


ORIGINAL ARTICLE

# Phase I trial of the MuSic to CONnect (MuSiCON) protocol: feasibility and effect of choir participation for individuals with cognitive impairment

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## Abstract

**Background:** Individuals living in residential aged care facilities with cognitive decline are at risk of social isolation and decreased wellbeing. These risks may be exacerbated by decline in communication skills. There is growing awareness that group singing may improve sense of wellbeing for individuals with dementia. However, to date few studies have examined broader rehabilitative effects on skills such as communication of individuals with dementia.

**Aims:** To determine the feasibility and acceptability of the MuSic to Connect (MuSiCON) choir and language/communication assessment protocol in people with cognitive impairment living in non-high-care wards of a residential facility.

**Methods:** Six individuals with mild-moderate cognitive impairment participated (age range 55–91 years, five female, one male). A mixed method approach was used. Quantitative outcomes included attendance rates, quality of life and communication measures. The qualitative measure was a brief survey of experience completed by participants and carers post-intervention.

**Results:** Overall, MuSiCON was perceived as positive and beneficial, with high attendance, perception of improved daily functioning and high therapeutic benefit without harmful effects. While there was no reliable change in communication skills over the course of the six-week intervention, most participants successfully engaged in the conversational task, suggesting it is a suitable and ecologically valid method for data collection

**Conclusions:** The MuSiCON protocol demonstrated feasibility and was well received by participants and staff at the residential facility. A co-design approach is recommended to improve upon feasibility, acceptability and validity of the assessment protocol prior to Phase II testing.

**Keywords:** Music; singing; dementia; wellbeing; communication

## Introduction

The potential of group singing as an easily accessible activity that may improve sense of wellbeing and quality of life for individuals living in aged care facilities is increasingly proposed (Camic et al., 2013; Davidson et al., 2014; Ward, Milligan, Rose, Elliott & Wainwright, 2020). Group singing may also have broader rehabilitative effects, such as improving communication. Musical activities (i.e., listening and playing/ singing) activate similar regions of the brain used during talking,

communication and social exchange (Särkämö & Sihvonen, 2018; Sihvonen et al., 2017; Sihvonen et al., 2019; Zatorre, Chen, & Penhune 2007). In addition, learning lyrics may activate semantic brain networks in a similar way as word-retraining interventions, with song singing and reminiscence having been shown to significantly improve spontaneous speech content and fluency (Brotons & Koger, 2000; Dassa & Amir, 2021). Moreover, skills required to engage in group activities, like group singing, may also support social interactions (Clare et al., 2020; Särkämö & Sihvonen, 2018). Thus, from a theoretical perspective, group singing has potential to improve language and social communication. Despite this, replicable experimental studies that explore the effects of group singing interventions in dementia are scant. To our knowledge, even fewer examine the potential positive effects on language and none evaluate the effects on social communication skills.

Individuals living in residential aged care facilities are at risk of social isolation and decreased quality of life and wellbeing (Brimelow & Wollin, 2017). For individuals living with cognitive decline (e.g., from dementia), risks of social isolation and reduced quality of life may be exacerbated by decline in communication skills (Banovic et al., 2018). Manifestation and progression of communication impairments in diseases of ageing are heterogeneous, depending on disease aetiology and stage (Kempner & Goral, 2008) and pre-existing conditions (e.g., traumatic brain injury or developmental disorders (Rogalski et al., 2014; Rogalski, et al., 2008)). Deficits range from word finding difficulties, higher level language and pragmatic deficits, circuitous and empty speech, to adynamic aphasia and mutism (Fraser et al., 2016; Savage et al., 2013a; Shany-Ur et al., 2012). Therapies targeting both the impairment and participation levels include word retrieval therapies (Savage et al., 2013b), memory books (Bourgeois, 1993; Taylor et al., 2009) and communication partner training (Conway & Chenery, 2016; Volkmer et al., 2018). However, the effectiveness of these interventions differs across disorder type and severity (El-Wahsh, Monroe, Kumfor, & Ballard, 2020). Despite increasing awareness of the impact that these communication difficulties have on older individuals with a dementia, access to communication therapy remains limited for most patients (El-Wahsh et al., 2020). Group singing may represent an economical, pleasurable and scalable intervention that is suitable for a wide range of people with dementia, and a wide range of disease types and disease stages.

This study aimed to determine the feasibility and acceptability of a new choir and language/communication assessment protocol in people with cognitive impairment living in non-high-care wards of a residential facility. We defined a choir as a singing group that meets regularly to sing together with (1) song singing as the main focus (representing >50% of the session time) and (2) a shared group goal of improving the quality of the sung output for performance. This distinguishes it from, for example, a sing-along activity with no specific group goal of improvement of output for performance, or groups that focus substantial time on individual breathing and vocal exercises (e.g., Tamplin et al., 2019). We hypothesised that all participants would engage with the choir programme by voluntarily attending at least 80% of sessions and reporting positive experiences in a post-choir survey. We also hypothesised that residential care facility staff would report positive effects for the participants in a post-choir survey. To explore potential positive effects of choir participation and feasibility of the chosen measurement tools, the assessment protocol pre- and post-intervention included measures of (i) self- and carer-rating of quality of life carer-report of overall daily functioning, and (iii) language and communication skill during conversations with facility care staff. We predicted that participants and facility carers would complete >80% of the assessment activities at the prescribed time. We also hypothesised that measures of language and communication skill for each participant post-choir would be improved compared with baseline.

## Methods

The study was approved by the Human Research Ethics Committee at the University of Sydney (2018/915). Written consent for participation was obtained from all participants and their person responsible.

