Bodily expressivity and coordination in classical ensemble playing

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UiO : RITMO
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mdw
universität
für musik und
darstellende
kunst wien

FWF Der Wissenschaftsfonds.



















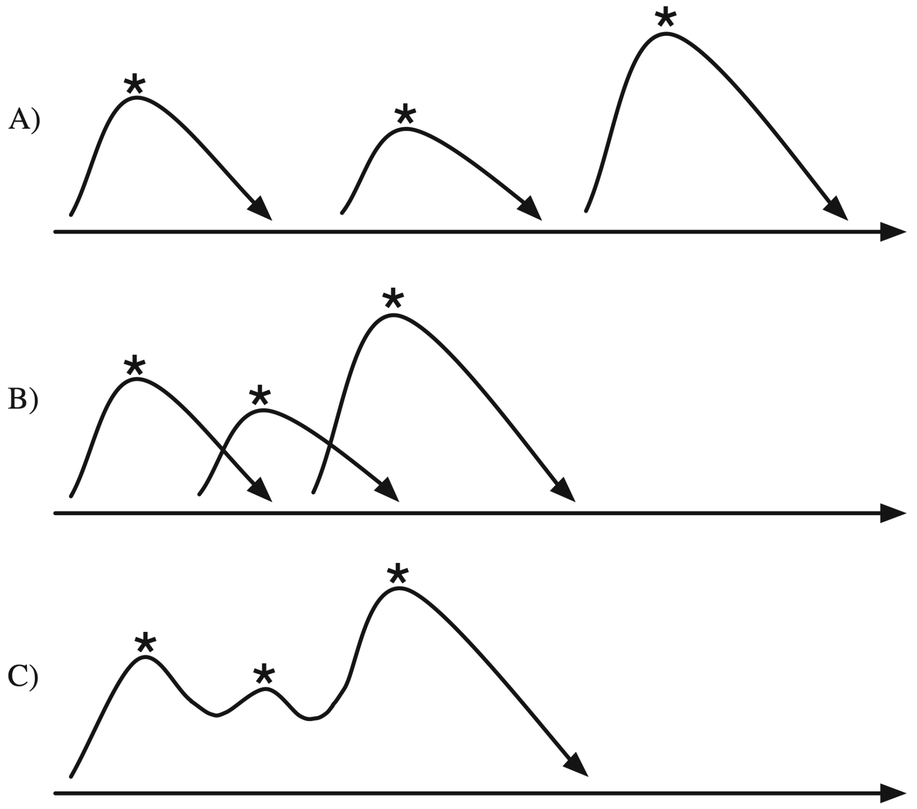


Photo: Annica Thomsson

Music-related body motion

- Sound-producing
- Sound-facilitating
- Sound-accompanying
- Communicative

(Jensenius, Wanderley, Godøy & Leman, 2010)



(figure from Godøy, 2014)

Ancillary motion of performing musicians

- Ancillary motion can be expressive of:
  - Timing or tempo (Bishop & Goebl, 2015)
  - Tonal context (Moura et al., 2023)
  - Musical tension, sound intensity, rhythmic fluency (Nusseck & Wanderley, 2009)
  - Phrasing (Demos, Chaffin & Logan, 2017)
  - Emotional intensity (Thompson & Luck, 2011)

How do musicians move when performing together?

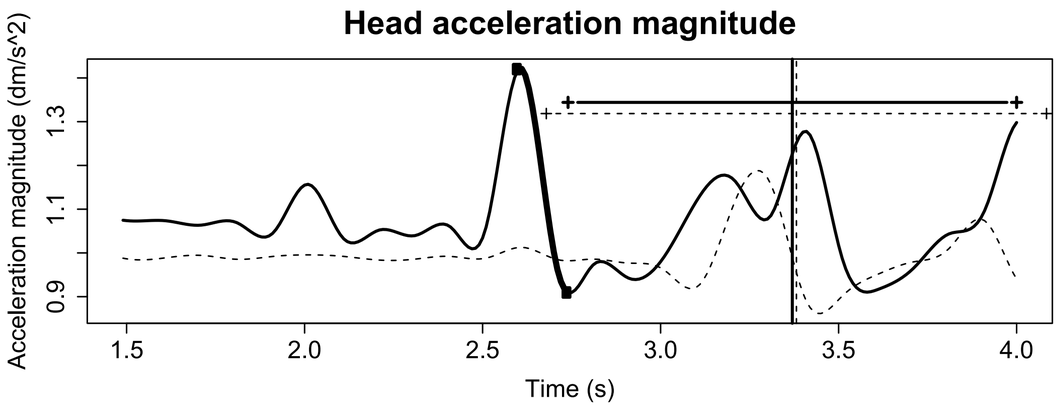
What factors affect their ancillary motion?

How does ancillary motion contribute to their performance?

Mechanics of coordination in small ensembles

How do cueing gestures communicate timing?





Gestures that are…

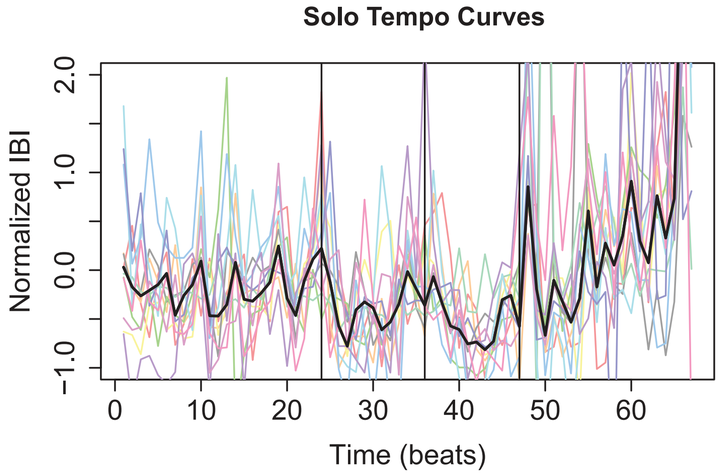
- Larger
- Smoother
- Less prototypical
- Given by an experienced performer

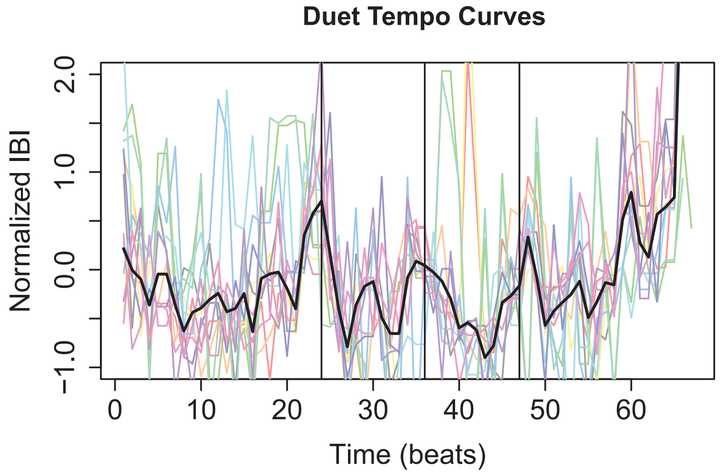
… are easier to synchronize with.

(Bishop & Goebl, 2018, Psychology of Music)

Negotiating a shared interpretation

How do pianists coordinate different interpretations?









(Bishop & Goebl, 2020, Music & Science)

Visual interactivity in small ensembles

How do gaze and motion coordination change with rehearsal?

Pre-rehearsal performance

Mid-rehearsal performance

Post-rehearsal performance

Post-rehearsal performance WITHOUT visual contact



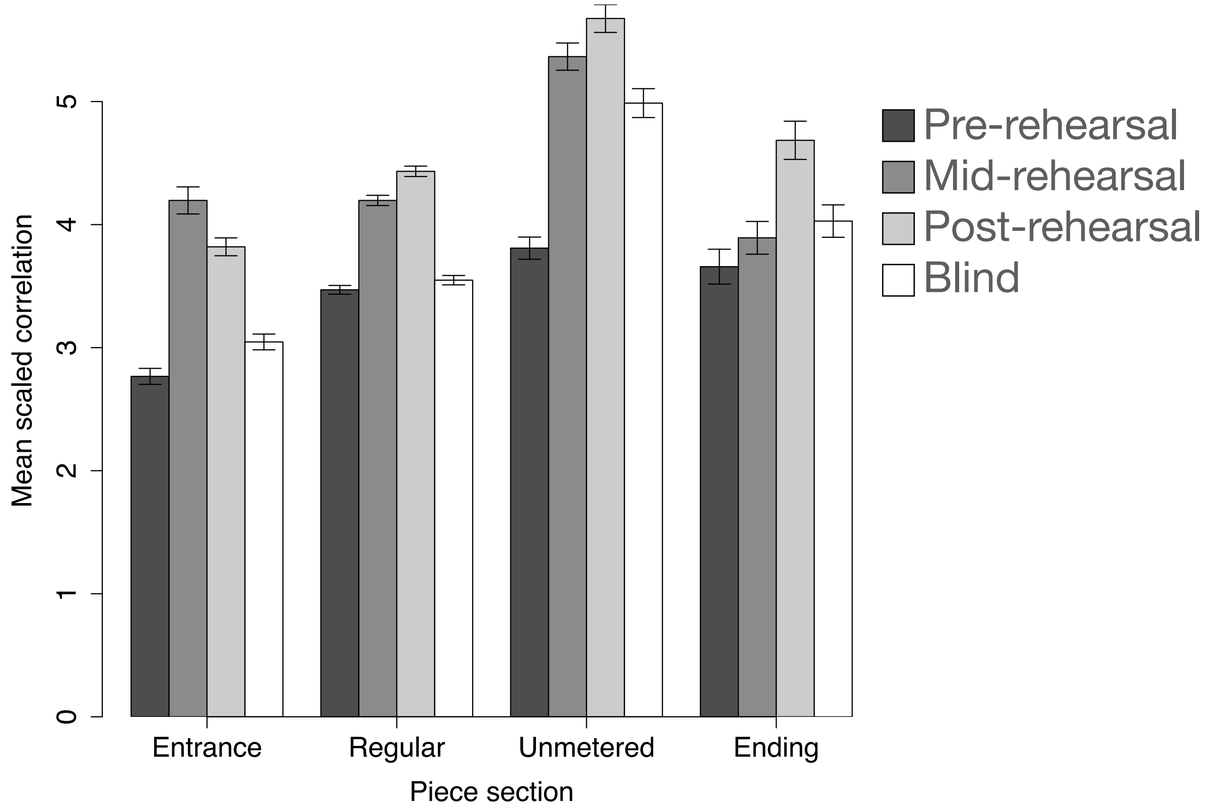


(Bishop, Cancino-Chacón & Goebl, 2019, Music Perception; Bishop, Cancino-Chacón & Goebl, 2019, Consciousness & Cognition)

