	1	2	3	4	5
I feel I have excellent communication with the people in this group.	1	2	3	4	5
I feel that way I participate in this group activity is a true expression of who I am.	1	2	3	4	5
I am able to meet the requirements of this activity.	1	2	3	4	5
My relationships with the people in this group are close.	1	2	3	4	5
I feel that I have the opportunity to make choices with regard to the way I participate in this activity.	1	2	3	4	5

(WEMWBS) Below are some statements about feelings and thoughts. Please choose the number that best describes your experience of each over the past 2 weeks.

STATEMENTS	None of the time	Rarely	Some of the time	Often	All of the time
I've been feeling optimistic about the future	**1**	**2**	**3**	**4**	**5**
I've been feeling useful	**1**	**2**	**3**	**4**	**5**
I've been feeling relaxed	**1**	**2**	**3**	**4**	**5**
I've been dealing with problems well	**1**	**2**	**3**	**4**	**5**
I've been thinking clearly	**1**	**2**	**3**	**4**	**5**
I've been feeling close to other people	**1**	**2**	**3**	**4**	**5**
I've been able to make up my own mind about things	**1**	**2**	**3**	**4**	**5**

(Measures of psychological climate, cohesion sub-scale) There are 5 statements below asking your opinion about how this group interacts. Please choose the number that best reflects <u>your experience of the group</u>.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
In this group, people pitch in to help each other out.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
In this group, people tend to get along with each other.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
In this group, people take a personal interest in one another.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
There is a lot of "team spirit" amongst this group.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
I feel like I have a lot in common with the people that I know in this group.	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Once participants reach the end of all the surveys, they will be prompted:

Would you like to submit your survey responses?

☐ YES

☐ NO (Note: This option will exclude your surveys from analysis)

(End message at the conclusion of the survey)

All done - thank you!

Many thanks for your time and assistance with this research project.

If you are interested in receiving any publications of findings from this research, please email the lead researcher: Susan.Maury@Monash.Edu

Want to help a little more?

If you are interested in helping us to better understand how membership in a social group may improve wellbeing, we are running a second study which you can also participate in if interested. This study will begin in approximately 1 month, and will involve answering a very short – 2 questions – survey every day for 2 weeks, in the evening. One question will be on how you are feeling right now – how happy, active and socially connected. The second question asks what you've been doing today – listening to music, exercising, and/or participating in a social group. If you are busy, it's okay to take a day off from responding to the questions. If you would like to participate, please provide us with your email. We will only use the email to send you a daily link to the survey. Each email will also include an 'opt out' link so you can stop participating at any time.

Yes! I would like to participate! My email address is: ______________________

Please tell us what country you live in. This will allow us to send you the emails in the early evening.

I live in: ______________________

Key data outputs: Individual attitudes as mechanisms of wellbeing (Chapter 7)

Conducted using SPSS version 26 using the PROCESS version 2.4 add-in (Hayes, 2019)

Computation: mediated regression analyses (Choir to Exercise, Choir to Other, Exercise to Other)

Outcomes:

Positive affect (PANAS)

Negative affect (PANAS)

Social cohesion (Measures of psychological climate, cohesion sub-scale)

Mental wellbeing (SWEMWBS)

Mediators:

Flow (Short Dispositional Flow Scale)

Competence (BPNES)

Autonomy (BPNES)

Relatedness (BPNES)

Intrinsic motivation (SIMS)

Identified regulation (SIMS)