**Table 1.** Participant demographics and baseline neuropsychological testing

Participant	F1	F2	F4	F6	F7	M2
<b>Age (years)</b>	82	82	91	55	82	82
<b>Diagnosis on file</b>	MCI/ hypoxic brain injury	MCI	Dementia not specified	Intellectual disability	Vascular dementia	Parkinson's disease & dementia
<b>Profession</b>	Nurse	Teacher	Farm owner/ housewife	Not known	Bank officer	Engineer
<b>Prior choir experience</b>	Yes	Yes	Yes	Yes	Yes	Yes
<b>ACE-III</b>						
<b>Attention (/18)</b>	10	14	10	12	12	13
<b>Memory (/26)</b>	16	17	10	17	8	10
<b>Fluency (/14)</b>	8	10	4	2	7	7
<b>Language (/26)</b>	24	24	17	20	23	20
<b>Visuospatial (/16)</b>	8	11	6	10	13	11
<b>Total (/100)</b>	<b>66</b>	<b>76</b>	<b>47</b>	<b>61</b>	<b>63</b>	<b>61</b>
<b>SYDBAT</b>						
<b>Naming (/30)</b>	20	22	8	15	20	17
<b>Semantic association (/30)</b>	26	27	7	17	12	23

Note. F = Female, M = Male; MCI = Mild cognitive impairment; ACE = Addenbrooke's Cognitive Examination (Hsieh et al., 2013); SYDBAT = Sydney Language Battery (Savage et al., 2013a) which assesses integrity of the lexical and semantic systems.

### Participants

Inclusion criteria for participants were (1) English as their primary language of daily communication, (2) cognitive impairment with a score of between 35-80/100 on the Addenbrooke's Cognitive Examination-III (ACE-III) (Hsieh et al., 2013) and (3) adequate hearing on pure tone audiometry (with hearing aids if usually worn) to follow instructions during the group singing sessions. Specific medical diagnosis and stage of disease were not used for inclusion/ exclusion.

Participants were recruited from non-high-care wards of a single residential aged care facility in rural NSW, Australia. Flyers were provided to the facility and information sessions were held by the research team for residents and staff. Residents were encouraged to tell a staff member if they were interested in participation. The care facility staff passed on the details of interested residents to the research team. Due to recruitment being at arms-length, it was not possible to estimate how many residents saw the flyer and therefore the percentage of uptake.

Care facility staff informed the researchers that 13 residents were interested in participating in the study. Of the 13, one declined when asked about participation by the researchers and 12 were tested against the inclusion criteria. Six of these were suitable for inclusion in the study. Their ages ranged between 55 and 91 years (median = 82, inter-quartile range [IQR] = 9), and baseline scores on the ACE-III ranged between 47 and 76 (median = 62, IQR = 11). Participants also completed the Confrontation Naming and Semantic Association subtests of the Sydney Language Battery (SYDBAT, Savage et al., 2013a). See Table 1 for participant demographics and pre-intervention profile on neuropsychological testing. The remaining six residents scored <35 on the ACE-III. They were invited to sing with the choir but contributed no data to the study.

During the staff information session, staff members were invited to participate in the study by (i) acting as communication partner for the participants during the conversation samples

and (ii) providing ratings of perceived quality of life on the DEMQOL-4 proxy questionnaire. Staff were eligible to participate if they were available across the entire period of the study and had daily contact with at least one of the participants. A total of 11 staff (nine nursing staff, the activities coordinator and the facility manager) indicated interest in participating and completed the consent process.

### **Design**

A mixed method approach was used. The qualitative measure was a brief survey of experience administered to participants and carers within one-week post-intervention. Rating scales were used to measure overall daily function was scheduled before and within one-week post-intervention. The Dementia Quality of Life Questionnaire (version 4) (DEMQOL-4; Smith et al., 2005), A rating scale measure of quality of life was administered at baseline, after choir session 4 (Probe 1) and 8 (Probe 2), and within one week after the final 12<sup>th</sup> session (End). Participant's daily functioning was rated with the Clinical Global Impressions Scale (CGI) (Guy, 1976) once at baseline and then again at the end of the study, within one-week post-intervention. To assess change in language and communication skill, a single case experimental design (SCED) was applied with multiple baselines across participants. Participants were randomised to have between three and five baseline assessments of their communication skills over a two-week period pre-intervention. Randomisation of start-point for the treatment phase, through varying the number of baseline assessments, is required in single case experimental design to minimise risk of bias (Kratochwill et al., 2010; Tate et al., 2013). A sequence of numbers ranging from 3 to 5 was randomly generated with each number in the sequence assigned to the participants in order of recruitment. Experimental probes to reassess language and communication skills were administered at Probe 1, Probe 2 and End.

### **Intervention**

The MuSiCON group singing intervention consisted of 12 group singing sessions of 1 h:45 min each, twice a week for six weeks, and a final half-hour concert (see supplementary material for a detailed description of the choir protocol). Singing sessions comprised (1) 5-min group welcome and upper body stretches from the chair (2) 10 minutes of breathing exercises and vocal warm up, (3) 20 min singing well-known songs, (4) 20 minutes of either new learning of song material or work on refining group production of known material, (5) half-hour tea break and (6) 20-min consolidation of material rehearsed during the session. Feedback and coaching were given at the group level only (as would happen in an amateur community choir). The intervention was led by one of the researchers (PM) who is a speech pathologist, a trained choral conductor and classical singer. The singing sessions and final concert were accompanied by a local pianist who had considerable experience working with choirs. Other residents of the care facility, family members and the local press were invited to the final concert.

### **Outcome measures**

#### *Attendance*

Attendance (out of 12 sessions) was counted if the participants were present for the full session. Reasons for non-attendance were recorded (e.g., other appointment, illness, personal choice).