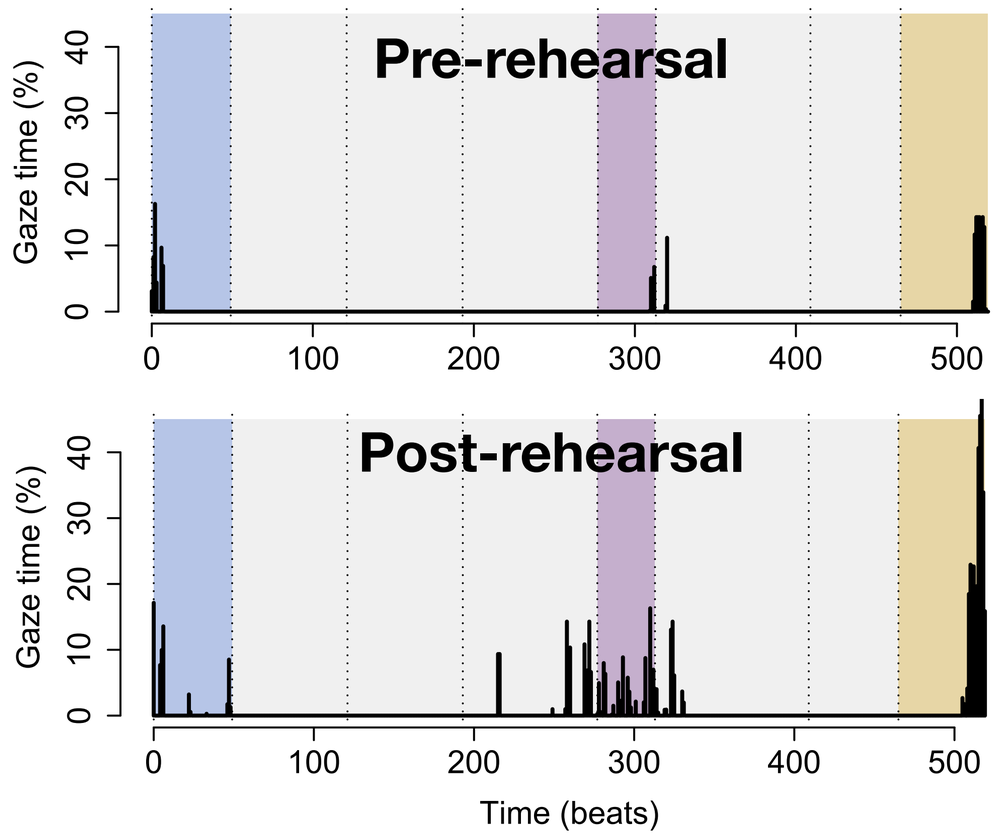
Visual interactivity in small ensembles

How do gaze and motion coordination change with rehearsal?

Coordination of expressive head motion



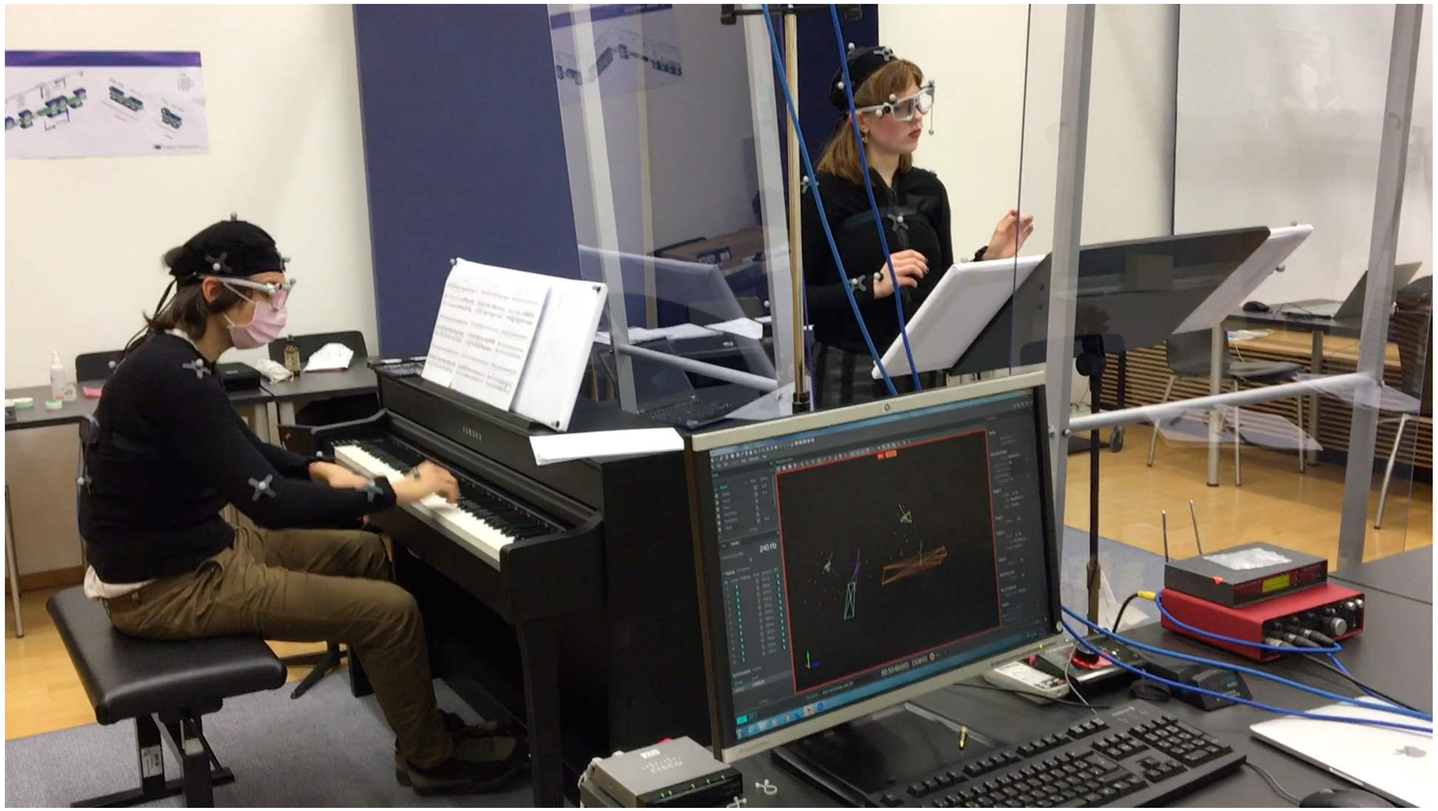
Clarinettists' bidirectional eye-gaze



(Bishop, Cancino-Chacón & Goebl, 2019, Music Perception; Bishop, Cancino-Chacón & Goebl, 2019, Consciousness & Cognition)

Bodily alignment and musical togetherness

Are pupil size, body motion coordination, or breathing synchrony linked to musicians' sense of togetherness?



Individual practice

↓

Joint performance pre-rehearsal

↓

Joint rehearsal

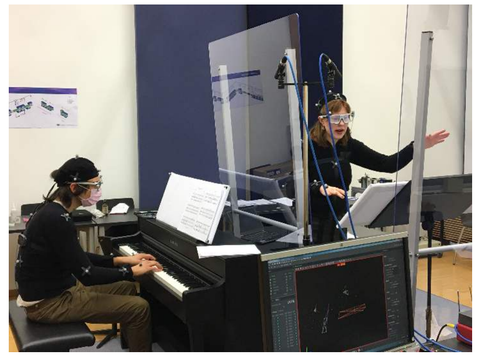
↓

Joint performance post-rehearsal

↓

Togetherness ratings

+ Short-answer question about what informs their togetherness judgements



How much togetherness do you perceive?

