

Overview

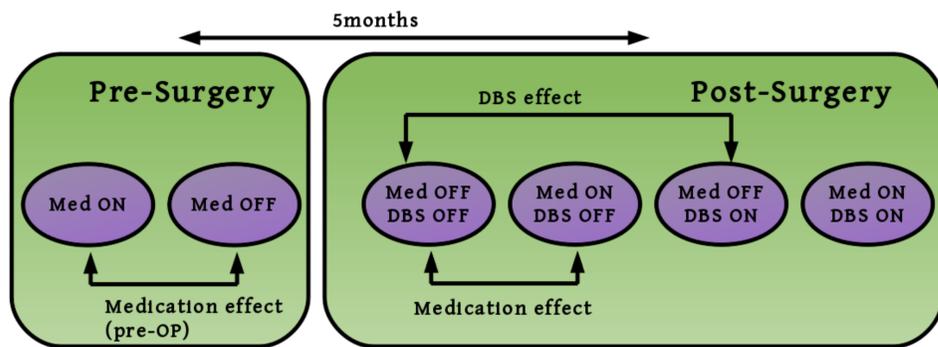
Background — Various therapeutic approaches have been established for the treatment of movement disorders such as Parkinson's disease, dystonia or essential tremor. However, the effects of such therapies on fine and more sophisticated motor movements (which are particularly important for musicians) are not well known.

Aims — The aim of this study was to develop a reliable tool that would allow assessment of treatment effects on fine motor movements through measures of musical performance. We investigated the case of a violin player with Parkinson's disease undergoing different treatments. During each of these treatments, his playing was recorded and evaluated afterwards by music students.

Results — The ratings revealed reliable test-retest judgments. Moreover, the ratings allowed striking differentiation between recordings made during the different treatment conditions.

Conclusions — Deep-Brain Stimulation and medication deteriorated metronome-paced timing, but improved intonation and musical expression. Effects of treatments on fine motor control can be established through evaluation of musical playing.

Treatment Conditions



Musical materials

During each treatment condition, the patient was recorded playing on the violin:

1. a G-major scale across two octaves with metronome (**scale+metr**),
2. a G-major scale without metronome (**scale-metr**),
3. a theme from the violin concerto by Felix Mendelssohn-Bartholdy (**mendelssohn**), and
4. the "Méditation" from Jules Massenet's opera *Thaïs* (**massenet**).

The total of 24 extracts were normalised:

- ▶ for sound intensity (RMS) and
- ▶ for time preceding and following each extract

Therefore extracts could not be differentiated based on low-level sound properties.

Rating procedure

11 violin/viola students rated the audio extracts using a custom designed Java computer program. All extracts were presented twice in random order and rated on a **continuous scale** between -4 and +4 along the following dimensions:

- ▶ To familiarise the raters with the procedure, they first rated two dummy extracts not used elsewhere
- ▶ **Rating block 1** scale+metr: **timing precision** and **intonation**.
- ▶ **Rating block 2** scale-metr: **timing precision** and **intonation**.
- ▶ **Rating block 3** mendelssohn: **emotionality** of the melody and **articulation** of the triplets.
- ▶ **Rating block 4** massenet: **emotionality**

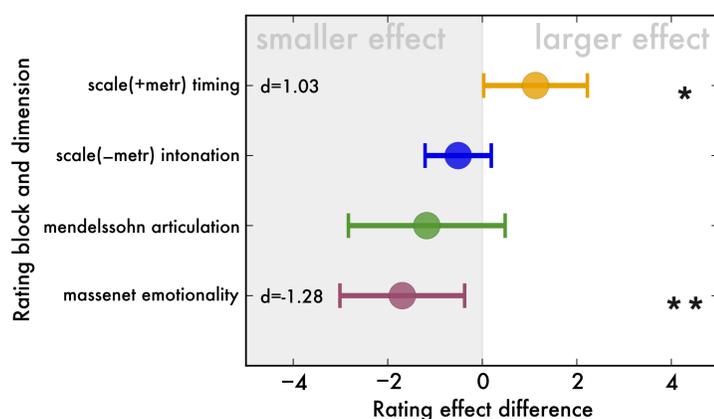
Raters were instructed to give ratings relative to the overall level and use the full scale. They were unaware of the medical background to these recordings.