#### *Survey*

Participants in the group singing activity and the staff members who had consented to participate in the study were invited to complete a brief feedback survey on their perceptions and experiences

with the intervention. The survey was delivered face-to-face by the first author (PM), who read the questions aloud and audio-recorded the responses for later analysis. Open-ended questions were read aloud to participants from the singing group, by the researcher, to support comprehension and completion of the task. To keep this method constant across all survey participants, questions were also read, and responses recorded for the staff members who provided feedback. Staff members who participated in the survey were also asked a general feedback question: “What were your experiences of having sung in the choir?”, followed by two more specific questions: “What do you think you gained?”, and “How did you feel singing in the concert?” Care staff were also asked a general feedback question: “Would you like to give some feedback on the choir project? For example, what are your thoughts on having had the project happen here?”.

#### *Quality of life and overall functioning*

Participants and one staff member per participant completed the DEMQOL-4 at Baseline, Probe 1, Probe 2 and End. The questions were read aloud by the researchers to support comprehension and completion of the task.

One staff member (the facility’s Activity Coordinator), who was familiar with all participants, rated each participant’s daily functioning using the CGI. Daily functioning was assessed once at Baseline and then again at End.

#### *Language and communication skills*

Each participant was audio-recorded engaging in a 10-min conversation with their carer, discussing recent or pending personal events or life history, but avoiding discussion of the choir. The conversation task was used, rather than commonly used monologue story-retell tasks, to evaluate a more naturalistic daily interactional context for these participants. The first 2 min and final 3 min of the conversation were discarded to avoid greetings, establishing the topic and exhausting the topic; the analysis was completed on the intervening 5 min. In four of the conversation samples (i.e., Probe 1 for F4; baseline 4, Probe 1 and End for F7), conversational output was limited so portions of the initial 2 min were included to make up a 5-min analysis window.

Four outcome measures were taken from each sample to quantify the diversity, complexity, amount and efficiency of information conveyed in discourse. These measures served as proxies for quality of contribution to a conversation and have been observed to be reduced in the conversation of adults with cognitive-linguistic impairment (Berube *et al.*, 2019; Boschi *et al.*, 2017; Matias-Guiu *et al.*, 2022; Mueller, *et al.*, 2018). The first two measures quantified participant language skill using standard measures of word/conceptual diversity (i.e., type-token ratio [TTR]) and morphosyntactic complexity (mean length of utterance in words [MLU], capturing amount of information conveyed per sentence)<sup>1</sup>. TTR and MLU are computer-generated using CLAN software (MacWhinney, 2000), from text transcriptions of each conversation sample. The remaining two measures evaluated quantity and efficiency of a participant’s contribution to the communicative interaction as a whole and were based on the number of correct information units produced (CIUs; Nicholas & Brookshire, 1993). A CIU is a word that is intelligible, accurate, relevant and informative about the topic of conversation. Scoring of CIUs followed the guidelines of Nicholas and Brookshire (1993) with modifications for the conversation task (Leaman & Edmonds, 2019). Percent CIUs was calculated as the number of CIUs divided by total number of words produced by the participant. Communication efficiency was calculated as the number of CIUs produced per minute of the participant’s talking time. Praat software (Boersma, 2001) was used to segment the 5-min analysis window into examiner and participant speaking epochs (see Supplementary Material) to determine the amount of time the participant was speaking. An

<sup>1</sup>TTR is the total number of unique words divided by the total number of words used in a sample. MLU is the average number of words per utterance, which is usually a sentence.

independent scorer (a qualified speech pathologist experienced with rating CIUs) coded 100% of the samples, blinded to time point, for number of words, number of CIUs and segmentation of speech into examiner and participant epochs.

Inter-rater reliability was measured for the narrative transcriptions and coding of CIUs only, as all other measures were standardised measurement tools. First, an independent external transcription service transcribed 40% (15/38) of the conversation samples, randomly selected from participant and time point and blinded to time point. Agreement between the independent transcriber and the first author (PM) on these 15 samples was 100% for words transcribed and 95% for placement of utterance boundaries. As reliability was high, the first author transcribed the remaining 60% (23/38) of samples.

Inter-rater reliability between the independent rater and the first author for words coded as CIUs was conducted on a randomly selected 10% (4) of the conversational samples. Point-to-point agreement was high, ranging from 88 to 95% across samples.

### **Data analysis**

All survey responses were transcribed verbatim and are reported, collated across each question. Rating scale measures pre- and post-intervention for the DEMQOL-4 are tabulated and for the CGI are presented visually. The small sample size precluded statistical analysis. The outcome measures from the conversation samples were visually analysed for level, trend, variability and overlap, as is customary for small-N/single case experimental designs (Kratochwill et al., 2010).

## **Results**

### **Attendance**

Median attendance was 10/12 sessions (83%; IQR = 2.75; see Table 2 for non-attendance reasons). Study participants were supported by between five and eight ad hoc singers per choir rehearsal session. These extra singers were other residents of the facility who were either not eligible for participation or who had not registered interest in participation at the beginning of the study. No data are available for these individuals as they were not enrolled in the study.

### *Survey*

Five of the 11 consented staff members (four nurses and the facility manager) and four of the six participants were available to provide feedback in the survey. Of the other two participants, one was in hospital at the time of the survey and the other could not remember having participated. All four participants responded to the first question providing general feedback on the choir, while the other two questions did not elicit responses from all four participants. All responses are shown verbatim in Table 3. All responses regarding the choir group were positive and suggest that staff and participants perceived the concert to be an integral part of the programme.