1. Choir to Exercise comparison: Positive affect

```
Model  : 4
    Y  : PATotal
    X  : GroupSIn
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : External
   M5  : Competen
   M6  : Autonomy
   M7  : Relatedn

Sample
Size:  116
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 PATotal

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .0084      .0001    27.0262      .0080     1.0000   114.0000      .9290

Model
              coeff         se          t          p       LLCI       ULCI
constant    40.7241      .6826    59.6587      .0000    39.3719    42.0764
GroupSIn     -.0862      .9654     -.0893      .9290    -1.9986     1.8262

Standardized coefficients
              coeff
GroupSIn     -.0167

Covariance matrix of regression parameter estimates:
           constant   GroupSIn
constant      .4660     -.4660
GroupSIn     -.4660      .9319
```

```
************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI       c_ps
     -.0862      .9654     -.0893      .9290    -1.9986     1.8262     -.0167

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI      c'_ps
     -.4974      .9390     -.5297      .5974    -2.3590     1.3641     -.0961

Indirect effect(s) of X on Y:
             Effect     BootSE   BootLLCI   BootULCI
TOTAL         .4112      .8714    -1.2245     2.2269
FlowTota     -.0405      .1627     -.4073      .2717
Intrinsi      .2453      .3468     -.2783     1.0902
Identifi     -.1498      .2787     -.7314      .4159
External      .0936      .3589     -.4588      .9605
Competen     -.1175      .2977     -.8311      .3984
Autonomy      .0138      .2063     -.4415      .4518
Relatedn      .3664      .2941     -.0626     1.0415
```

2. Choir to Exercise comparison: Negative affect

```
**********************
Model  : 4
    Y  : NATotal
    X  : GroupSIn
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : External
   M5  : Competen
   M6  : Autonomy
   M7  : Relatedn

Covariates:
 Age

Sample
Size:  115
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 NATotal

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .0937      .0088     4.7756      .4959     2.0000   112.0000      .6103

Model
              coeff         se          t          p       LLCI       ULCI
constant    12.3576      .9923    12.4534      .0000    10.3915    14.3237
GroupSIn      .1129      .4315      .2617      .7940    -.7420      .9679
Age         -.0169      .0170     -.9936      .3226    -.0505      .0168

Standardized coefficients
              coeff
GroupSIn      .0519
Age         -.0990

Covariance matrix of regression parameter estimates:
           constant   GroupSIn        Age
constant      .9847      .0522     -.0161
GroupSIn      .0522      .1862     -.0024
Age         -.0161     -.0024      .0003
```

```
************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI       c_ps
      .1129      .4315      .2617      .7940     -.7420      .9679      .0519

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI      c'_ps
      .0020      .5124      .0038      .9969    -1.0140     1.0179      .0009

Indirect effect(s) of X on Y:
             Effect     BootSE   BootLLCI   BootULCI
TOTAL         .1109      .2982     -.4258      .7558
FlowTota      .0464      .0889     -.1238      .2466
Intrinsi      .0145      .0796     -.1415      .1992
Identifi      .2243      .1724     -.0168      .6447
External     -.1329      .1796     -.4311      .2957
Competen     -.0771      .1416     -.4256      .1483
Autonomy      .0198      .1211     -.2253      .2950
Relatedn      .0158      .0973     -.1892      .2221
```

3. Choir to Exercise comparison: Cohesion

```
*********************
Model  : 4
    Y  : Cohesion
    X  : GroupSIn
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : External
   M5  : Competen
   M6  : Autonomy
   M7  : Relatedn

Sample
Size:  116
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 Cohesion

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .1312      .0172      .6214     1.9976     1.0000   114.0000      .1603

Model
              coeff         se          t          p       LLCI       ULCI
constant     6.0138      .1035    58.0982      .0000     5.8087     6.2188
GroupSIn      .2069      .1464     1.4134      .1603     -.0831      .4969

Standardized coefficients
              coeff
GroupSIn      .2613

Covariance matrix of regression parameter estimates:
           constant   GroupSIn
constant      .0107     -.0107
GroupSIn     -.0107      .0214
```

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y

Effect	se	t	p	LLCI	ULCI	c_ps
.2069	.1464	1.4134	.1603	-.0831	.4969	.2613

Direct effect of X on Y

Effect	se	t	p	LLCI	ULCI	c'_ps
-.0487	.1211	-.4018	.6886	-.2888	.1914	-.0615

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	.2556	.1354	-.0249	.5150
FlowTota	.0012	.0130	-.0255	.0314
Intrinsi	.0147	.0264	-.0269	.0803
Identifi	.0124	.0282	-.0519	.0665
External	.0119	.0476	-.0787	.1138
Competen	.0019	.0296	-.0631	.0618
Autonomy	.0008	.0229	-.0588	.0401
Relatedn	.2126	.1035	.0164	.4239

