

Piano playing skills in a patient with frontotemporal dementia: A longitudinal case study

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Patients with dementia, such as Alzheimer's disease, can continue to play the piano skillfully despite profound cognitive impairment. It has been suggested that this may be because these skills have been well-rehearsed and become automatic motor movements. Less is known about how these musical skills may be related to the performance of everyday functional abilities and, also, how the ability to play a musical instrument may be affected in other dementia types. Recordings of a patient diagnosed with behavioral-variant frontotemporal dementia, a dementia syndrome clinically characterized by marked behavioral and cognitive changes, playing the piano was taken 12 months apart. Aspects of musical performance (accuracy, tone quality, dynamics, rhythm, tempo, and interpretation) were rated by professional musical teachers. The physical and mental skills required to complete activities of daily living were assessed. Tests of cognitive functioning and brain imaging were also conducted over this period. Results showed that over one year, significant declines were observed in the areas of cognition, the mental abilities required for everyday skills, as well as brain atrophy on imaging. Physical skills for the performance of activities of daily living were relatively preserved, as was the ability to play the piano. These findings confirm previous reports and demonstrate the relative independence of procedural skills in the context of significant cognitive impairment in patients with dementia.

Keywords: frontotemporal dementia; piano playing; activities of daily living; cognitive assessment; neuroimaging

Dementias are progressive neurodegenerative brain diseases characterized by multiple deficits in cognition (e.g. memory, language, etc.), changes in behavior, and everyday functional impairment. Clinical profiles tend to be distinct for the different dementia types, although overlaps do exist. In contrast to cognition, musical skills may be well-preserved in dementia (Baird and Samson 2009), although this is an area that has not been well studied. Several case reports have described patients with Alzheimer's disease who remain capable of playing musical instruments skillfully over a number of years despite increasing cognitive deficits (Beatty *et al.* 1999).

Patients with dementia who have shown an ability to play musical instruments typically play pieces that have been well-rehearsed prior to the onset of disease. It is speculated that these skills may therefore reflect automatic motor movements which are reliant on the implicit memory system (Crystal *et al.* 1989). Some of these patients perform normally on tests of implicit skills (e.g. speeded mirror reading, Crystal *et al.* 1989).

The neural basis of preserved musical performance skills in dementia has been thought to rely on the motor circuits in the brain (i.e. basal ganglia, cerebellum, motor areas of the thalamus, and cortex; Beatty *et al.* 1999) as these remain relatively intact until the end stages of the Alzheimer's disease process.

No studies to date have compared musical performance skills with the formal examination of performance on activities of daily living (ADLs), abilities that can also be conceptualized as skills that have been learned and well-rehearsed prior to the onset of dementia. In addition, little is known about how musical performance skills may be affected in other dementia syndromes.

The aim of the study was to investigate change in piano playing skills together with assessments of cognitive functioning, everyday skills, and brain imaging over a 12-month period in a patient diagnosed with behavioral-variant frontotemporal dementia (FTD; Neary *et al.* 1998). FTD is a dementia syndrome clinically and pathologically different to Alzheimer's disease. It is characterized by marked behavior change and executive dysfunction. Brain pathology is most pronounced in the prefrontal and anterior temporal cortices.

METHOD

Case description

RD is a 70-year-old, right-handed man with 18 years of education and an amateur pianist. He has played the piano since childhood. In mid-2007, he

was diagnosed with behavioral-variant frontotemporal dementia. Disease duration from the symptom onset to the time of the assessment was 3 years.

Procedure

Video recordings of RD playing Rachmaninoff's Prelude in C# minor (Edition by Jean St John) with the music score were obtained a year apart in 2007 and 2008. This piece was well known to RD prior to the diagnosis of dementia. At the time of the recordings, RD was playing it about once a week.

Each recording was subdivided into six sections of 30 to 60 s duration, and each section was rated for the following: accuracy, tone quality, dynamics, rhythm, tempo, and interpretation. Five independent raters who were professional music teachers and blind to RD's condition rated each aspect on a Likert scale (1-5, where 1=poor and 5=excellent) analogous to that used by Beatty *et al.* (1999). Intra-class coefficients calculated to examine agreement among the raters were statistically significant ($p < 0.05$).