### *Quality of life and overall functioning*

*Quality of life:* Four of the six participants were able to complete the self-report DEMQOL-4 questionnaire at baseline, with total score ranging between 79 and 97 (median: 88, IQR: 12). Three of the four also completed ratings at Probe 1, Probe 2 and End, with the fourth participant unavailable at End due to illness (see Table 4). The minimum important difference in score is 5 to 6 points (Lee et al., 2021). There was no consistent change in scores for three of the four participants. One participant (F2) experienced a reduction in quality of life, primarily in the feelings domain, at Probe 1 but had returned to their baseline level at Probe 2.



**Table 2.** Feasibility of the MuSiCON intervention protocol

Measure	Result	Detail
<i>Participants</i>		
Attendance at sessions	Median attendance 10/12 (83%), IQR 2.75 Range 6 – 11 of 12 sessions	Reasons for non-attendance: illness; doctors' appointments; church attendance (the project happened over the Easter period)
Attendance at concert	5/6	1 participant was ill
Survey & rating scales	4/6 able to complete DEMQOL-4 self-rating scale and complete survey	2/6 participants (F4 and F7) were not able to complete the DEMQOL-4 self-rating scale or provide feedback on the singing activity as, when asked, one was unable to recall events from the preceding week or attendance at the singing group and the other became quite upset in response to the questions on the questionnaire leading to testing being discontinued and not reattempted.
Conversation samples	97.6% of scheduled samples collected (40/41) 95% (38/40) of collected samples used in analysis	1 participant (F1) was not available for data collection at end data point due to illness. 2 of the 40 samples collected were not transcribed for analysis due to poor audio quality because of excessive background noise. All 38 samples included in the data analysis were > 5 min in length. However, 4 of the samples were < 9 min in length due to participant liability (F7; 3/4) or interruption by other facility activities (F4; 1/4).
<i>Staff</i>		
Survey & rating scales	4 staff members and the facility manager were available to complete the survey. The same staff member (the Activities Coordinator) was available to complete the CGIS at baseline and end data points for all the participants. Staff availability to complete the DEMQOL-4 was inconsistent, and it was not possible to have the same staff member rate a single participant across all of their data collection points.	Staff availability and scheduling led to inconsistency in the availability of staff members to rate participants on the DEMQOL-4
Conversation samples	Staff members participated in 3/38 samples (8%). Researchers served as conversation partner for 35/38 samples (92%).	10 staff members signed consent forms indicating intent to participate in the study. However, at data collection time points, staff were usually unavailable due to competing demands or scheduling changes. One staff member remarked that they were nervous to have a 10-min conversation with one of the participants as they felt this would be a challenging task.

We initially aimed to have care staff also complete the proxy questionnaire for the DEMQOL-4. However, we were unable to have the same caregiver rate any participant across all four time points. As a result, degree of familiarity and contact of the carers with a given participant varied. In addition, there were delays in completion of some forms. Therefore, these data were not useable.

*Daily functioning:* On the Clinical Global Impressions (CGI) scale, rating scales for each question are coded so that lower scores are positive (e.g., less severe illness or greater benefit from

**Table 3.** Survey responses from facility staff and participants

Question asked	Staff member	Verbatim responses (pauses and repetitions/rephrasing removed)
Would you like to give some feedback on the choir project? For example, what are your thoughts on having had the project here?	S1	One of the resident's families came and asked if it was going to be an ongoing thing because he thought that his mother got a great benefit out of it.
	S2	The residents who have been involved have been a lot more content in themselves. They know they've got something to look forward to. They have activities every day, but they know that this is something they contribute to for the community.
	S3	There's been a lot more involvement and mingling [between the two buildings] since you've been bringing them together for the choir.
	S4	While she [one of the participants] doesn't remember the choir if asked directly, is asking if she has singing today most days.
	Facility manager	<p>It was exciting. It created a level of excitement for the residents, and they had purpose and that they had some commitment as well. So, I found that every week people would come over and ask, 'is it choir today?' and they really didn't want to miss it. But they had that purpose and direction that they were part of something that brought joy to them, and they were being fulfilled in a different way than what they can be just on an everyday basis. So, I think from that perspective it was lovely to see and hear people that because it was important. It was something very important and they wanted to fulfil. Some of the residents that got involved are residents that don't get involved in anything else and for me that was one of the best things – in the fact that I could see those people that tend to isolate themselves – it was a whole different opportunity for them. They came forward and they were part of it, and they shone.</p> <p>I did see the joy in the participants faces [at the concert] and in the people watching it was just amazing!</p> <p>On the day of the concert, it was just beautiful! Everyone's singing along and it was just lovely! It's created a smaller community within our community. So, for me it's certainly engaged residents that don't normally participate but also residents who don't normally know each other. That's what it's all about – getting people to live, to enjoy their life and find those people who have common interests and that [the choir] was an opportunity.</p> <p>All of those people [the audience] could tell they [the singers] were so proud to be sitting there, they were so proud to be singing. You could see they just wanted to be part and just wanted to do well.</p> <p>They sung their little hearts out and it was just gorgeous, it was really touching. [They] built relationships.</p>

(Continued)



Table 3. (Continued)