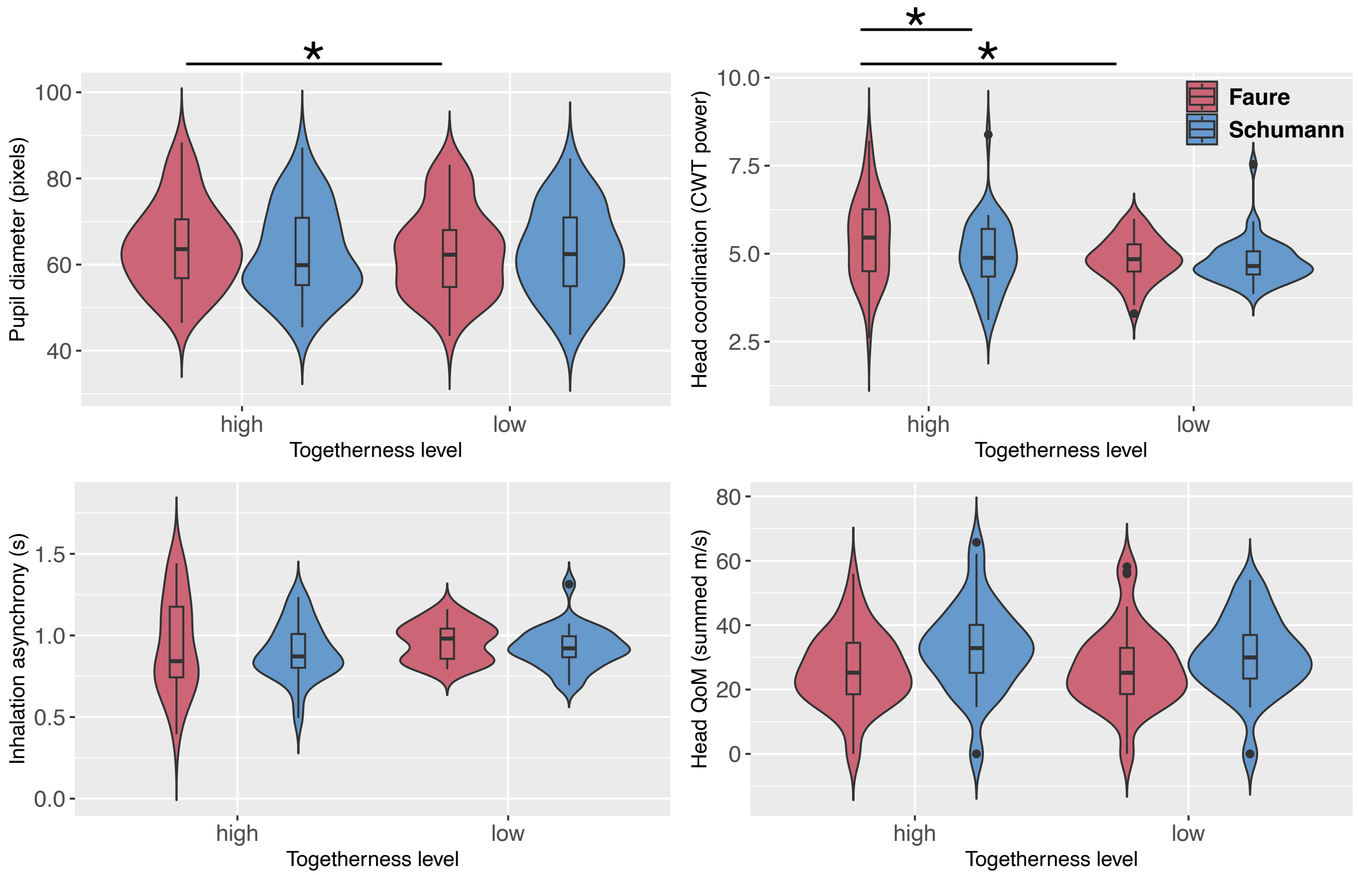
Low Togetherness — High Togetherness

Please, adjust the slider anytime you perceive a change in togetherness.

(Bishop, Niemand, D'Amario & Goebl, in press, Psychology of Music)

Bodily alignment and musical togetherness

Are pupil size, body motion coordination, or breathing synchrony linked to musicians' sense of togetherness?



* p<.013

(Bishop, Niemand, D'Amario & Goebl, in press, Psychology of Music)

MusicLab Copenhagen

MusicLab is an innovation project by RITMO and the University Library. The aim is to explore new methods for the collection and communication of music-related research data.



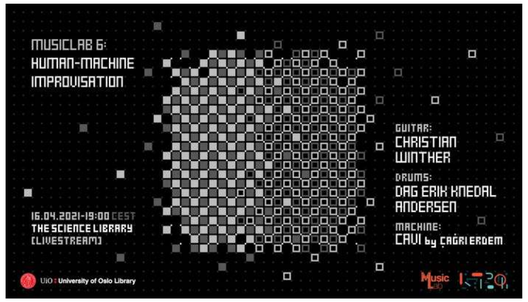




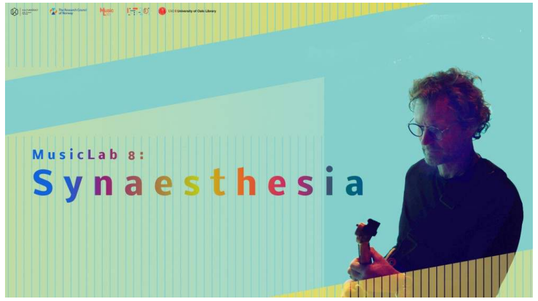












https://www.uio.no/ritmo/english/projects/musiclab/


DSQ
FESTIVAL
2021
Music
Lab
26 oktober 19:15
STREAM ONLINE



Interactivity & adaptability in string quartets

Borealis String Quartet
(students with 1 year playing together;
performed in the fourMs MoCap lab)



Photo: Annica Thomsson

Danish String Quartet
(experts with 13-20 years playing together,
Performed at the Musikhuset København)

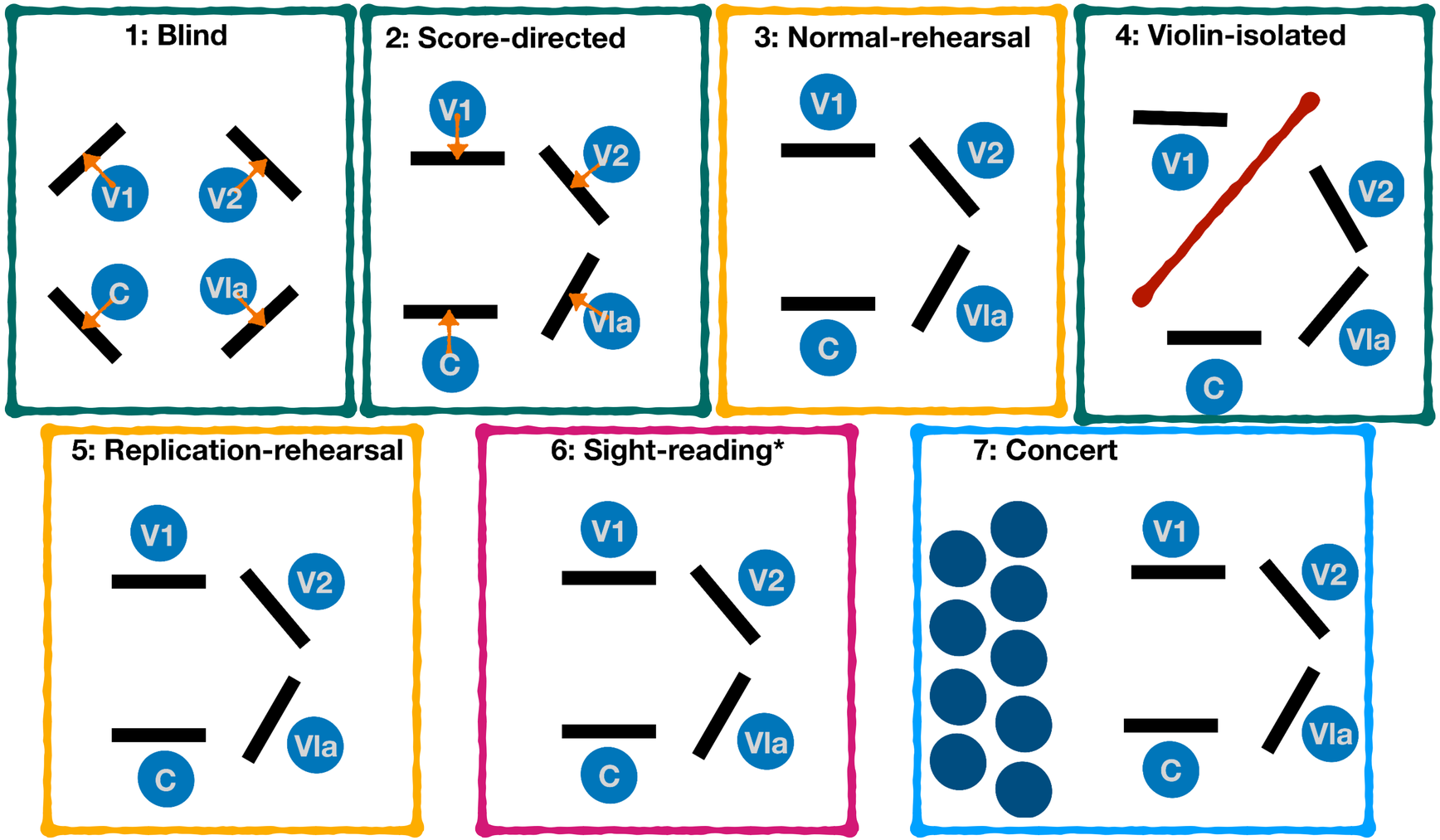


Interactivity & adaptability in string quartets



DSQ in the Blind condition

Haydn's String Quartet Op. 76, No. 4, 1st movement, bars 1—68



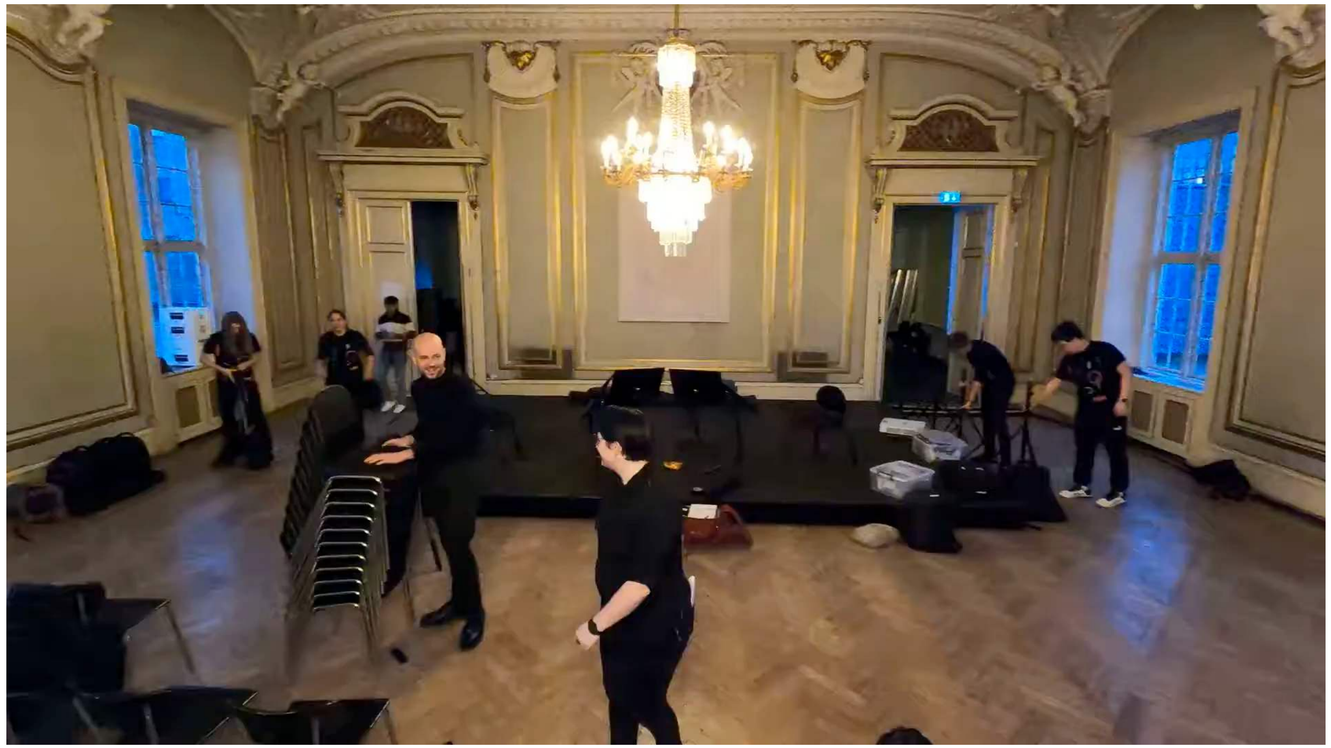
Interactivity & adaptability in string quartets