4. Choir to Exercise comparison: Mental wellbeing

```
*********************
Model  : 4
    Y  : WEMWBSRe
    X  : GroupSIn
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : External
   M5  : Competen
   M6  : Autonomy
   M7  : Relatedn

Covariates:
 Age

Sample
Size:  115
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 WEMWBSRe

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2910      .0847    12.8665     5.1815     2.0000   112.0000      .0070

Model
              coeff         se          t          p       LLCI       ULCI
constant    20.6905     1.6288    12.7030      .0000    17.4633    23.9178
GroupSIn    -1.1343      .7083    -1.6015      .1121    -2.5376      .2690
Age           .0881      .0278     3.1635      .0020      .0329      .1432

Standardized coefficients
              coeff
GroupSIn     -.3052
Age           .3028

Covariance matrix of regression parameter estimates:
           constant   GroupSIn        Age
constant     2.6530      .1407     -.0434
GroupSIn      .1407      .5016     -.0065
Age          -.0434     -.0065      .0008
```

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y

Effect	se	t	p	LLCI	ULCI	c_ps
-1.1343	.7083	-1.6015	.1121	-2.5376	.2690	-.3052

Direct effect of X on Y

Effect	se	t	p	LLCI	ULCI	c'_ps
-1.2491	.7593	-1.6451	.1029	-2.7547	.2564	-.3361

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	.1148	.5856	-1.1135	1.2344
FlowTota	-.0386	.1083	-.3320	.1137
Intrinsi	.1092	.1527	-.2122	.4156
Identifi	-.0096	.1723	-.3886	.3368
External	-.1426	.3942	-.9265	.6660
Competen	.0668	.1860	-.3170	.4757
Autonomy	.0391	.2367	-.5331	.4777
Relatedn	.0905	.1978	-.2640	.5497

5. Choir to Other comparison: Positive affect

```
********************
Model  : 4
    Y  : PATotal
    X  : GroupSin
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : Competen
   M5  : Autonomy
   M6  : Relatedn

Sample
Size:  115

--------------------
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 PATotal

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2485      .0618    39.5525     7.4396     1.0000   113.0000      .0074

Model
              coeff         se          t          p       LLCI       ULCI
constant    37.4386      .8330    44.9438      .0000    35.7883    39.0889
GroupSin     3.1993     1.1730     2.7276      .0074      .8755     5.5232

Standardized coefficients
              coeff
GroupSin      .4949

Covariance matrix of regression parameter estimates:
           constant   GroupSin
constant      .6939     -.6939
GroupSin     -.6939     1.3758
```

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y

Effect	se	t	p	LLCI	ULCI	c_ps
3.1993	1.1730	2.7276	.0074	.8755	5.5232	.4949

Direct effect of X on Y

Effect	se	t	p	LLCI	ULCI	c'_ps
1.0092	.8826	1.1435	.2554	-.7404	2.7589	.1561

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	2.1901	1.0480	.2585	4.3709
FlowTota	.2982	.2685	-.1082	.9496
Intrinsi	.9200	.6104	.0256	2.3521
Identifi	.4190	.4407	-.0815	1.5994
Competen	.0537	.5020	-.9995	1.0774
Autonomy	.4754	.4540	-.2549	1.5613
Relatedn	.0239	.2100	-.4273	.4838

6. Choir to Other comparison: Negative affect

```
********************
Model  : 4
    Y  : NATotal
    X  : GroupSin
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : Competen
   M5  : Autonomy
   M6  : Relatedn

Covariates:
 Age

Sample
Size:  113
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 NATotal

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2643      .0698     8.0320     4.1300     2.0000   110.0000      .0186

Model
              coeff         se          t          p       LLCI       ULCI
constant    14.4555     1.2398    11.6597      .0000    11.9985    16.9124
GroupSin    -1.1286      .5470    -2.0632      .0414    -2.2127     -.0445
Age          -.0302      .0202    -1.4900      .1391     -.0703      .0100

Standardized coefficients
              coeff
GroupSin     -.3875
Age          -.1406

Covariance matrix of regression parameter estimates:
           constant   GroupSin        Age
constant     1.5371      .0007     -.0239
GroupSin      .0007      .2992     -.0025
Age          -.0239     -.0025      .0004
```