Investigation of reliability of ratings

- ▶ **Intra-rater correlation** for the two ratings of each extract was good for each subject (mean Spearman $\rho = .54 \pm .20$) and they were henceforth averaged.
- ▶ **Inter-rater agreement** was moderate to high on the ratings along the seven dimensions (average Kendall's coefficient of concordance $w = .50 \pm .18$)

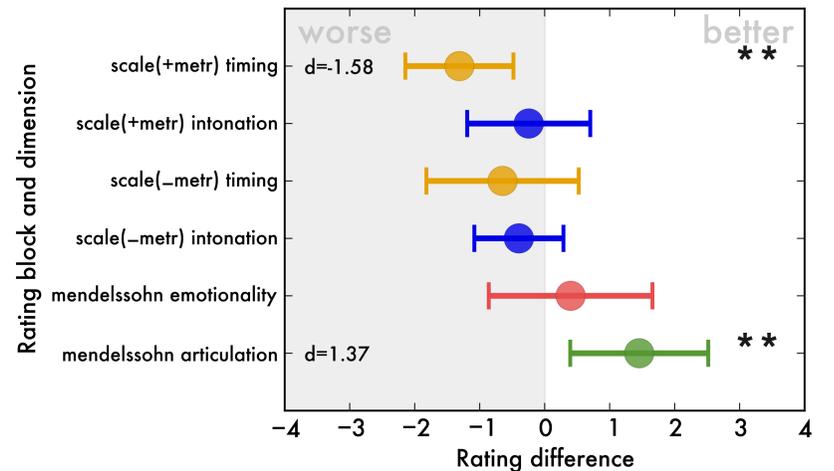
Comparing the effects of medication and DBS

DBS vs. medication effect

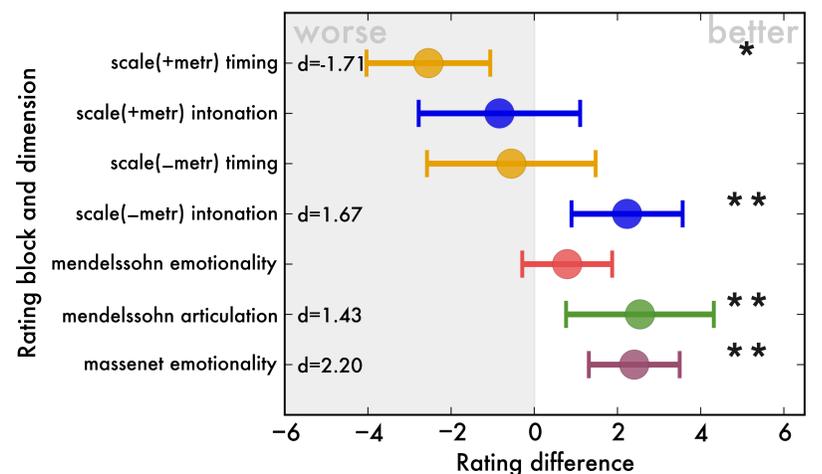


Results

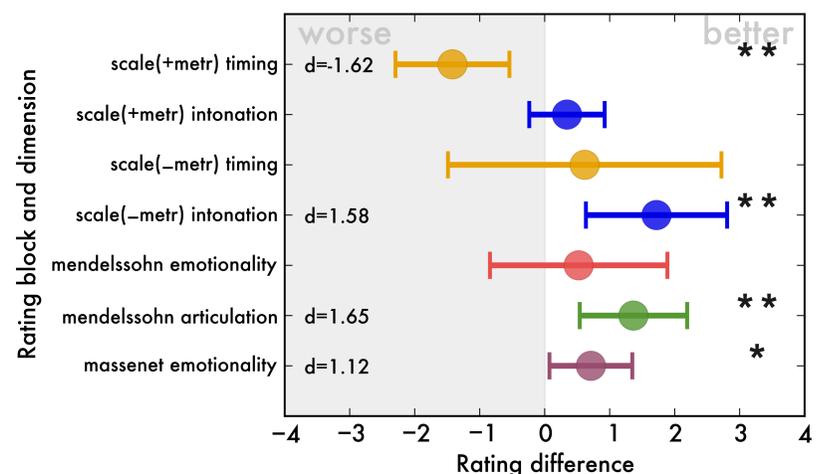
Medication effect (pre-OP)



Medication effect (post-OP, off-DBS)



DBS effect (off-Medication)



Conclusion

- ▶ DBS and Medication:
 - ▶ **Deteriorated** metronome-paced timing
 - ▶ Improved **intonation** and **articulation**
 - ▶ Improved **emotionality** (but DBS less so than medication)
- ▶ Evaluation of musical playing through independent raters is a reliable tool to assess impact of treatment on fine motor skills
 - ▶ For example, the medication effect is very similar pre-surgery and post-surgery.
- ▶ Our study provides an innovative way of evaluating the **impact of movement disorders** per se and of **different treatment modalities** on sophisticated motor functions.
- ▶ We speculate that medication and DBS impair the patients **sensori-motor integration** skills and therefore disrupt timing with external metronome, but improve fine motor skills and mood.

Future research

- ▶ The rating procedure can readily be extended to other movement disorders (dystonia, essential tremor) as well as to other instruments.
- ▶ In order to investigate the influence of the external time-keeper, we would have the patient play the Mendelssohn extract with metronome, and again these extracts could be rated on articulation or timing.

Acknowledgements

- ▶ This work was supported by the European Community's Seventh Framework Programme under the EBRAMUS project - grant agreement n.238157
- ▶ The authors are indebted to **Dr. André Lee** for insightful musical comments and discussions.
- ▶ This poster was created with L^AT_EX (BEAMERPOSTER) based on a style file by David Vilar.