Borealis String Quartet



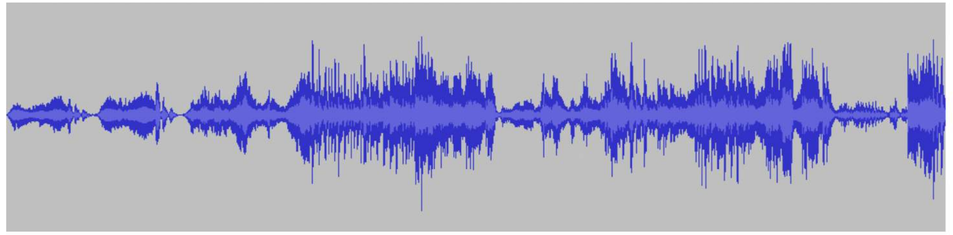
Photos: Annica Thomsson

Danish String Quartet

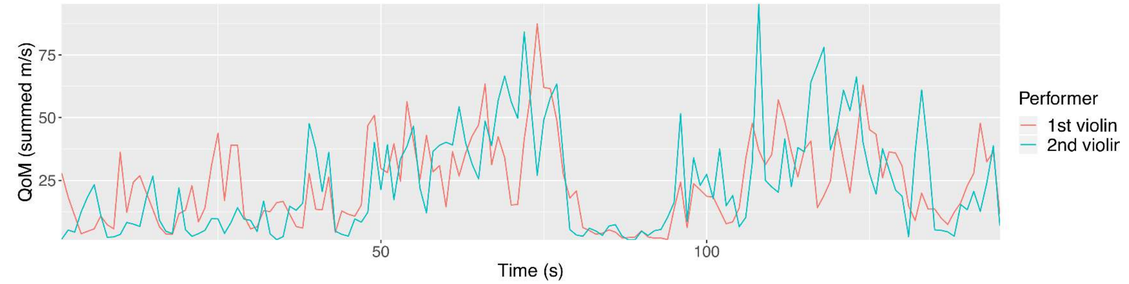


	BSQ	**DSQ**
Motion capture	Qualisys Oqus & OptiTrack Flex	OptiTrack Flex
Eye-tracking	SMI wireless eye-trackers	Pupil Labs Core
ECG	Delsys Trigno	Delsys Trigno
Audio-video	(Various)	(Various)

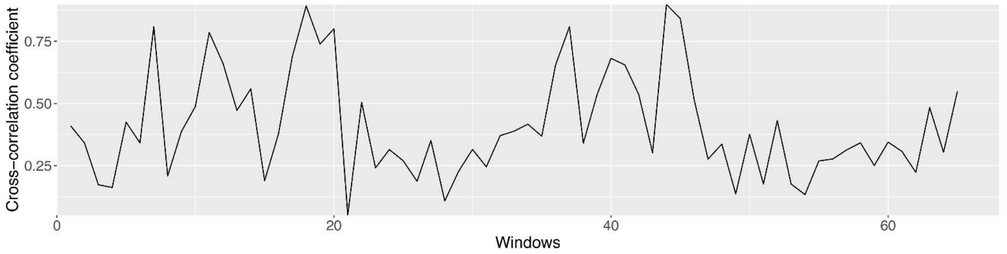
Audio waveform



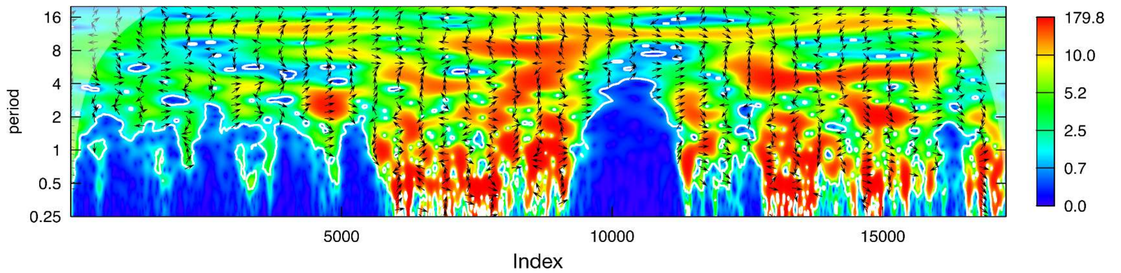
Quantity of motion



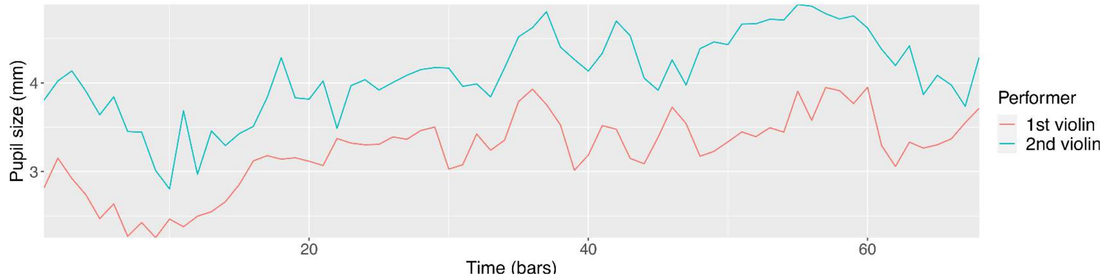
Motion similarity



Motion coupling

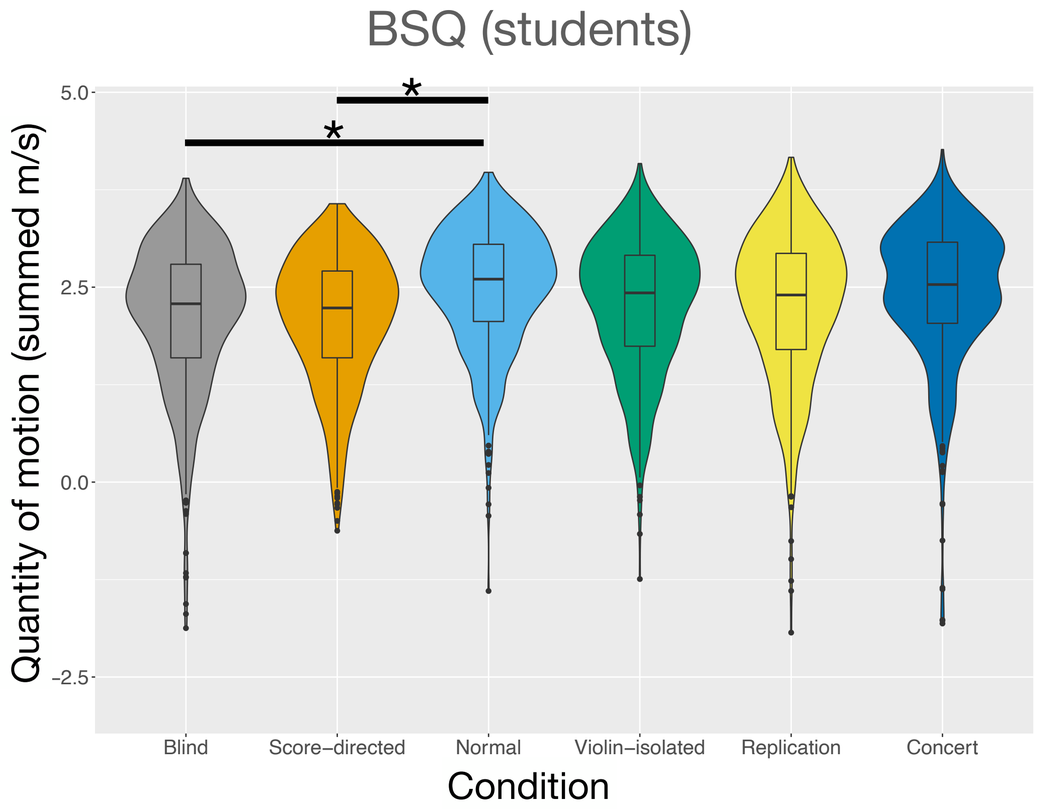


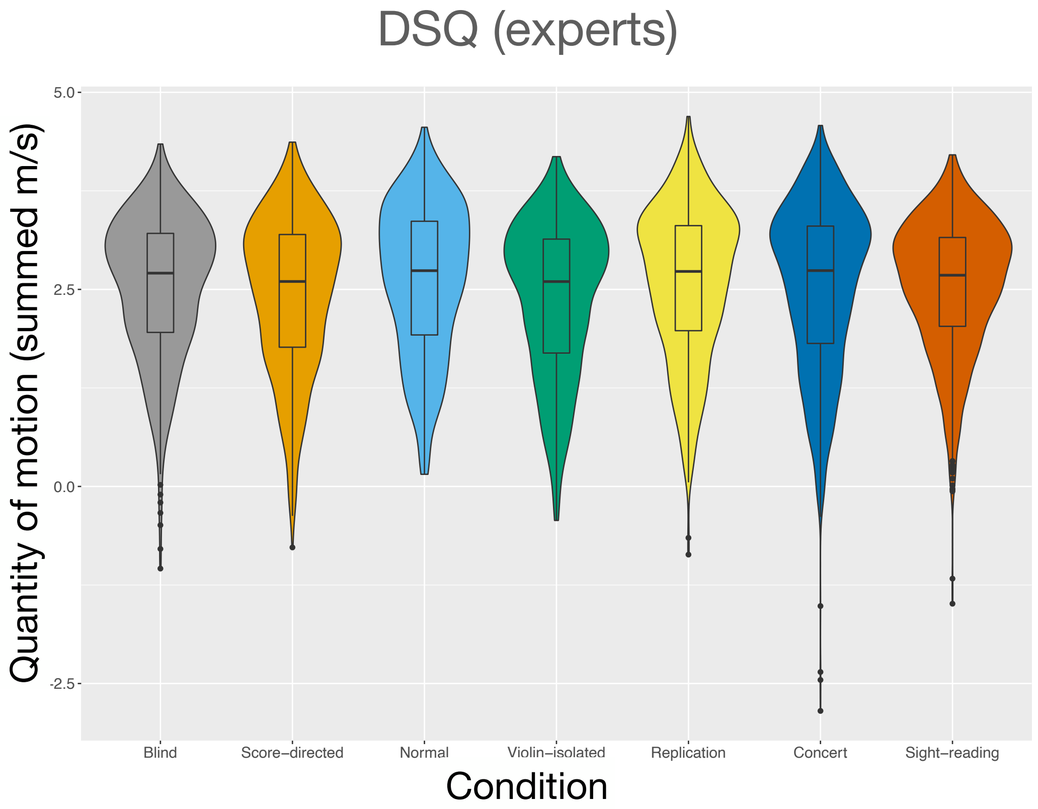
Pupil size curves



Interactivity & adaptability in string quartets

Students showed a negative response to blind playing conditions:
↓ quantity of motion