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y

Effect	se	t	p	LLCI	ULCI	c_ps
-1.1286	.5470	-2.0632	.0414	-2.2127	-.0445	-.3875

Direct effect of X on Y

Effect	se	t	p	LLCI	ULCI	c'_ps
-.7919	.5569	-1.4220	.1580	-1.8962	.3124	-.2719

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	-.3367	.3089	-1.0427	.1819
FlowTota	-.1136	.1424	-.4733	.0750
Intrinsi	-.0634	.3098	-.7616	.5115
Identifi	-.1730	.2251	-.7417	.1605
Competen	-.0293	.2381	-.5374	.4317
Autonomy	.0911	.1809	-.2295	.5287
Relatedn	-.0486	.1273	-.3797	.1353

7. Choir to Other comparison: Cohesion

```
********************
Model  : 4
    Y  : Cohesion
    X  : GroupSin
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : Competen
   M5  : Autonomy
   M6  : Relatedn

Sample
Size:  115
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 Cohesion

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .1624      .0264      .6839     3.0602     1.0000   113.0000      .0829

Model
              coeff         se          t          p       LLCI       ULCI
constant     5.9509      .1095    54.3289      .0000     5.7339     6.1679
GroupSin      .2698      .1542     1.7494      .0829     -.0358      .5754

Standardized coefficients
              coeff
GroupSin      .3234

Covariance matrix of regression parameter estimates:
           constant   GroupSin
constant       .0120      -.0120
GroupSin      -.0120       .0238
```

```
************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI       c_ps
      .2698      .1542     1.7494      .0829     -.0358      .5754      .3234

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI      c'_ps
      .1532      .0908     1.6870      .0945     -.0268      .3333      .1836

Indirect effect(s) of X on Y:
             Effect     BootSE   BootLLCI   BootULCI
TOTAL         .1166      .1301     -.1316      .3790
FlowTota      .0239      .0259     -.0157      .0848
Intrinsi     -.0896      .0528     -.2108     -.0090
Identifi      .0491      .0395     -.0095      .1419
Competen     -.0761      .0544     -.2034      .0069
Autonomy      .1075      .0689      .0001      .2680
Relatedn      .1018      .1008     -.0818      .3195
```

8. Choir to Other comparison: Mental wellbeing

```
*******************
Model  : 4
    Y  : WEMWBSRe
    X  : GroupSin
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : Competen
   M5  : Autonomy
   M6  : Relatedn

Covariates:
 Age

Sample
Size:  113
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 WEMWBSRe

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2545      .0647    15.6922     3.8078     2.0000   110.0000      .0252

Model
              coeff         se          t          p       LLCI       ULCI
constant    20.2466     1.7329    11.6835      .0000    16.8123    23.6808
GroupSin      .2368      .7646      .3097      .7574    -1.2785     1.7520
Age           .0737      .0283     2.6040      .0105      .0176      .1297

Standardized coefficients
              coeff
GroupSin      .0583
Age           .2463

Covariance matrix of regression parameter estimates:
           constant   GroupSin        Age
constant     3.0030      .0013     -.0467
GroupSin      .0013      .5846     -.0048
Age          -.0467     -.0048      .0008
```

*************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y ***************

Total effect of X on Y

Effect	se	t	p	LLCI	ULCI	c_ps
.2368	.7646	.3097	.7574	-1.2785	1.7520	.0583

Direct effect of X on Y

Effect	se	t	p	LLCI	ULCI	c'_ps
.0229	.6975	.0328	.9739	-1.3603	1.4060	.0056

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	.2139	.5039	-.7993	1.2068
FlowTota	.2259	.2353	-.1287	.7763
Intrinsi	-.3447	.3209	-1.1015	.1755
Identifi	.0720	.1401	-.2079	.3849
Competen	-.2957	.3360	-1.0115	.3506
Autonomy	.4032	.3365	-.1226	1.1925
Relatedn	.1532	.2685	-.3236	.7834