Question asked	Staff member	Verbatim responses (pauses and repetitions/rephrasing removed)
		Other people who don't know our community [the journalists] were really touched and I mean emotionally touched with what they saw and heard that day [concert]. For me that was really important because they could see what was being done and I believe they could see the outcomes. That gentleman reporter was, 'oh this is amazing,' and 'I've not seen this before.'
Question asked	Participant	Verbatim responses (pauses and repetitions/rephrasing removed)
What were your experiences of singing in the choir?	F1	It was great. Very special. Enjoyed it – yes again and again! I've only had good reports about it.
	F6	It took a bit to get into but once I got into it, I was right.
	F7	I just enjoyed singing in the choir.
	M2	[I] enjoyed it very much so.
What do you think you gained?	F1	Very good and happy to think that I can do those sorts of things. Oh, to know that you can do things to make people feel good. And it makes me feel really good.
	F6	I gained confidence. My sisters thought I gained confidence out of it.
	F7	(Participant did not respond to this question)
	M2	Fellowship amongst people. Being able to sing!
How did you feel singing in the concert?	F1	We had one dear soul in the front when we were doing the singing [concert]. A - She was sitting in the front and her little face just beamed. She's hard to talk to but a couple of days later I spoke to her and said, 'did you enjoy the singing and the music and everything?' And she said yes.
	F6	A little bit nervous and proud.
	F7	(Participant did not respond to this question)
	M2	(Participant did not respond to this question)

S# = staff-member; F/M# = participant (female/ male).

therapy). Question 1 of the CGI asks about illness severity: “*Considering your total clinical experience with this particular population, how mentally unwell is the patient at this time?*” Baseline scores ranged between 1 (normal/ not functionally impaired) to 7 (among the most impaired patients) (median: 5.5, IQR: 5.25). The two participants rated as functionally normal (1) at baseline retained this rating at post-intervention. All four remaining participants were rated as having improved by 1 or 2 points on question 1 (see Fig 1).

Question 2 of the CGI asks about global improvement after intervention<sup>2</sup>: “*Rate improvement in functioning, whether or not, in your judgment, it is due to the intervention.*” All participants were rated as being “much improved” (score of 2 on the 7-point scale).

<sup>2</sup>The Global Clinical Impressions scales were developed for assessment of change in illness for studies of medications. Here, it is used to assess change in behaviour in response to the behavioural intervention of choir singing.

**Table 4.** DEMQOL-4 (Smith et al., 2005) self-report scores over time by participants able to complete the task

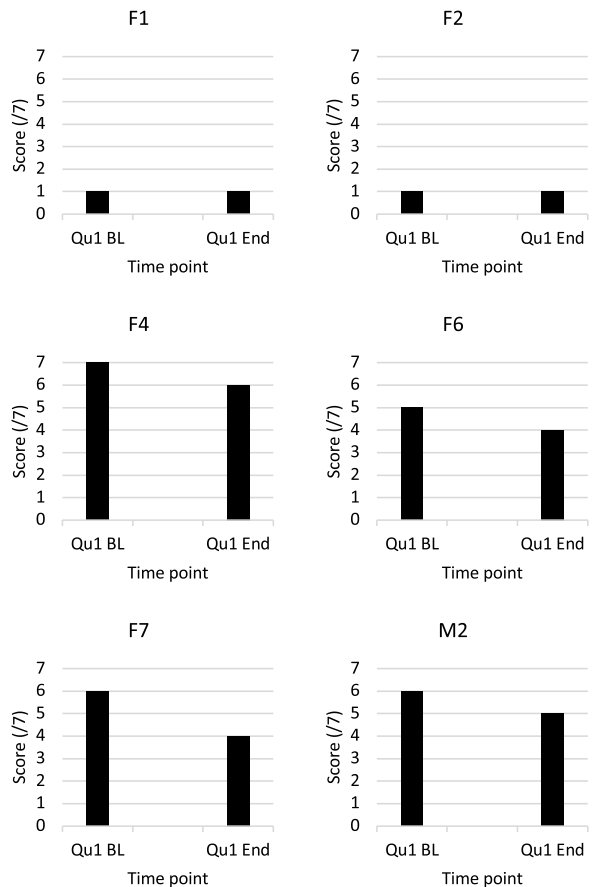
Timepoint	Baseline	Probe 1	Probe 2	End
<b>F1</b>				
Feelings subtest	45	45	39	38
Memory subtest	18	20	20	19
Everyday subtest	26	28	30	28
<b>Total</b>	<b>89</b>	<b>93</b>	<b>89</b>	<b>85</b>
MID*	> 94, <84			
<b>F2</b>				
Feelings subtest	43	31	44	
Memory subtest	20	20	22	
Everyday subtest	34	28	33	
<b>Total</b>	<b>97</b>	<b>79</b>	<b>99</b>	
MID <sup>a</sup>	> 102, <92		*	
<b>F6</b>				
Feelings subtest	37	33	35	35
Memory subtest	22	22	22	21
Everyday subtest	26	25	29	31
<b>Total</b>	<b>85</b>	<b>80</b>	<b>86</b>	<b>87</b>
MID*	> 90, <80			
<b>M2</b>				
Feelings subtest	33	31	32	28
Memory subtest	17	21	21	18
Everyday subtest	29	27	30	30
<b>Total</b>	<b>79</b>	<b>79</b>	<b>83</b>	<b>76</b>
MID*	> 84, <74			

<sup>a</sup>Minimum Important Difference (Lee et al., 2021) from baseline score (improvement, deterioration); \* total score represents an important difference.

Question 3 asks about intervention efficacy: “Select the terms that best describe the degrees of therapeutic effects and side effects.”. The intervention was rated as having had a “marked therapeutic effect” for five of the six participants with no side effects (score of 1 on the 16-point scale) and a “moderate therapeutic effect” for the sixth participant, also with no side effects (score of 5).

#### *Language and communication skills*

*Feasibility.* It was planned with the care facility management that the participants’ conversation samples would be with a familiar staff member and that the same staff member would record all conversations across the study period for a given participant. However, care staff were only available for 3/41 conversations in total (see Table 2). Therefore, a research assistant (final year speech pathology student) or the first author acted as communication partner for the remainder of the conversation samples. This resulted in 40/41 scheduled conversation samples being successfully collected, with one sample missed due to participant illness.



