

Music and Dementia: Two Case-studies

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Abstract. In this paper two current related projects on music and dementia are described. One is a project which culminated in a performance made up of memory jingles, some of which were algorithmically generated and developed for an early-stage dementia patient. She provided a list of her ordered daily activities and a description of one of her medication dosages. The daily activity list was rhythmically adjusted, and a tune was written to it, by a composer. However it is not possible for all people with dementia to have a “composer-in-residence”. Hence computer music techniques were also investigated towards some form of automation of composition. This algorithm was used to compose a tune for the medication description from the volunteer. A few weeks later she exhibited the ability to recall both tunes and words in multiple informal environments (including high pressure situations). The second project is a form of “research by production”. It details the making of a 60 minute BBC radio program which was produced in collaboration with people living with dementia and experts and carers. The program consisted of a mixture of tunes and documentary segments. These discussed various topic relating to dementia, radio and music (including an on the above memory jingles research). The structure of the program was designed in such a way as to make it more understandable to people living with dementias.

Keywords: Alzheimer’s, dementia, jingles, algorithmic composition, radio, broadcast, memory, reminiscence

1 Introduction

Music as a means to help those living with dementias has been widely studied. For example the Alzheimer’s Society in the UK run Singing for the Brain sessions [1] in which people living with dementia can attend with carers. During these sessions familiar songs are sung, sometimes with synchronized movements. The sessions provide a social venue as well. The film “Alive Inside” [2] attracted much attention, premiering at the Sundance festival, and demonstrating anecdotally the positive effects of music on residents in care homes living with dementia. However there has not been as much attention paid to the use of music to create new memories as opposed to reminiscence on older ones, nor on the use of radio broadcasting in supporting people with dementia. In this paper two projects which are currently addressing these issues are introduced. The first utilizes music to aid memory, culminating in a performance, made up of memory jingles developed for an early-

stage dementia patient. The week before the performance she exhibited the ability to recall both tunes and words in multiple informal environments (including high pressure situations such as radio interviews [3]), with only two cases of forgetting or mistakes. The second project - Project EAR (Environments for Alzheimer's-friendly Radio) – involved working alongside the BBC to investigate ways of making radio broadcasts more dementia-friendly. The project takes the approach of “Research by Production” and short survey information was used to structure a fully-produced 60 minute broadcast on the BBC Radio Devon “Music, Memory and Making Radio”. It is now being used as a case-study to get broader feedback from listeners with dementias, their carers and experts, and those who are not affected by dementia.

2 Related Work

The use of non-pharmacological methods such as music in therapies for dementias and Alzheimer's disease has a long history [4]. Music has been widely used in wellbeing therapy. Examples include testing whether individualised or classical relaxing music in the background in a residential home was more effective at calming people with Alzheimer's disease and related disorders [5]. Reminiscence therapy is another approach using music from the patient's past. [6] examined the positive effects of reminiscence therapy on depressed elderly persons with dementia. [7] surveyed a number of such approaches, suggesting that reminiscence therapy can improve both mood and some cognitive function.

[8] actually performed a systematic review covering the effects of music therapies on those with Alzheimer's. They suggest that short duration music therapy leads to moderate reduction of anxiety, and small positive effects on behavioural symptoms. Extending the length to three months has a large effect on reducing anxiety.

Aside from as anxiety and social issues, the best known symptoms of dementia and Alzheimer's disease are memory recall and retaining new memories. Music has also been utilized in relation to these symptoms. It has been found that autobiographical recall in patients with dementia improves significantly when music is playing [9]. In terms of creating new memories, people with Alzheimer's exhibit frontal lobe damage and [10] showed using near-infrared spectroscopy that pre-frontal cortex activity is decreased by music in such a way as to help memory encoding. [11] showed that those with mid-term Alzheimer's were able to memorize gesture sequences better with a musical mnemonic than without. [12] suggests that music recognition is spared in dementia and Alzheimer's. [13] later concluded that musical memory including lyrics may be spared in the early and mid-stages of Alzheimer's, and even preserved in some late-stage patients.