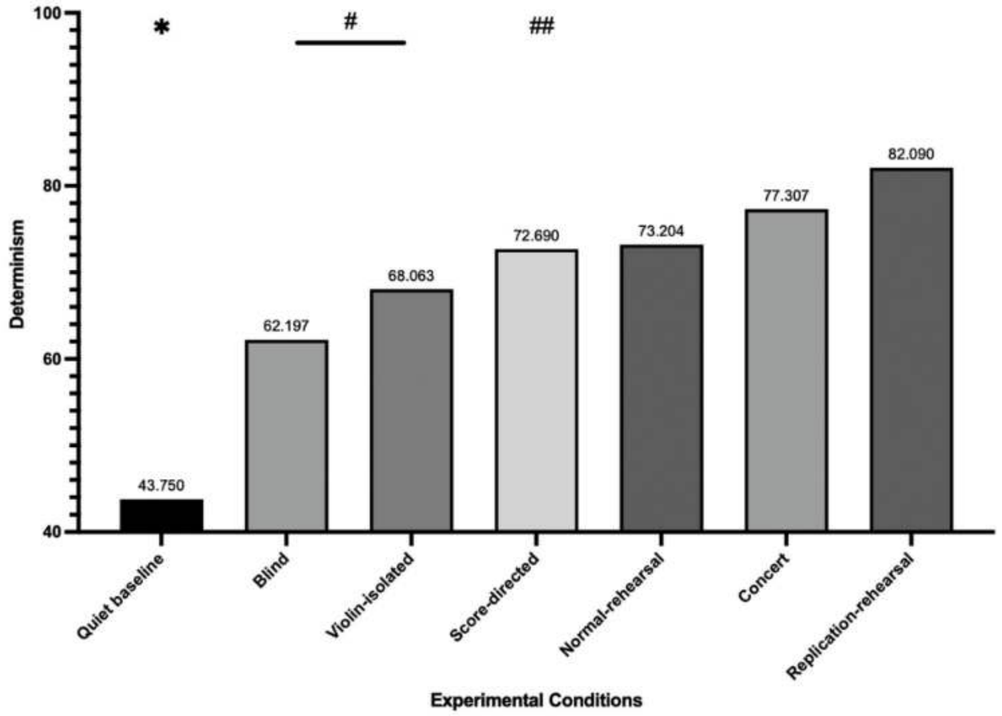


(Bishop et al, 2021, JNMR; Bishop et al., 2023, Music & Science)

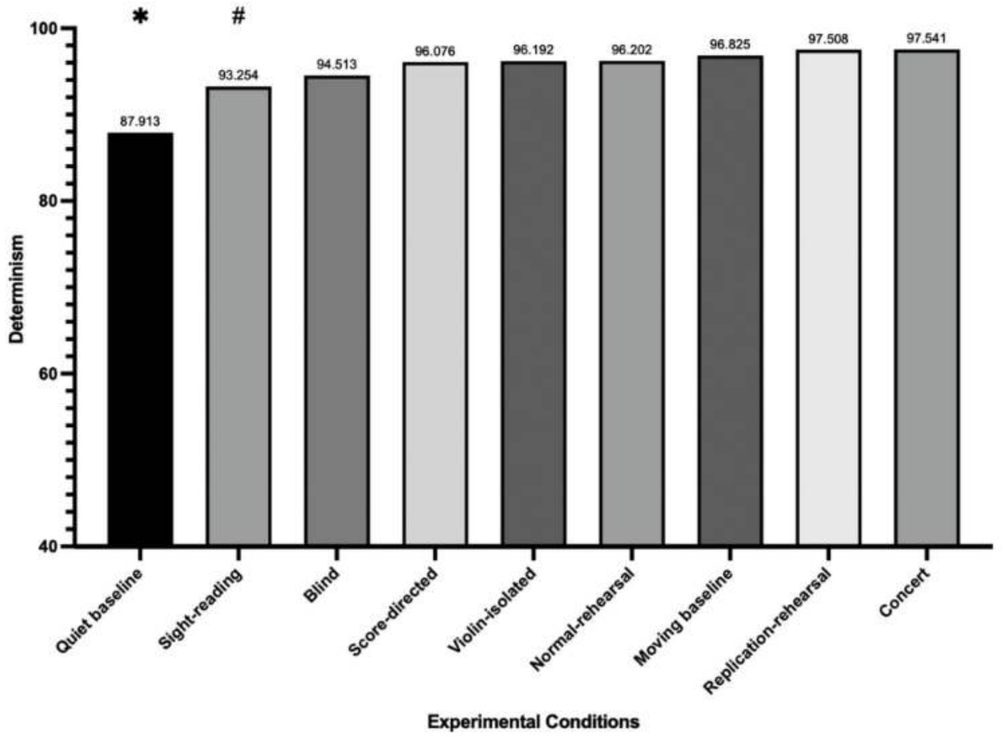
Interactivity & adaptability in string quartets

Students showed a negative response to blind playing conditions:
↓ quantity of motion, ↓ **cardiac synchrony**

BSQ (students)



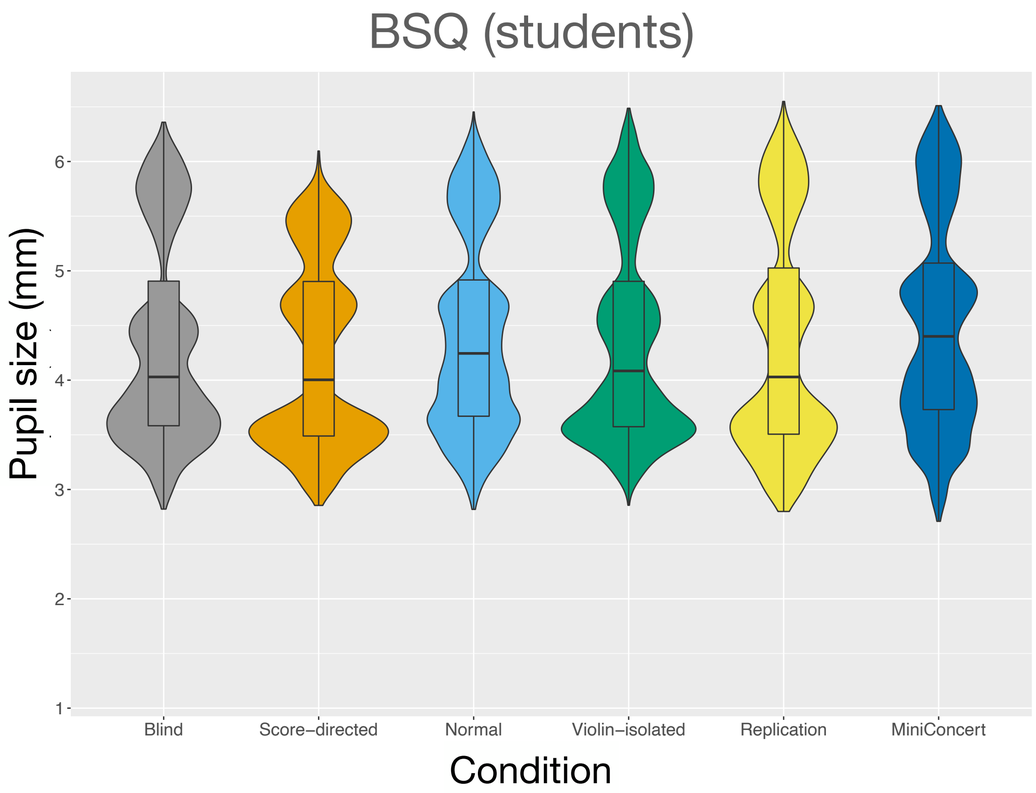
DSQ (experts)

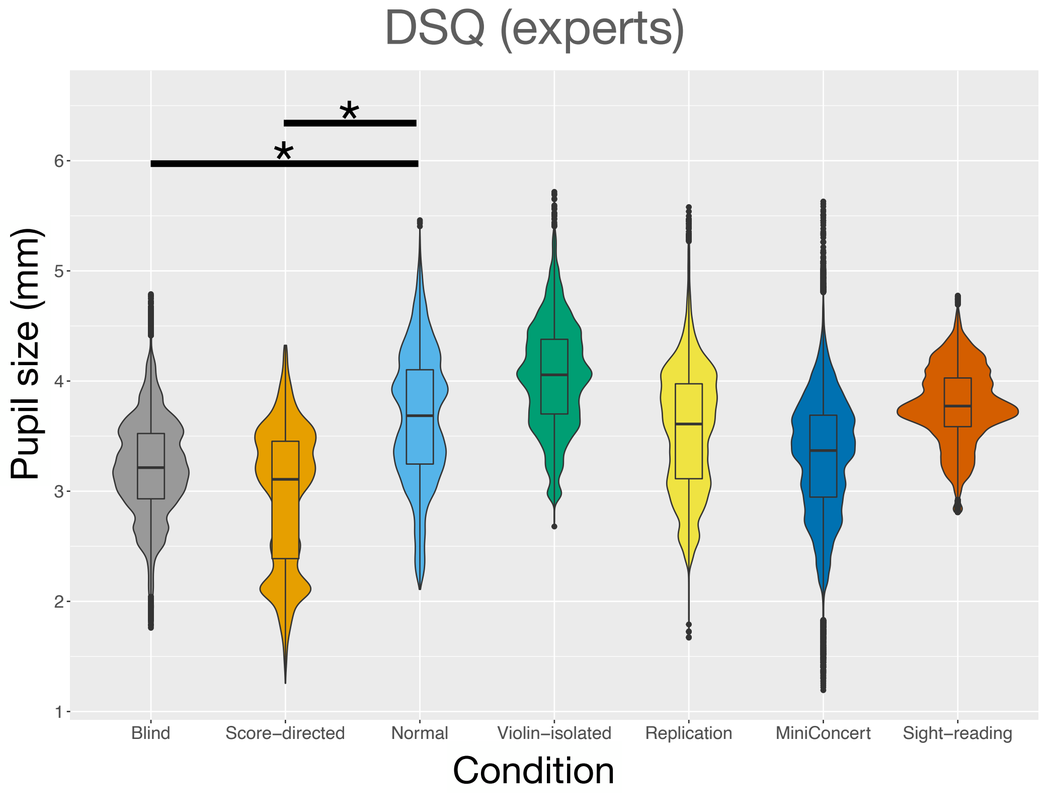


(Høffding et al., 2023, Music & Science)