**Figure 1.** Clinical global impressions scale by participant at baseline (BL) and post-intervention (End), completed by the activity coordinator. question 1 (Qu1) asks: “Considering your total clinical experience with this particular population, how mentally unwell is the patient at this time”. Severity of illness rating is on a scale of 0–7 with 0 being not assessed, 1 being normal and 7 being among the most unwell.

*Outcomes.* Data for TTR and MLU are shown in Table 5. Percent of correct information units (%CIUs) and CIUs per minute are presented in Figures 2 and 3, respectively. No discernible change in level, slope, variability, or overlap over time was identified for any of the participants on any of the four discourse measures. F1 showed non-overlapping data points for the percent of CIUs and MLU in baseline versus intervention probes. Of note, her performance was higher during baseline than intervention for percent of CIUs but higher during intervention for MLU. F4 showed non-overlapping data for CIUs per minute with higher performance in the baseline than intervention phase. No other cases of non-overlapping data were observed.

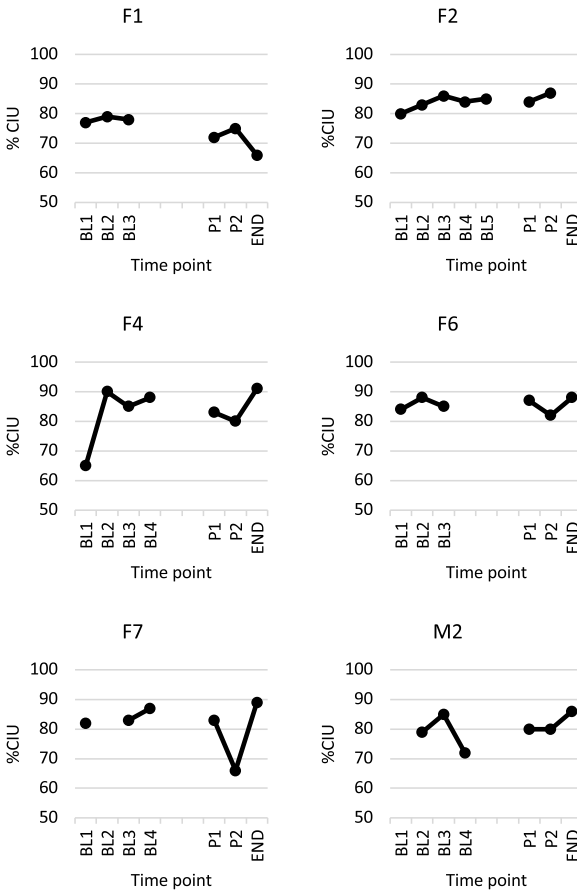
## Discussion

The primary aim of this study was to test the feasibility and acceptability of the MuSiCON choir and assessment protocols. The secondary aim was to explore the effects of group singing activities on psychological wellbeing and communication in individuals with cognitive impairment living in residential aged care. Overall, the choir intervention was perceived as positive and beneficial, with high participant attendance and perception of the facility manager of improved daily functioning and high therapeutic benefit without harmful effects. While there was no reliable change in language and communication skills over the course of the six-week intervention, most participants successfully engaged in the conversational assessment task, suggesting it is a suitable and ecologically valid method for data collection. Involvement of care staff in collection of outcome measures

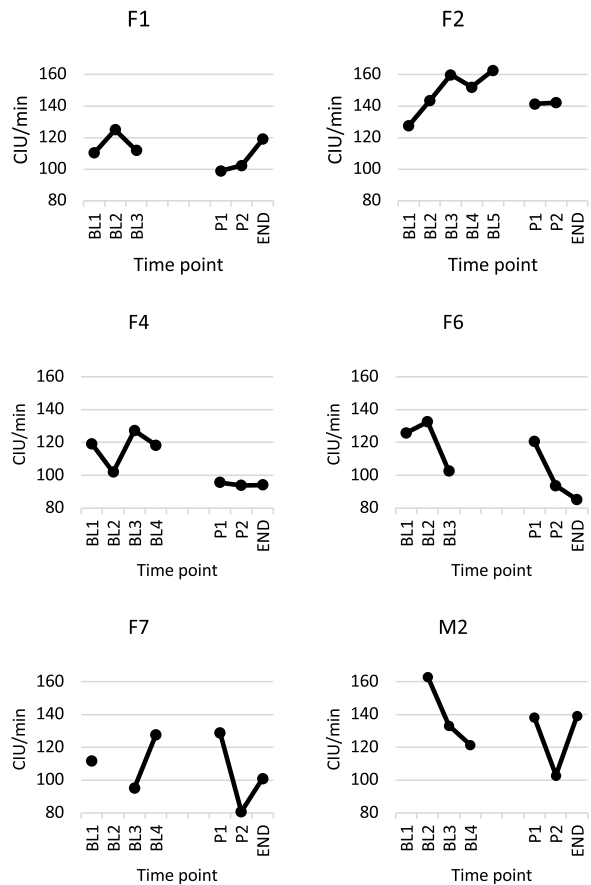
**Table 5.** Type token ratio (TTR) and mean length of utterance in words (MLU) by participant and time point

TTR	Baseline 1	Baseline 2	Baseline 3	Baseline 4	Baseline 5	Probe 1	Probe 2	End
<b>F1</b>	0.55	0.47	0.40			0.48	0.40	0.47
<b>F2</b>	0.43	0.41	0.39	0.40	0.42	0.42	0.39	
<b>F4</b>	0.50	0.48	0.49	0.48		0.39	0.45	0.48
<b>F6</b>	0.51	0.49	0.53			0.49	0.46	0.48
<b>F7</b>	0.41		0.47	0.48		0.45	<b>0.55</b>	<b>0.51</b>
<b>M2</b>		0.48	0.41	0.45		<b>0.49</b>	0.35	0.44
<b>MLU</b>								
<b>F1</b>	4.33	4.90	5.05			<b>5.33</b>	<b>6.05</b>	<b>5.10</b>
<b>F2</b>	4.93	7.02	5.54	6.45	5.16	6.22	5.04	
<b>F4</b>	3.00	3.36	2.77	2.99		3.33	2.58	2.77
<b>F6</b>	3.59	4.20	3.50			<b>5.39</b>	4.20	<b>5.09</b>
<b>F7</b>	4.57		4.36	3.78		3.32	2.75	3.88
<b>M2</b>		3.85	5.85	3.03		3.70	<b>5.93</b>	4.78

Note. Bold values for probes are higher than any baseline value.