9. Exercise to Other comparison: Positive affect

```
********************
Model  : 4
    Y  : PATotal
    X  : GroupExe
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : Competen
   M5  : Autonomy
   M6  : Relatedn

Sample
Size:  117

********************
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 PATotal

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2720      .0740    39.9741     9.1882     1.0000   115.0000      .0030

Model
              coeff         se          t          p       LLCI       ULCI
constant    37.4386      .8374    44.7062      .0000    35.7798    39.0974
GroupExe     3.5447     1.1694     3.0312      .0030     1.2283     5.8611

Standardized coefficients
              coeff
GroupExe      .5419

Covariance matrix of regression parameter estimates:
           constant   GroupExe
constant      .7013     -.7013
GroupExe     -.7013     1.3675
```

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y

Effect	se	t	p	LLCI	ULCI	c_ps
3.5447	1.1694	3.0312	.0030	1.2283	5.8611	.5419

Direct effect of X on Y

Effect	se	t	p	LLCI	ULCI	c'_ps
1.3152	.9213	1.4275	.1563	-.5108	3.1411	.2010

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	2.2296	1.0235	.3565	4.3350
FlowTota	.4516	.2980	.0110	1.1675
Intrinsi	.6894	.4571	.0239	1.7940
Identifi	.9944	.6145	.0014	2.3735
Competen	.0921	.2563	-.2902	.7817
Autonomy	.1316	.3436	-.5288	.8815
Relatedn	-.1296	.2305	-.7393	.1758

10. Exercise to Other comparison: Negative affect

```
*******************
Model  : 4
    Y  : NATotal
    X  : GroupExe
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : Competen
   M5  : Autonomy
   M6  : Relatedn

Covariates:
 Age

Sample
Size:  116
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 NATotal

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .3192      .1019     8.0510     6.4108     2.0000   113.0000      .0023

Model
              coeff         se          t          p       LLCI       ULCI
constant    16.1254     1.4014    11.5066      .0000    13.3490    18.9018
GroupExe    -1.4555      .5295    -2.7486      .0070    -2.5046     -.4064
Age          -.0588      .0231    -2.5416      .0124     -.1046     -.0130

Standardized coefficients
              coeff
GroupExe     -.4904
Age          -.2276

Covariance matrix of regression parameter estimates:
           constant   GroupExe        Age
constant     1.9639     -.2105     -.0312
GroupExe     -.2105      .2804      .0011
Age          -.0312      .0011      .0005
```

```
************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI       c_ps
    -1.4555      .5295    -2.7486      .0070    -2.5046     -.4064     -.4904

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI      c'_ps
    -1.1925      .5917    -2.0154      .0464    -2.3656     -.0195     -.4018

Indirect effect(s) of X on Y:
             Effect     BootSE   BootLLCI   BootULCI
TOTAL        -.2629      .3022     -.9291      .2782
FlowTota     -.1929      .1735     -.5786      .1092
Intrinsi      .0026      .2231     -.5040      .4166
Identifi     -.2217      .3657    -1.0460      .4092
Competen     -.0584      .1417     -.4188      .1788
Autonomy      .1554      .2274     -.2228      .6848
Relatedn      .0519      .0985     -.1283      .2879
```