Cognitive ability and ADLs were also measured on these two occasions. Cognitive domains of orientation, memory, fluency, language, and visuospatial skills were examined using the Addenbrooke's Cognitive Examination-Revised (ACE-R; Mioshi *et al.* 2006). Physical and mental skills required to complete ADL activities were measured using the Assessment of Motor and Process Skills (AMPS; Fisher 2003). In addition, high resolution structural T1 images were obtained on a 3T MRI scanner in 2007 and 2008. Percentage brain volume change was estimated using SIENA (Structural Image Evaluation, using Normalisation, of Atrophy; Smith *et al.* 2002), which is part of FSL (Smith *et al.* 2004, www.fmrib.ox.ac.uk/fsl).

RESULTS

At baseline, cognitive performance on the ACE-R was 70/100, which is below the cut-off of 82 typically used to indicate the presence of dementia. RD lost points primarily on the orientation, memory, fluency, and language sections of the test. Visuospatial skills were found to be preserved. At the 12-month follow-up, RD's score had dropped to 50/100; again, scores remained within the normal range for visuospatial skills.

On the AMPS, RD's motor and process scores at baseline were 1.61 and 0.64, respectively. Both these scores were below the level expected for his age, indicating impairment in physical and mental skills required to complete ADLs. At follow-up, AMPS motor and process scores were 1.32 and -0.09, respectively. The relative decline in the AMPS scores over this period was

Table 1. Mean ratings for eight attributes of RD's piano playing skill.

	<i>Year 1</i>	<i>Year 2</i>	<i>F_{1,8}</i>
Accuracy of notes	2.63	2.16	2.27
Tone quality	2.90	2.70	<1
Dynamics	2.67	2.37	1.31
Accuracy of rhythm	2.17	2.10	<1
Tempo	1.87	1.67	<1
Interpretation	2.23	2.10	<1

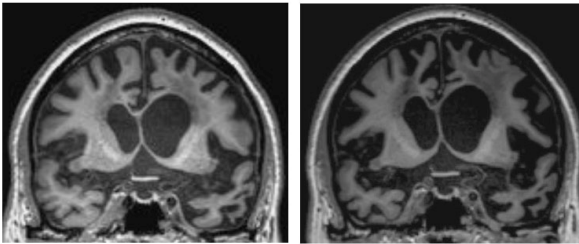


Figure 1. Coronal MRI T1 images obtained in 2007 (left) and 2008 (right).

smaller for the motor than process scales and suggests that the physical aspects of ADL performance were relatively preserved in RD.

Mean ratings for RD's piano playing for both recordings are summarized in Table 1. While all ratings of piano playing attributes at Year 2 were lower than at Year 1, none of the changes reached statistical significance.

Structural MRIs showed significant orbitofrontal and anterior temporal atrophy (see Figure 1), which became worse over 12 months. The estimated percentage total brain volume loss over one year was 3.17%.

DISCUSSION

This case study examined piano-playing skills in a patient diagnosed with behavioral-variant frontotemporal dementia over a 12-month period in conjunction with assessment of cognition, ADL abilities, and brain imaging.

Over the interval of one year, deterioration on formal assessment of cognition, functional abilities, and brain imaging was observed. In contrast, RD's ability to play the piano remained consistent over this period. These findings

are similar to case reports in the literature of patients with Alzheimer's disease who have relative preservation of musical performance skills despite impairment in other domains (Beatty *et al.* 1999).

Although physical abilities required for the performance of ADLs remained relatively stable in RD over 12 months, the mental skills necessary for the same ADLs had worsened. This finding suggests that motor skills were reasonably preserved in RD and may have supported RD's ongoing capacity to play familiar musical pieces on the piano.

This case study has some limitations. First, the rating scale for the assessment of musical performance used emphasized the motor aspects of playing a musical instrument (e.g. accuracy of the notes and rhythm). The ability to convey the mood and nuances of musical pieces was not studied. Development of a scale to measure these aspects of musical performance will be of interest, particularly as deficits in emotion processing are a prominent feature of patients with frontotemporal dementia. Second, while there was an increase in atrophy over time, it is unclear where this may have occurred. Analysis of atrophy in the motor regions of the brain, relative to the frontal and temporal lobar areas, would also be of interest in the future.

Finally, RD was seen relatively early in the course of FTD. It is unclear whether there is a resilience of musical skills overall in dementia or whether different abilities decline at different rates with disease progression. Further longitudinal assessments of musical performance skills as well as cognition and activities of daily living should also be examined.

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