Interactivity & adaptability in string quartets

Experts showed a positive response to playing with visual contact:
↑ **mental effort**





(Bishop et al., 2023, Music & Science)

Interactivity & adaptability in string quartets

Expertise effects





BSQ (students)

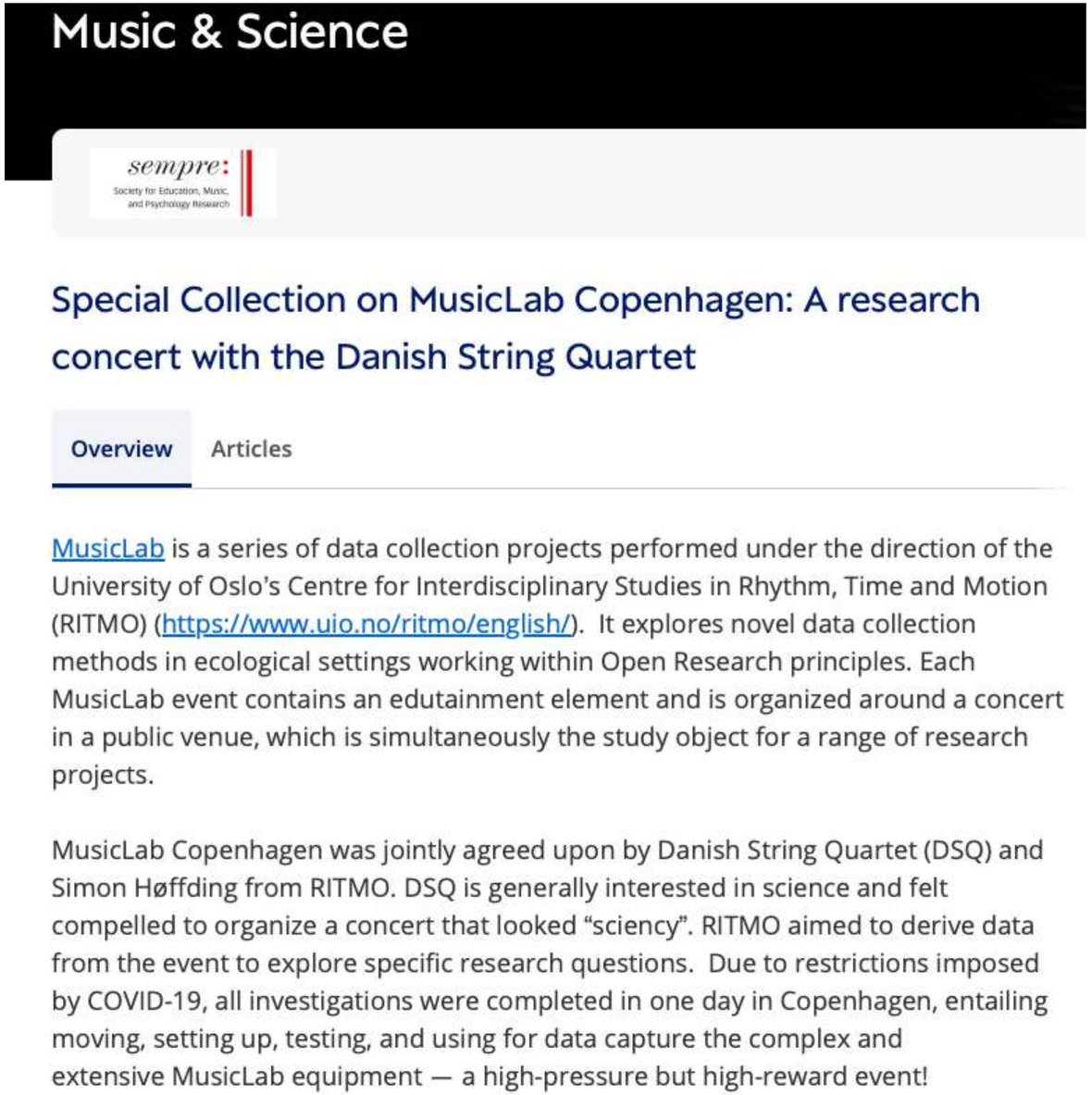
		Viewing musician			
		1st violin	2nd violin	Viola	Cello
Viewed musician	1st violin	–	6.5%	3.0%	26.2%
	2nd violin	0%	–	5.0%	16.3%
	Viola	3.1%	6.9%	–	2.1%
	Cello	0.2%	11.9%	2.5%	–

DSQ (experts)

		Viewing musician		
		1st Violin	2nd Violin	Viola
Viewed musician	1st Violin	–	0.9%	2.9%
	2nd Violin	6.3%	–	0.8%
	Viola	4.9%	0.3%	–
	Cello	6.4%	5.8%	3.4%

- Experts moved more than students
- Experts showed stronger motion similarity
- Experts and students spent a similar amount of time watching their co-performers
- Experts also distributed gaze between their co-performers more equally than students

(Bishop et al, 2021, JNMR; Bishop et al., 2023, Music & Science)



Bishop, L., González Sánchez, V., Laeng, B., Jensenius, A. R., & Høffding, S. (2021). Move like everyone is watching: Social context affects head motion and gaze in string quartet performance. *Journal of New Music Research*, *50*(4), 392–412. https://doi.org/10.1080/09298215.2021.1977338

Bishop, L., Høffding, S., Lartillot, O., & Laeng, B. (2023). Mental effort and expressive interaction in expert and student string quartet performance. *Music & Science*, *6*. https://doi.org/10.1177/2059204323120800

Bishop, L., & Jensenius, A. R. (2020). Reliability of two IR motion capture systems in a music performance setting. In Proceedings of the 17th Sound and Music Computing Conference, Torino, Italy.

Bishop, L., Jensenius, A. R., & Laeng, B. (2021). Musical and bodily predictors of mental effort in string quartet music: An ecological pupillometry study of performers and listeners. *Frontiers in Psychology*, *12*, 653021. https://doi.org/10.3389/fpsyg.2021.653021

Høffding, S., Yi, W., Lippert, E., Sanchez, V. G., Bishop, L., Laeng, B., Danielsen, A., Jensenius, A. R., & Wallot, S. (2023). Into the hive-mind: Shared absorption and cardiac interrelations in expert and student string quartets. *Music & Science*, *6*. https://doi.org/10.1177/20592043231168597

Høffding, S., Bergstrøm, R. J. F., Bishop, L., Lucas, P., Burnim, K., Cancino-Chacón, C., Clim, A., Good, M., Hansen, N. Chr., Karlsen, E. S., Kvale, L. H., Laeng, B., Lartillot, O., Lippert, E., Martin, R., Nielsen, N., Omprakash, R., Paulsrud, T. S., Rosas, F., … Jensenius, A. R. (2025). Introducing the MusicLab Copenhagen Dataset. *Music & Science*, *8*. https://doi.org/10.1177/20592043241303288

See special collection for articles on audience experience and behaviour!

MusicLab Abels KORK







MusicLab Abels KORK featuring the Norwegian Radio Orchestra and popular science radio show Abels Tårn

Photos: Simen Kjellin, UiO

Bodies in Concert project

- BiC investigates when and how performers' and audience members' bodies act together during classical music concerts.
- Collaborations with professional orchestras for data collection and science communication during live concerts.
- Platform for many different studies
- Interdisciplinary perspectives (music psychology, music technology, physiology, neuroscience, philosophy, musicology)





Research questions

- What effect does the conductor have on coordination of expressive body motion in string sections?
- Does coordination differ between rehearsal and concert settings?



Photo: Simen Kjellin, UiO







Equivital LifeMonitor sensors

- Tri-axial acceleration
- Respiration
- ECG
- Body temperature



Synchronized with audio using audio-acceleration cues given by shaker table

Tous droits réservés

Til Heimefrontens
store og små kjempere

KJEMPEVISE-SLÅTTEN
(Canto rivoltoso)

Durata: 5½ min.

Harald Sæverud, Op. 22a nr. 5

Andante un poco sostenuto (♩= 72)

2 FLAUTI
2 OBOI
2 CLARINETTI (Notazione in C)
2 FAGOTTI
4 CORNI (Notazione in C)
3 TROMBE
TROMBONI I-II
TROMBONE III e TUBA
TIMPANI
BATTERIA
ARPA
VIOLINO I
VIOLINO II
VIOLA
VIOLONCELLO
CONTRABASSO

ben f lamentoso
1. con sord.
p marc.
ppp smorz.
pp
Gran Cassa e Piatti
pp misterioso
mf
p ma ben marc.
ff

1) <> = marc. espr.

Non Rit. !!