It is a short step from these ideas to considering explicitly using music to help memorization of words in patients with Alzheimer's. As far back as [14], it was found that some patients diagnosed with Alzheimer's can, with practice, learn new words for a new song, even when they are not able to remember new spoken words in general. [15] used lyrics of unfamiliar children's songs accompanied by either a sung or spoken audio of the words, and found that those with Alzheimers had higher recognition accuracy for the sung words than the spoken words. Whereas older adults without Alzheimer's showed no significant difference. [16] involved a single Alzheimer's patient and found that they were able to learn new words with music better than words without music. This work was extended to 6 patients successfully

[17]. However [18] found mixed results of putting words to music – in that there was not a significant improvement in memorization of specific phrases when music was added to the phrases. Though there was a better memory of the concept behind the words. These final results, although very helpful, are a long way from being conclusive. They depend on the music used and the way words are fitted to the melodies. Some melodies and lyrics are simply more memorable than others. These factors are not specifically addressed or tested in [18]. Their work also raised the issue of what environment should be used for learning: the tests were done in time limited laboratory conditions. Whereas recreational music listening is usually done in a far more relaxed and repetitive way. Clearly more research needs to be done to systemize the composition and presentation of memory songs.

3 Remember a Day and Memory Jingles

The Remember a Day project began with a meeting with a trustee of the Alzheimer's society, who was asked what information might be useful for people living with dementia to have memory support for. He said that their daily plan, phone numbers and medication would be useful. An Alzheimer's Society session of Singing for the Brain was attended and a lady of 83 who was in the early stages of dementia was recruited to collaborate on the project. She had tentative diagnoses of Alzheimer's or Dementia with Lewy bodies, and Parkinson's disease. She provided her regular daily routine reminders, and an example of a medication she took regularly. Her daily plan is: open curtains, check calendar/diary, let the dog out, have breakfast, take medication, feed dog, brush teeth, shower, dress, walk the dog, clean dishes, clean the cooker, and brush the dog. An example of the medication was her Parkinson's disease medication: Cobeneldopa which she takes twice a day, dosage 25/100.

The daily plan was set to music manually written by a composer. The medication description was set to music with the help of an algorithmic composition system. The process for writing the daily plan tune was to firstly re-arrange the words to make them more rhythmic and lyrical: "Wake up, Pull curtains, Do you diary, Let the dog out, Have breakfast, Take tablets, Feed dog. Clean your teeth and take a shower, get dressed and walk the dog, do the dishes, clean the cooker, brush dog." A first draft of the tune was then composed manually by the first author. The process used was to tread a compositional line between direct copying of old tunes, while still keeping the tune pleasant, recognizable and clichéd. This was to aid memory. The resulting tune is shown in Figure 1.

It was interesting that there were repeated questions from people who heard the tune who thought they recognized the music it was based on. This supports the generic nature of the composition – however it was not based on any particular tune. The use of descending phrases for "have breakfast, take tablets, feed dog" and then again for the second half of the tune are particularly clichéd.

The process for the second tune was a result of the recognition that even if "memory jingles" are effective tools for those living with dementia, people cannot have their own personal composers assigned to them throughout the country or world. Hence some level of automation would be desirable. The automation was only partially achieved in preparing for the performance. The method used was to base the timing of notes on the syllable rhythms in the entered text, and the pitches on the vowels in each syllable. The standard model of a syllable is: (i) consonant or

consonant cluster; (ii) a vowel or syllabic consonant; (iii) a “coda”, often another consonant. In English the most common form of syllable is produced by pairing a vowel and a consonant. There are consonants which syllabic too, such as “y”. This model only covers a subset of words but is used as a first approximation in the system described here.