11. Exercise to Other comparison: Social cohesion

```
*********************
Model  : 4
    Y  : Cohesion
    X  : GroupExe
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : Competen
   M5  : Autonomy
   M6  : Relatedn

Sample
Size:  117
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 Cohesion

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .0541      .0029      .7956      .3371     1.0000   115.0000      .5626

Model
              coeff         se          t          p       LLCI       ULCI
constant     5.9509      .1181    50.3705      .0000     5.7169     6.1849
GroupExe      .0958      .1650      .5806      .5626     -.2310      .4226

Standardized coefficients
              coeff
GroupExe      .1077

Covariance matrix of regression parameter estimates:
           constant   GroupExe
constant      .0140     -.0140
GroupExe     -.0140      .0272
```

```
************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y
     Effect         se          t          p       LLCI       ULCI       c_ps
      .0958      .1650      .5806      .5626     -.2310      .4226      .1077

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI      c'_ps
      .1682      .1163     1.4465      .1509     -.0623      .3988      .1892

Indirect effect(s) of X on Y:
             Effect     BootSE   BootLLCI   BootULCI
TOTAL        -.0725      .1447     -.3605      .2159
FlowTota      .0256      .0351     -.0367      .1067
Intrinsi     -.0547      .0422     -.1587      .0059
Identifi      .0759      .0448      .0052      .1765
Competen     -.0076      .0279     -.0775      .0379
Autonomy     -.0035      .0518     -.0977      .1156
Relatedn     -.1080      .1326     -.3780      .1534
```

12. Exercise to Other comparison: Mental wellbeing

```
**********************
Model  : 4
    Y  : WEMWBSRe
    X  : GroupExe
   M1  : FlowTota
   M2  : Intrinsi
   M3  : Identifi
   M4  : Competen
   M5  : Autonomy
   M6  : Relatedn

Covariates:
 Age

Sample
Size:  116
```

```
************************** TOTAL EFFECT MODEL ****************************
OUTCOME VARIABLE:
 WEMWBSRe

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .3683      .1357    15.6282     8.8682     2.0000   113.0000      .0003

Model
              coeff         se          t          p       LLCI       ULCI
constant    17.3848     1.9525     8.9038      .0000    13.5165    21.2531
GroupExe     1.5830      .7378     2.1457      .0340      .1214     3.0447
Age           .1227      .0322     3.8084      .0002      .0589      .1866

Standardized coefficients
              coeff
GroupExe      .3756
Age           .3345

Covariance matrix of regression parameter estimates:
           constant   GroupExe        Age
constant     3.8123     -.4086     -.0606
GroupExe     -.4086      .5443      .0022
Age          -.0606      .0022      .0010
```

************** TOTAL, DIRECT, AND INDIRECT EFFECTS OF X ON Y **************

Total effect of X on Y

Effect	se	t	p	LLCI	ULCI	c_ps
1.5830	.7378	2.1457	.0340	.1214	3.0447	.3756

Direct effect of X on Y

Effect	se	t	p	LLCI	ULCI	c'_ps
.9067	.7335	1.2361	.2191	-.5474	2.3607	.2151

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
TOTAL	.6764	.5303	-.2763	1.8331
FlowTota	.5393	.3206	.0670	1.3012
Intrinsi	-.0493	.2306	-.5306	.4280
Identifi	.1071	.2589	-.4563	.5826
Competen	.1952	.2502	-.1653	.8002
Autonomy	-.0103	.2953	-.5746	.6687
Relatedn	-.1056	.1556	-.4433	.1960

Social group participation and wellbeing: 14-day diary

(Daily diary email text)

Subject line: Social group participation and wellbeing – day 1 diary

Hello! You are receiving this email because you expressed interest in participating in the research project "Social group participation and wellbeing". A link to a very short survey will be sent to you daily for 14 days. Each day you will be asked a question about how you are feeling (happy, connected, active) and a question on what you've been up to (exercising, singing, listening to music, or participating in a social group activity). <u>Please try to answer the survey in the evening, after you have finished with any activities for the day.</u> If you are too busy to respond, that's okay - just skip the prompt and wait for the prompt for the next day. Please don't respond retrospectivity - this research is interested in how you feel TODAY.

For Days 2 – 14 the text was much shorter: Hello! This is your prompt for Day 2 (changed each day) of 14. <u>Please try to answer the survey in the evening, after you have finished with any activities for the day.</u> If you are too busy to respond, that's okay - just skip the prompt and wait for the prompt for the next day. Please don't respond retrospectivity - this research is interested in how you feel TODAY.

This is the prompt for Day 1.

If you've changed your mind, you can click on the "opt out" link below (on any email).