Ottavino tutta forza

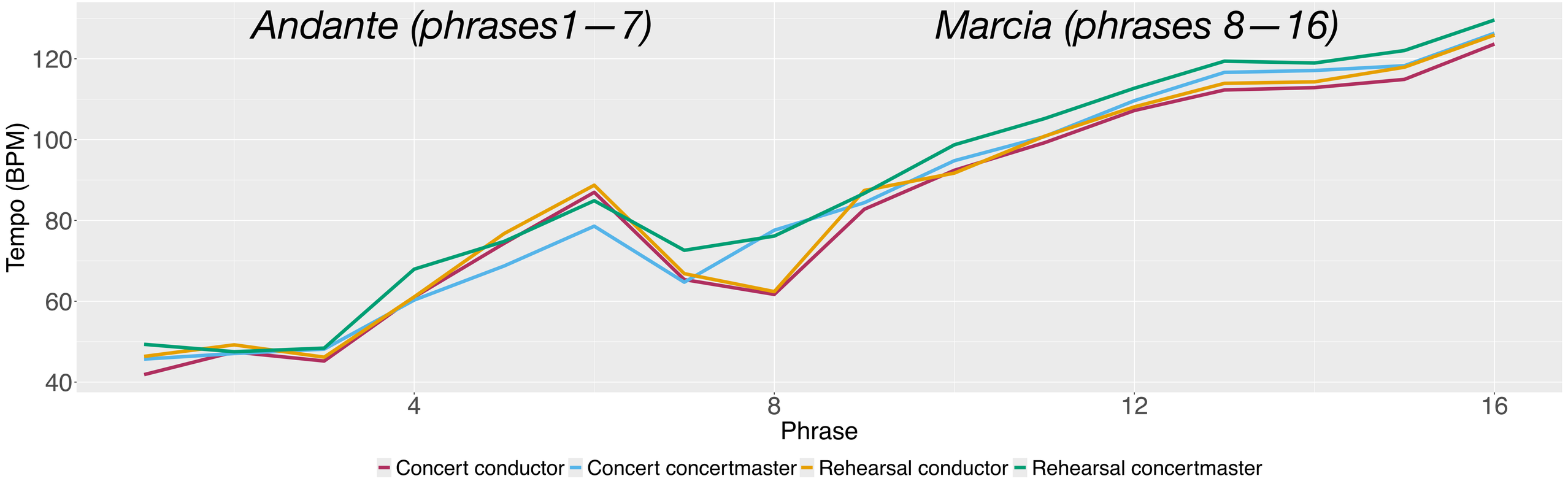
non più che ♩= 132 (vedi pag. 7)

tutta forza
a 2
sff
marcatissimo
sf
fff
ffff
Tamtam

1) ffff strumenti in aria

Göransson Lithogr. Officin Wolhavensgt. 19 Oslo.

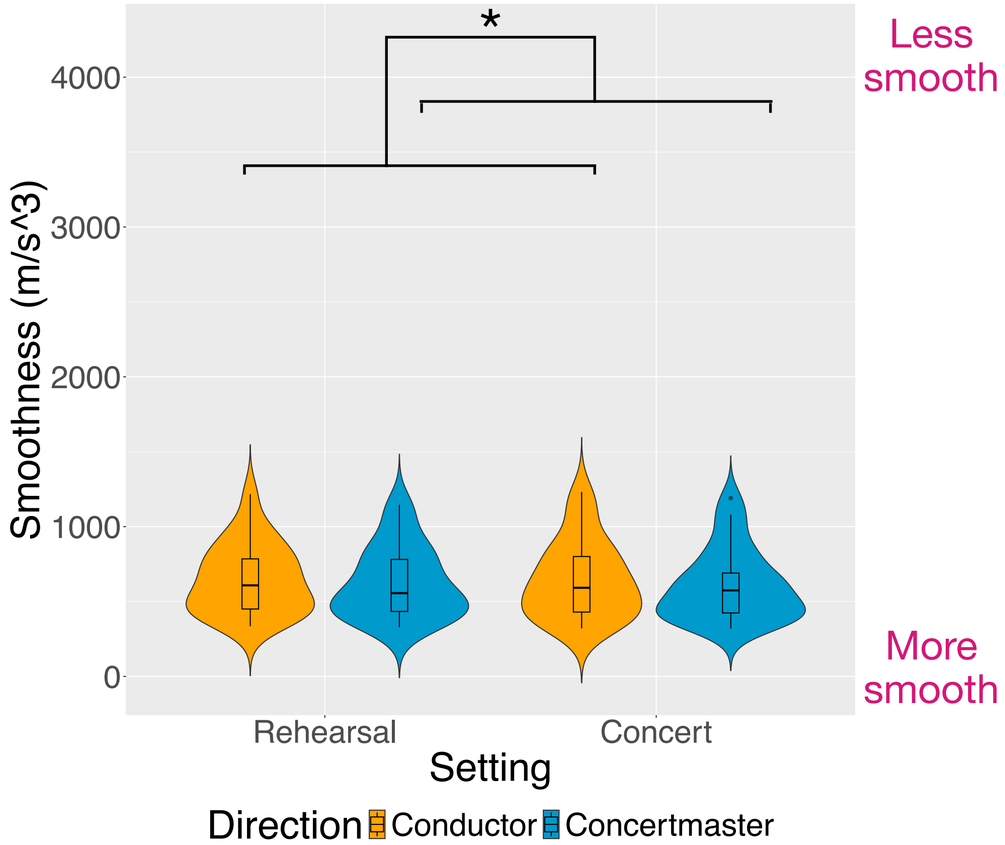
Role of conductor in coordinating orchestral strings



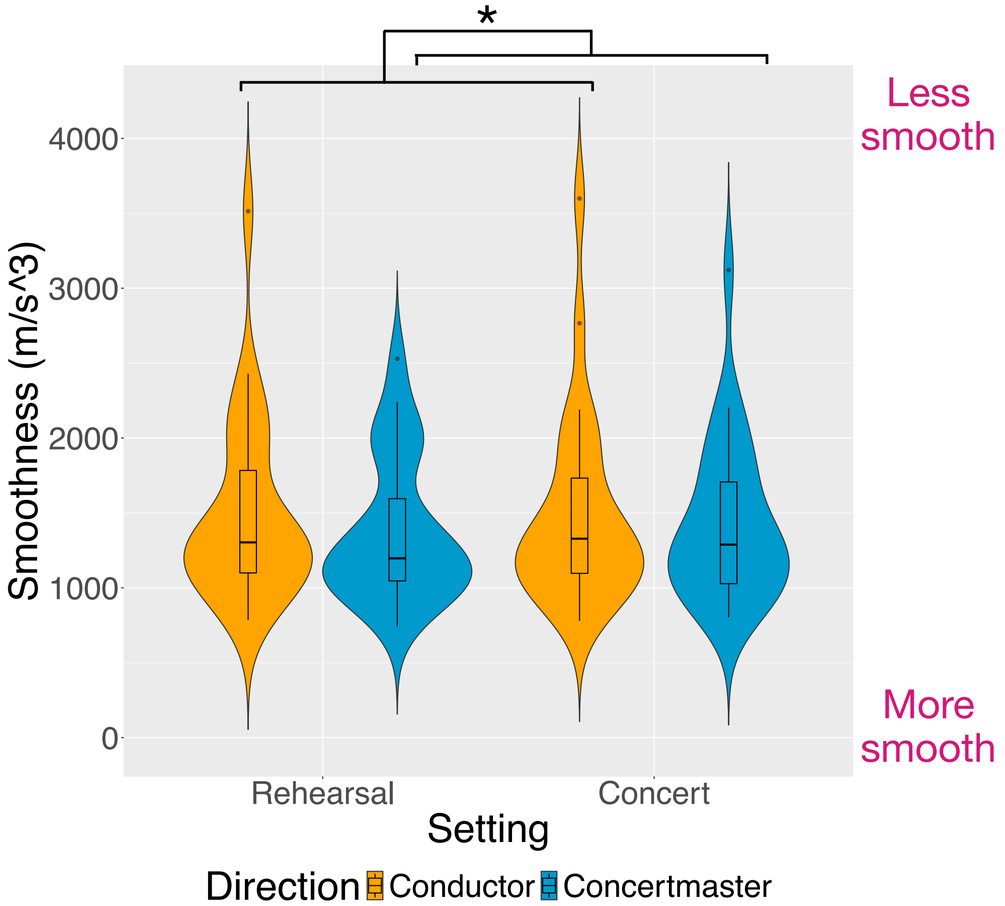
Role of conductor in coordinating orchestral strings

- In both parts, motion is smoother with CM than with CD (no effect of setting)