Figure 1: Daily Plan Song

The system is written in Matlab and first takes a text string as input. In this case “cobeneldopa, twice a day, twenty five, one hundred”. The system then goes through and converts the text in vowels, consonants and pauses, giving:

“CVCVCVCCVVCV- CCVVCV- V-CVC- CCVCCV_CVCV-
_VCV_CVCCCVC”

Note that because “y” is a syllabic consonant, it is converted to “V” not “C”. The “_” represents the shorter pause of a word gap, the “-” the longer space of a comma. Next the system gets rid of consecutive repeats. Thus becoming:

“CVCVCVCVCV- CVCV- V-CVC- CVCV_CVCV- VCV_CVCVC”

These are then converted to syllables using a VC and CV rule moving forwards through the string:

“SSSSS- SS- S-SC- SS_SS- SV_SSC”

where each “S” represents a syllable.

The string is then analyzed for any free standing vowels or consonants, which clearly are also syllables. There are none in this case. Finally it removes straggling consonants and vowels, on the assumption (only approximately correct) that they do not make independent syllables:

“SSSSS- SS- S-S- SS_SS- S_SS”

It can be seen that the final analysis is incorrect. But it does give the approximate syllable structure with pauses. These are then converted to musical pitches based on Table 1. Each syllable is either a vowel, or a consonant-vowel or vowel-consonant pair. So the syllable’s vowel is used to define the pitch from Table 1. These pitches were selected initially based on letter frequency mapped on the frequency of desired pitches by the composer (first author). However they were tweaked compositionally to get the final Table 1 values, during multiple informal tests by ear. The rhythms of

the notes were defined by placing rests between them, with short rests between “_” and longer rests for “-”.

Table 1. Mapping from vowels to pitches

Vowel	Dictionary Occurrence Frequency	Associated Note	MIDI value
A	8.5%	D	62
E	11.2%	C	60
I	7.5%	E	64
O	7.2%	F	65
U	3.6%	G	67
Y	1.8%	A	69



Figure 2: Memory Tune for the medication

After the text “cobeneldopa, twice a day, twenty five, one hundred” was entered into the system, the syllabic analysis was not only inaccurate but the resulting rhythmic effect was found to be unsuitable in terms of emphasis on syllables. The input was therefore adjusted by hand to give the final desired compositional effect. This involved deleting or adding certain letters and punctuation, to remove, shift or add syllables to the tune. The final melody is show in Figure 2. This approach means that the system is not yet suitable for full automation, but at least begins to address some of the issues and ask some of the questions needed for a more broadly automated approach. It certainly sped up the composition of the memory jingle.

Both tunes and words were sent to the collaborator living with dementia, on her tablet. A few weeks later she exhibited the ability to recall both tunes and words in multiple informal environments (including high pressure situations). This supports some of the other formal and informal testing done on “memory jingles” already discussed, as well as the methods used by one leader of an Alzheimer’s Society Singing for the Brain Session. The leader has set the days of the week to a well-known tune, and also encourages attendees’ carers to set shopping lists to music as well [19]

The tunes were used to construct a piece of music called Remember a Day, for mezzo soprano, cello and electronics, which was premiered at Peninsula Arts Contemporary Music Festival 2014. A recording is available here [20]. The performance was in fact in the form of a musical ‘embedding’ session itself. The 3 movements were very repetitive, so as to maximize the embedding of the tunes in the collaborator attending the concert. However the main purpose of the performance was to raise awareness of dementia (it was introduced by the Alzheimer’s Society UK) and to encourage the use and investigation of memory jingles. The resulting awareness raising was very successful with interviews about the collaboration

appearing on BBC Radio 4 and BBC Radio 2 at peak times. Also there were invitations to speak about memory jingles at a carer-support group.

4 Research by Production

Project EAR (Environments for Alzheimer's-friendly Radio) is a project working alongside BBC Radio Devon which investigates making the mechanics of radio-broadcasting more dementia friendly. As part of the project a 60 minute BBC Radio Devon programme was produced and broadcast which utilized some of the initial feedback on radio and dementia. The initial feedback stage was conducted using small sample discussions. There was a one-to-one long informal meeting with a person with dementia, visits to Plymouth Crownhill Alzheimer's Society Memory Café, and Exmouth Carers Support Group. The following were also contacted for feedback and responded: Life Care Radio, Alzheimer's Society Singing for the Brain Leader Plymouth, Alzheimer's Society Singing for the Brain Leader Exmouth, Director Plymouth Music Zone, and Alzheimer's Society Employee. There was no standardized questionnaire used, but the general question of "how can we make radio more dementia friendly" was put to people, including some of the answers already provided to give people a starting point for discussions.