Follow this link to the Survey:
Take the Survey

Or copy and paste the URL below into your internet browser:
https://monashmnhs.qualtrics.com/jfe/form/SV_6ygvNPtGjc5WtiR?Q_DL=9NZiPa42YyGRuU5_6ygvNPtGjc5WtiR_MLRP_0j5gLJL4z4hvbOB&Q_CHL=email

Follow the link to opt out of future emails:
Click here to unsubscribe

If you have any questions, please contact the lead researcher at Susan.Maury@monash.edu

(daily diary survey, day 1)

Social group participation and wellbeing: a 14-day diary

Day 1

Before we ask you about your activities for today, please tell us a little bit about yourself. These questions only need to be answered once. *(Days 2 – 14 went straight to the survey questions.)*

Are you:

1. **Are you:**
- ☐ Male
- ☐ Female
- ☐ Non-binary
- ☐ Prefer not to answer

2. **In what year were you born?** _________

Many thanks! The daily questions of activity and mood are on the next page. Please use the arrow key to advance.

What's your mood now? 1 = low, 7 = high

	1	2	3	4	5	6	7
Happy	0	0	0	0	0	0	0
Socially connected	0	0	0	0	0	0	0
Active	0	0	0	0	0	0	0

What have you been doing today? Check all that apply (or none).

- ☐ I've exercised by myself
- ☐ I've been singing by myself
- ☐ I've listened to or made music by myself (e.g., listening to the radio or practicing an instrument)
- ☐ I've attended an exercise class
- ☐ I've been singing in a choir
- ☐ I've listened to or made music with other people (e.g., music was playing in an exercise class or I played an instrument in a band)
- ☐ I've participated in another kind of group activity (please specify): ____________________

That's it for Day 1 – thank you! We will send you a daily reminder by email for the remainder of the 14 days.

(Day 14 also included this text: That's the last day of the 14-day diary – thank you for taking the time to stick with it until the end. Your answers will help us better understand the links between social group participation and wellbeing.

If you are interested in the findings from this research, please email the lead researcher: Susan.Maury@Monash.edu)

ESM survey interface

The daily diary was designed to be easily opened and answered on a phone, so that individuals could quickly fill it each evening. This circumvented the need for participants to download and use an app, which was found to be a barrier when testing the methodology. Below are screen shots of the demographics (asked only on Day 1) and the questionnaire (asked each day).