Andante

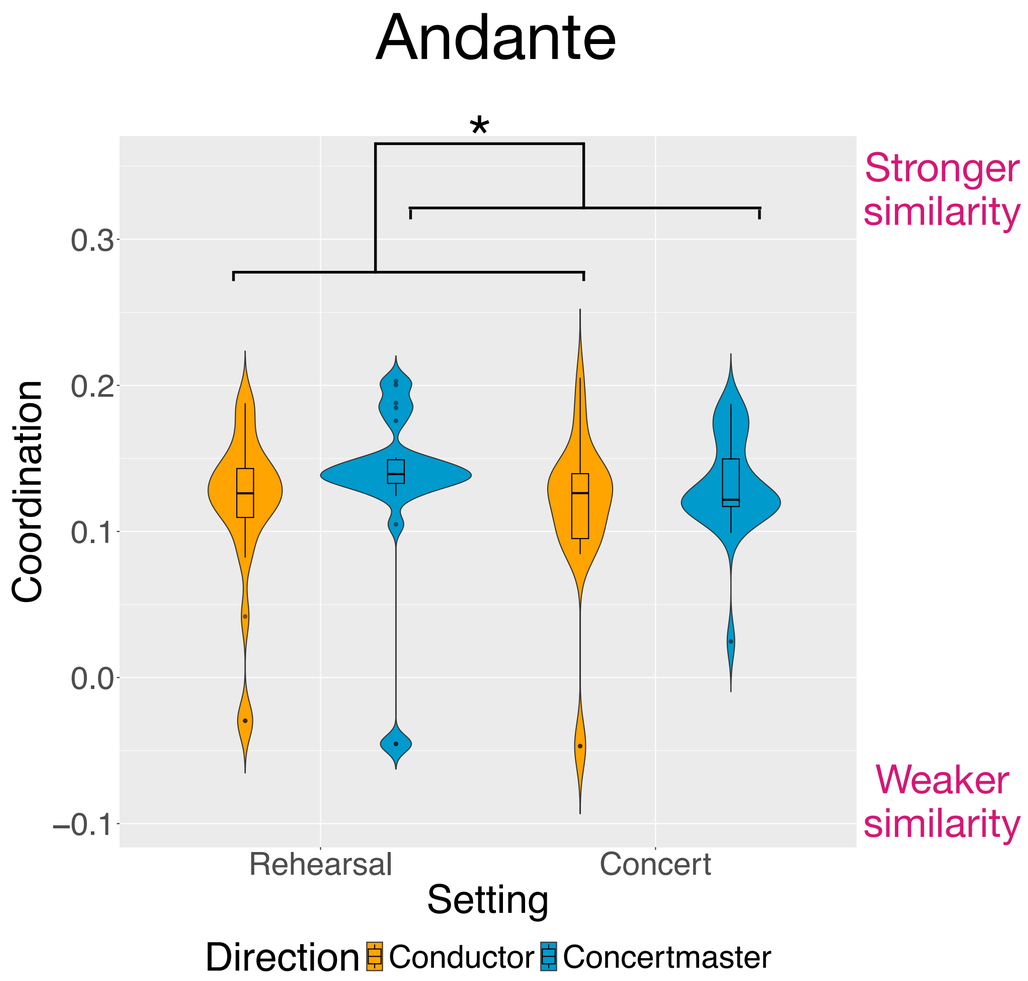


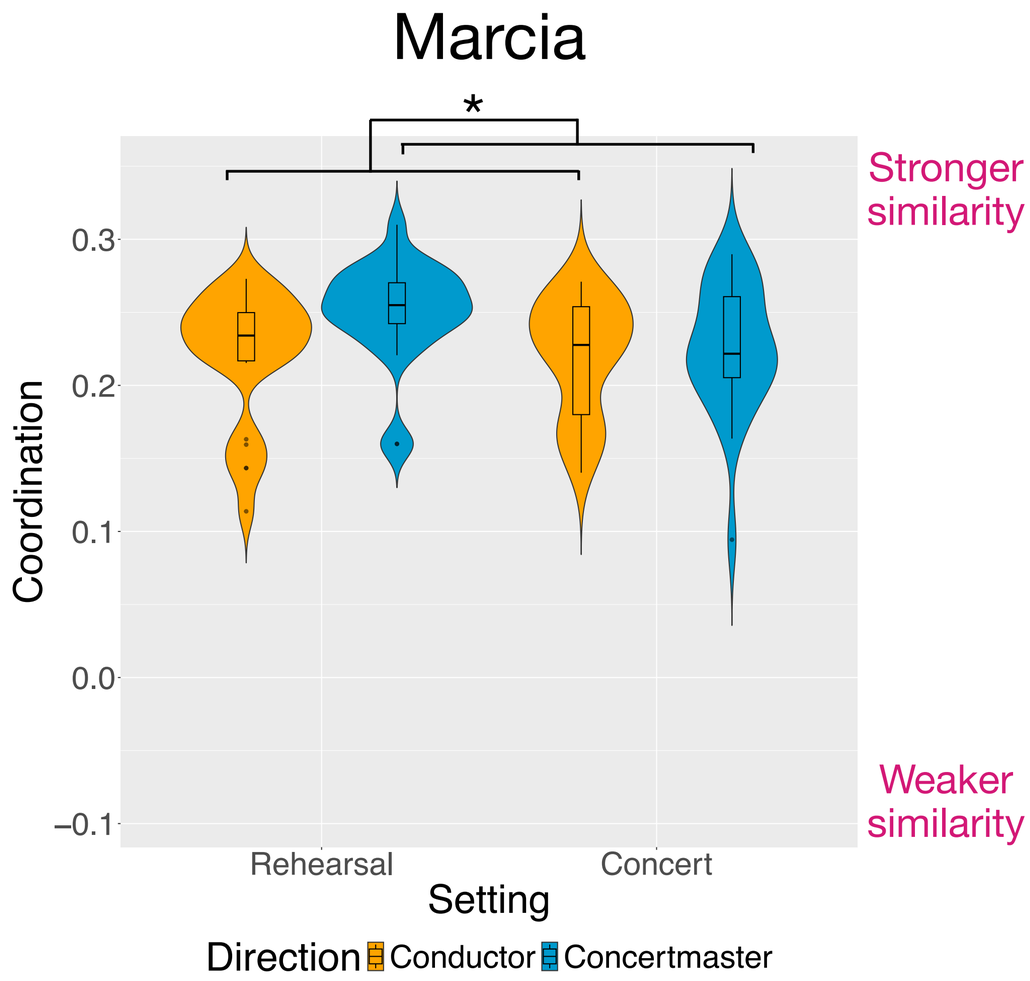
Marcia



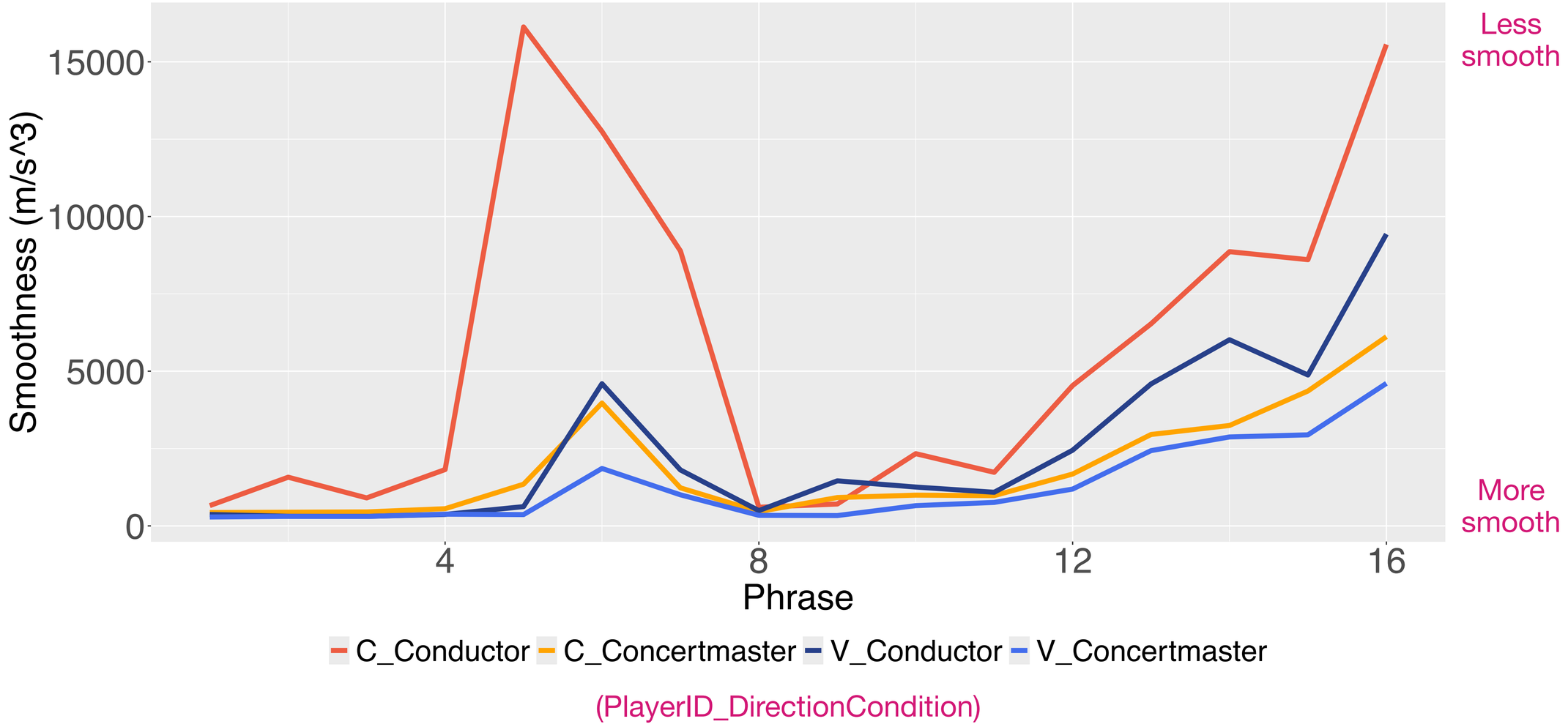
Role of conductor in coordinating orchestral strings

- In both parts, motion similarity is stronger with CM than with CD





Role of conductor in coordinating orchestral strings



Conclusions & lessons learned

- Musicians move expressively together when playing music together, and this relates to their sense of togetherness
- Students are more reliant on visual contact to make this happen than experts
- In orchestras, the conductor has a real-time effect on musicians' coordination; in the conductor's absence, coordination mechanisms shift and moving together is more important

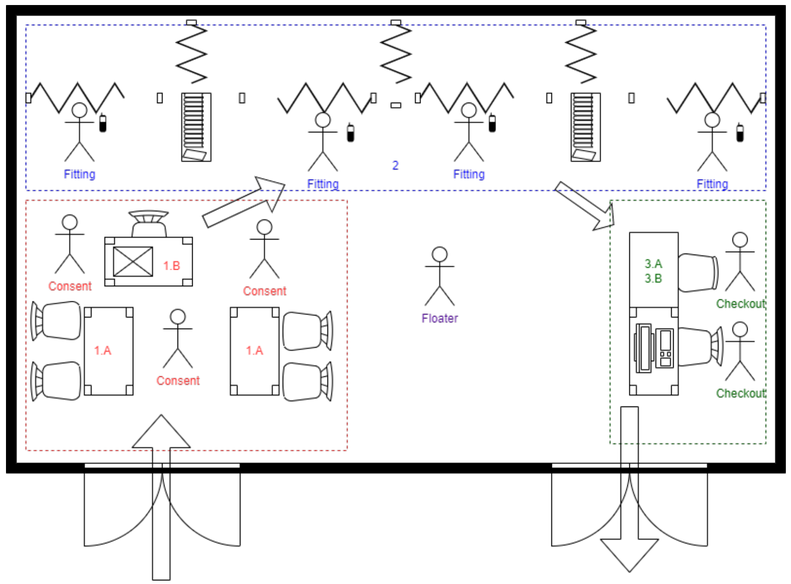
Conclusions & lessons learned

- Methodologically, assessing coordination in large groups requires new data collection and analysis pipelines (see also Demos & Palmer, 2023)
- Live concert research benefits from:
  - A lot of preparation
  - Adaptable and efficient data capture plans
  - Data-driven rather than experimental approaches
  - Well-maintained relationships with music organisations

Developing methods for live concert research

- What can we capture?
- What technology should we use?
- How does this tech compare to the state-of-the-art systems we use in lab?
- How do we capture data from 50–500 people simultaneously?
- How do we negotiate scientific and artistic priorities?









Thanks especially to Alexander Refsum Jensenius, Kayla Burnim, Simon Høffding, Finn Upham, Sara D'Amario, the rest of the BiC team, Carlos Cancino-Chacón, and the Togetherness team (Werner Goebl, Sara D'Amario & Anna Niemand)