**Figure 2.** Percent of correct information units (CIUs) by participant from baseline (BL; over a two-week period) to experimental probe 1 (P1) after the first four choir singing sessions over two weeks, probe 2 (P2) after the second four-choir singing sessions over two weeks, and within one week of completing the third and final four choir singing sessions over two weeks (End).



**Figure 3.** Correct information units (CIUs) per minute by participant from baseline (BL; over a two-week period) to experimental probe 1 (P1) after the first four choir singing sessions over two weeks, probe 2 (P2) after the second four-choir singing sessions over two weeks, and within one week of completing the third and final four choir singing sessions over two weeks (End).

was feasible when it involved minimal time in a structured task (i.e., a brief survey with the researchers); but was not feasible for the tasks of conversing with participants and completing the DEMQOL-4.

### **Feasibility and acceptability of the MuSiCON choir protocol**

The choir project was well received by participants, ad hoc singers, facility staff and family members. No participants dropped out of the project by choice and voluntary attendance rates at the rehearsals remained constant and above 80% across the project, albeit, some were prevented from attending due to illness. In ad hoc feedback provided during the running of the study, facility staff shared that the participants would frequently ask “do we have singing today?” even on non-rehearsal days. Staff also said that they perceived a “buzz” among the participants, stating that they felt like the participants had a new-found sense of purpose. These factors combined suggest the participants enjoyed the programme and found attendance and participation manageable. For the participants who were otherwise socially active, two rehearsals a week did represent a large time commitment and for future projects it would be worth considering reducing rehearsals to once a week but running the project for longer.

The addition of ad hoc singers did not appear to disturb the balance of the rehearsals. Many of these residents were significantly more cognitively impaired than the study participants and scored below the 35/100 inclusion criterion on the ACE-III. There was an atmosphere of congeniality and camaraderie within which those less able to join in were welcomed and supported by

individuals with higher functioning. For example, some of the more highly functioning individuals were witnessed ensuring those who were less able always had the right song/ page in front of them.

While implementation of the structure and content of the choir singing protocol was feasible, several challenges with assessment became apparent. It was initially planned that facility staff would act as communication partners with the participants during the recording of conversation samples. This was to try to minimise the effect of a research assistant or the choir leader transitioning from unfamiliar to familiar conversation partner over the course of the study. The facility management were supportive of care staff participating and 10 staff volunteered to take part in the study and completed the consent process. However, it was not possible to use care staff as communication partners during conversation sampling due to unplanned staffing changes, staff absences or staff reporting they were too busy with care responsibilities at the time of data collection, even if appointment times had been set. At least one staff member reported trepidation at the thought of having a 10-min conversation with some of the more impaired participants, which raises questions regarding the frequency and quality of conversational engagement of more cognitively impaired residents on a day-to-day basis. This phenomenon warrants consideration for future studies that may attempt to engage formal caregivers as communication partners. Communication partner training programmes such as FOCUSED (Ripich et al., 1995; Ripich et al., 2000; Ripich et al., 1998) report improvements in communication satisfaction post training for formal carers of individuals with dementia. It may be of benefit to provide such training to carers prior to future studies that intend to ask them to act as communication partners for conversation sampling to improve their confidence, skill base and therefore hopefully their willingness to participate.

Reduced familiarity of conversation partner may have impacted on the nature, depth, fluidity and topic focus of the conversation samples. Given a member of the research team acted as conversation partner, a familiarity effect might have been expected, with participant conversation contributions increasing across the study. Or the lack of change in diversity of words across conversation samples may instead reflect a superficiality in the topics chosen and a resultant lack of depth in the conversations that might have been evident had the samples been recorded between the participants and an individual well known to them (Brunell et al., 2007). These factors may have contributed to the lack of trend found on visual analysis of the measures of language communication. Also, despite overlap in neural pathways activated during both singing and talking (Sihvonen et al., 2017; Sihvonen et al., 2019; Zatorre et al., 2007), emerging literature on language therapy in the dementias suggests that specificity of target material may be critical to facilitating generalisation of therapy effects to daily conversation (Savage et al., 2013b; Taylor-Rubin et al., 2021). That is, the lack of similarity between the language practiced in the song singing and that used during the conversations may have played a role in the lack of change on the behavioural outcome measures selected.

A second practical limitation was the timing of the probe testing. A combination of factors resulted in variability in the timing of testing, with some participants being tested the day after the choir rehearsal and others being tested as late as the day before the next rehearsal. This may have resulted in some wash out of effects, especially given the relatively brief six-week period of behavioural intervention. The availability of participants due to other commitments/ activities, naps and mealtimes as well as the length of time it took to administer the tests and manage collection of conversation samples all played a role in the timing of data collection. This is an important factor to consider during future studies given previous authors have demonstrated that the effects of participating in a music programme on cognition appears to be greatest immediately post-sessions (Bruer et al., 2007). Potential short-term positive effects may have been missed in this study, due to delays in testing. The role of timing of testing on communication-related outcomes could be explored further with tighter control of timing of assessments as well as manipulating the length and intensity of the training protocol (Tamplin et al., 2018).