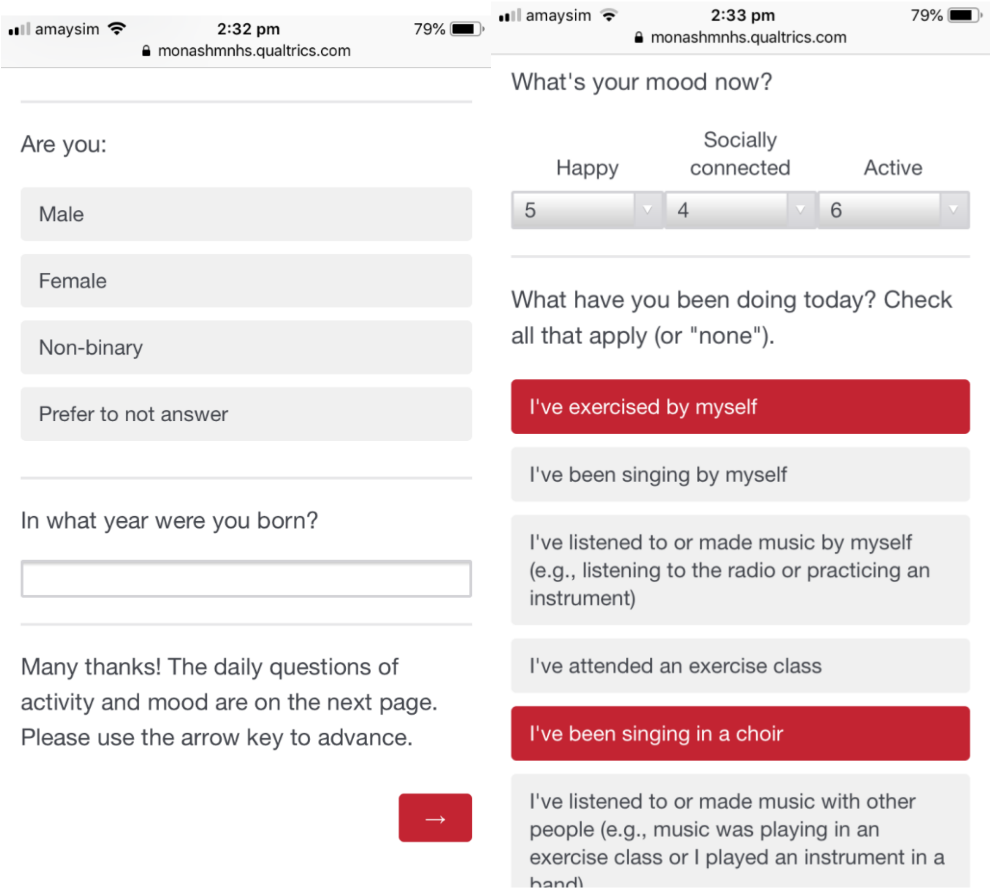

Figure A1: Screen shot of ESM demographics (left) and daily questionnaire (right)

Mechanisms of activity characteristics Key data outputs: Individual attitudes as mechanisms of wellbeing (Chapter 7)

Conducted using SPSS version 26

Computation: Repeated measures t-tests, comparing a day with any music engagement to a day with no music engagement, a day with any social group participation to a day with no social group participation, and a day with any exercise to a day with no exercise.

Measures:

How happy are you today?

How socially connected are you today?

How energetic are you today?

1. Any music engagement to no music engagement

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AllMusicHappy	5.2178	48	1.08027	.15592
	NoMusicHappy	5.2907	48	1.66417	.24020
Pair 2	AllMusicConnected	5.1861	48	1.39213	.20094
	NoMusicConnected	4.8505	48	1.35486	.19556
Pair 3	AllMusicActive	4.5754	48	1.37637	.19866
	NoMusicActive	4.3862	48	1.32670	.19149

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AllMusicHappy - NoMusicHappy	-.07289	1.42877	.20623	-.48776	.34198	-.353	47	.725
Pair 2	AllMusicConnected - NoMusicConnected	.33556	1.14754	.16563	.00235	.66877	2.026	47	.048
Pair 3	AllMusicActive - NoMusicActive	.18923	1.16786	.16857	-.14988	.52834	1.123	47	.267

2. Any social group to no social group

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AllGroupHappy	5.8672	44	1.67172	.25202
	NoGroupHappy	5.1762	44	.88732	.13377
Pair 2	AllGroupConnected	6.1533	44	2.24249	.33807
	NoGroupConnected	4.8248	44	1.15714	.17444
Pair 3	AllGroupActive	5.5302	44	1.71775	.25896
	NoGroupActive	4.4171	44	1.11604	.16825

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AllGroupHappy - NoGroupHappy	.69103	1.66880	.25158	.18367	1.19840	2.747	43	.009
Pair 2	AllGroupConnected - NoGroupConnected	1.32854	2.23953	.33762	.64766	2.00941	3.935	43	.000
Pair 3	AllGroupActive - NoGroupActive	1.11319	1.60998	.24271	.62371	1.60267	4.586	43	.000

3. Any exercise to no exercise

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	AllExerciseHappy	5.4442	42	.94525	.14585
	NoExerciseHappy	4.8894	42	1.06916	.16497
Pair 2	AllExerciseConnected	5.2880	42	1.01192	.15614
	NoExerciseConnected	4.6518	42	1.26033	.19447
Pair 3	AllExerciseActive	5.3886	42	1.08300	.16711
	NoExerciseActive	3.7217	42	1.33480	.20596

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	AllExerciseHappy - NoExerciseHappy	.55474	.74019	.11421	.32408	.78540	4.857	41	.000
Pair 2	AllExerciseConnected - NoExerciseConnected	.63628	1.04456	.16118	.31077	.96179	3.948	41	.000
Pair 3	AllExerciseActive - NoExerciseActive	1.66683	1.28575	.19840	1.26616	2.06750	8.402	41	.000