The key points that came from the initial discussions were:

1. Consistency - Avoiding DJ / presenter changes and switch-around when possible, pre-warn. Avoid too many schedule changes. Keep jingles consistent for as long as possible.
2. Content - Chatting preferable to long periods of music. People with dementias may prefer shorter "bitesize" information elements. Hits and headlines shows.
3. Speech - Avoid "gabbling", people speaking over each other, speaking over music with lyrics, or at least giving useful information at that time.
4. Information - Reinforce importance of time checks and including the full time of day and date if possible. Repeat key information.
5. Interaction - Find a simpler route to where to get more information as many people living with dementia are unable to go online. Support for people with dementias wanting to get involved in phone-ins.

This information was used to structure the fully-produced 60 minute broadcast on the BBC Radio Devon "Music, Memory and Making Radio" [21, 22]. The programme structure had an unusual mix of music and speaking, multiple repetitions of the presenter's names and the subject of the documentary, mini-features kept as short as possible, and during the recording of interviews, signs were put up asking people to speak clearly. The precise structure of the program is shown in Table 2. It incorporated mini-features on what makes music memorable, how music can be used to help people with dementias (in the memory jingles project), and the initial findings regarding dementia-friendly radio broadcasts. The broadcast is now being used as case-study to get broader feedback from listeners with dementias, their carers and experts, and those who are not affected by dementia. It is also being used by BBC Radio Devon to promote dementia friendly broadcasting to the BBC nationally.

Table 2. Structure of “Music, Memories and Making Radio” broadcast BBC Radio Devon December 27th 2014.

Time	Type	Topic
00:00	Spoken	Preview of topics and introduction
01:30	Spoken	Ear worms and memory jingles
08:22	Music	Humorous
13:04	Spoken	Repeated introduction
13:28	Spoken	Radio and Dementia: Cocktail Party Effect
17:38	Spoken	Repeated introduction and re-cap
18:18	Spoken	Music and Reminiscence (including some brief music clips)
27:42	Music	Bridge over Troubled Water
32:12	Spoken	Musical Memory
36:00	Music	My First, My Last, My Everything
38:25	Spoken	Time Checks; Music and Action (including music clips)
47:15	Music	Toms Diner
49:40	Spoken	Repeated introduction and summary
50:15	Spoken	Programmes targeted at people with dementia
55:28	Music	Toms Diner opening to fade out
55:44	End	

8 Conclusions and Future Work

In this paper two related projects involving music and dementia have been described. One is a project which culminated in a performance made up of memory jingles developed for an early-stage dementia patient. The patient provided a list of her ordered daily activities and a description of one of her medication dosages. The daily activity list was rhythmically adjusted, and a tune was written to it, by a composer. Computer music techniques were also investigated towards some form of automation of composition. An algorithm was used to compose a tune for the medication description from the volunteer. A few weeks later she exhibited the ability to recall both tunes and words in multiple informal environments (including high pressure situations). This project has now been developed into a 4-5 year project plan and collaboration with an expert music therapy group to fully investigate and automate the memory jingle system. In terms of evaluation plans, there have been attempts to use non-automated music composition to make text more memorable for people living with dementia - and their testing plans included a control. In other words: people with dementia trying to remember text with and without music, and people who did not have dementia were included as well. So we would utilize experience from these previous projects in testing our planned automated system.

The second project described was a form of “research by production”. It detailed the making of a 60 minute BBC radio program which was produced in collaboration with people living with dementia and experts and carers. The structure of the program was designed in such a way as to make it more understandable to people living with dementias. Currently in this project we are receiving feedback from listeners living with dementia and their carers as to how understandable and enjoyable

they found the programme. This includes direct individual feedback – from those with dementia who listened to the program, and also feedback from listening groups. For example, in one listening group people with dementia and their carers gathered, under the leadership of an enabler from the Alzheimer’s Society, to listen to the programme and provide feedback.

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