Another issue worth consideration is the exclusion of participants due to significant cognitive impairment, but who nevertheless participate in the choir protocol and concert as ad hoc singers,

and the inclusion of individuals with various aetiologies of cognitive impairment. A lower cut-off score was set as we thought the effects of the choir programme would be most beneficial for individuals with less profound cognitive impairment. The positive response and consistent attendance of the ad hoc singers who scored below our cut-off score, however, suggested the exclusion criteria could be less stringent. Our lower cut-off score on the ACE-III excluded half of the individuals who registered interest in the choir. While they were excluded from the study, these individuals all sang in the choir as ad hoc singers with several of them attending the whole programme and singing in the concert. One of these individuals was non-verbal during daily interactions with staff so would have been excluded on these grounds due to being unable to complete the communication and wellbeing tests used here. However, there is significant scope for expanding the range of communication skills assessed to include non-language-based measures and non-verbal communication behaviours. We set broad inclusion criteria as many individuals living in residential aged care may have cognitive impairment in the absence of a formal diagnosis of dementia. Diagnosis and disease stage were not known for the participants of the current study. However, it is plausible that an individual's response to singing as a therapeutic activity for communication impairment may depend on the individual's pattern of cognitive decline and neurodegeneration.

An additional factor which influenced feasibility was the arms-length recruitment method. Indeed, some residents who participated as ad hoc singers reported that they did not know about the choir or research project until after it had begun. This suggests that the researchers and project did not have a strong enough presence in the facility prior to the commencement of the project. One solution would be to conduct a second wave of the study within the same facility. This was not possible, however, due to the COVID-19 pandemic and subsequent restrictions imposed on entering residential aged care facilities, gathering in groups and singing. An alternative solution is to use rolling recruitment. This would necessitate the researchers establishing the choir activity within the care facility's weekly programme, running it for an extended period (i.e., beyond the planned period of measurement), taking baseline data before a new participant joins and probe data based off the length of their participation. Other benefits associated with this would be a more established presence of the researchers and activity within the facility and therefore the possibility of increased awareness and recruitment by word-of-mouth amongst the residents. Staggering baseline and probe data collection dependent on recruitment time would also ease pressure on the timing of data collection at probe points, possibly facilitating engagement of care staff in the data collection protocol.

No changes in DEMQOL-4 self-report scores were observed for the four participants who were able to complete the questionnaire. Previous studies have reported mixed results in terms of quality-of-life improvement in relation to music-based interventions for older adults (Reagon *et al.*, 2016). This is in contrast with our post-intervention survey where participants reported that the choir had positive effect on their lives and facility staff reported excitement and anticipation in the participants as well as a perceived change in their wellbeing. This contrast is consistent with previous studies that have found that perceived improvements in quality of life and health-related wellbeing are not always reliably reflected in standardised outcome tools (Reagon *et al.*, 2016). Our apparent null finding on the DEMQOL-4 could be because individuals are asked to reflect across their whole week. While participants may have looked forward to and enjoyed the choir rehearsals, the activity represented only a small part their entire week. Indeed, participants were observed to focus on other aspects of their lives (e.g., constraints of living in a residential aged care facility; issues with other residents). It is possible that more focused questions on social participation, mood and communication may better capture the impact of the intervention. It is also possible that conducting our survey within one-week post-intervention resulted in responses being affected by reduced episodic memory for the choir sessions in some participants. In future, it may be preferable to conduct the surveys immediately after sessions or across multiple time points. Importantly, four of the six participants were rated as demonstrating functional improvement on the CGI as a result of participating in the intervention with the remaining



two participants rated at ceiling at baseline. While the CGI reflects a subjective perception of the individual's functioning, it is a validated tool that can be used to complement self-report measures such as the DEMQOL-4. These findings provide compelling preliminary evidence that engaging in the choir had a positive impact on the participants' functioning.

In light of the positive reception of the project by facility staff, participants, and ad hoc singers, systematic exploration of participant and carer perceptions of change and wellbeing is important to determine what equates to wellbeing in the context of cognitive decline and residential aged care living, the potential benefit group singing activities may have for residents and care staff alike. A limitation of the current study was that the small sample size prohibited an in-depth thematic analysis of the survey results. To this end, and given the perceived benefits reported may be more subtle than can be detected on a quality-of-life tool such as the DEMQOL-4, a rigorous and in-depth qualitative component to any future exploration is indicated. Furthermore, the small sample size was a limiting factor in relation to statistical analysis of the quantitative data collected. In future studies, how the outcome assessment measures assessed can be adapted to accommodate participants across a wider range of functioning and severity of cognitive impairment will be important, including measuring both verbal and non-verbal modes of social interaction and communication. The inclusion of non-verbal behaviours and social cognitive outcomes would enable a deeper exploration of how the intervention influences broader communicative abilities, such as joint attention, empathy and success in social interactions.

## Conclusion

The MuSiCON choir protocol demonstrated feasibility and was well received by participants, staff at the residential aged care facility where it was run, as well as by family members, other residents and members of the wider community. Feedback from participants and staff reflect that the activity was seen as having value and perceived positive impact on functioning, despite absence of change captured by several of our formal outcome measures. A co-design approach is recommended to improve upon feasibility, acceptability and validity of the assessment protocol prior to Phase II testing.

**Supplementary materials.** For supplementary material for this article, please visit <https://doi.org/10.1017/BrImp.2022.32>

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**Conflict of interest.** None.

**Ethical standards.** The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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