The Sound of Teaching Music: Experts' sound modulation for novices

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Introduction

1. Human have developed expertise and unique cultures by learning from others (Whiten, 2017)

2. Adults intensively engage in instructed teaching (Tomasello, 2016)

3. Speech and action modulation for teaching purposes (e.g., infant-directed speech/action; Brand et al., 2002; Kuhl, 2004)

- Slower performance
- Exaggeration
  - Higher pitch, larger contour
  - larger trajectory
- These modulations are supposed to alter novices' attention to relevant properties (Csibra & Gergely, 2009)

Is this a general teaching behaviour?

- While teaching expertise such as musical expression, how can teachers differentiate their expresssive performance when they have the intention to teach from when they don't?

Predictions

How do experts modulate their performance for teaching purposes?

1. Expert would play more slowly when teaching than when performing (DV: Interonset intervals, IOIs)

2. Experts would exaggerate relevant properties of sound for teaching purposes

    - Articulation (smoothness): longer legato and shorter staccato (DV: Key-Overlap Ratio, KOR)
    - Dynamics (loudness): louder forte and smaller piano (DV: Key Velocity, KV)

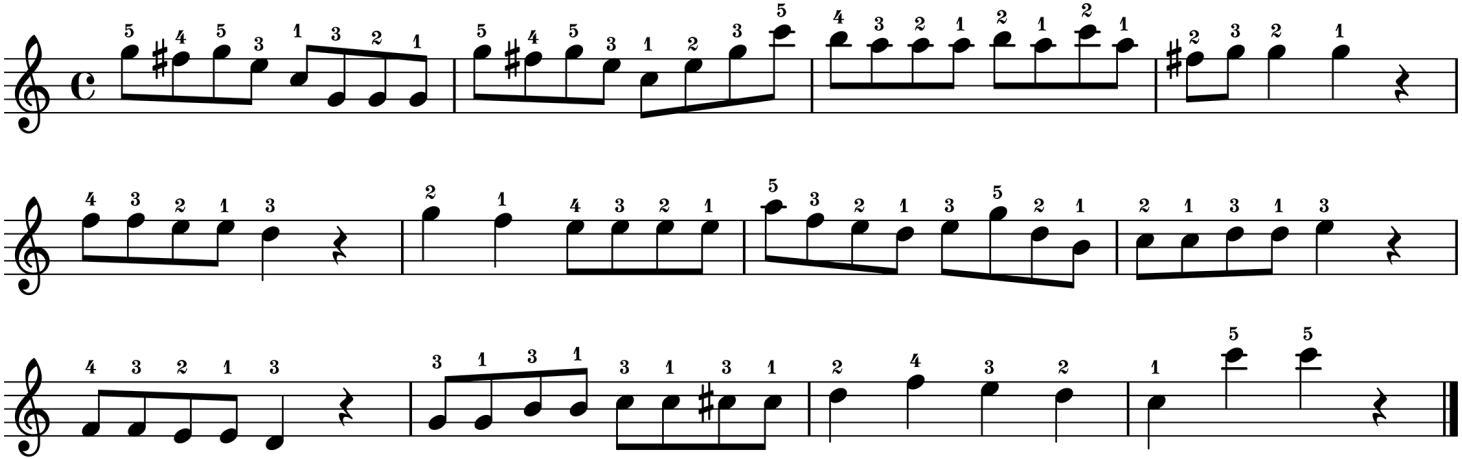
3. Experts would make a larger contrast between forte and piano (DV: Velocity difference)

Methods

- **21 participants** (1 participant excluded - could not complete the study)
- 15.7 years of experience in piano performance
- 11 male, 9 female

Task: Perform one excerpt of music with an expression on a digital piano

Piece: Clementi, Sonatina in C major, op. 36 no. 3 (Tempo: 100, 110, 120 bpm - participants could choose one of the tempi)



Methods

Condition (within-subjects)

Teaching:

Students already know how to produce the sequence of the tones and now are trying to *learn how to perform the piece expressively* by listening to your performance with your interpretation.

Do your best as a teacher to produce the piece according to the notation that you just practised.

Performing:

Perform the piece expressively with your interpretation.

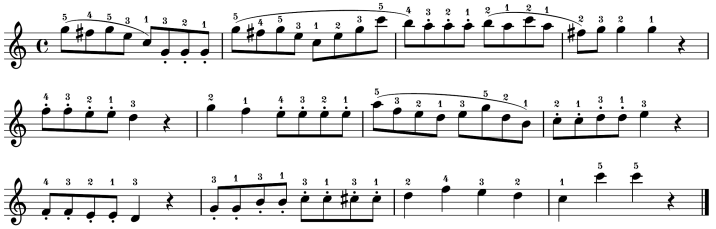
Do your best as a performer to produce the piece according to the notation that you just practised.

Methods

Skill (within-subjects)

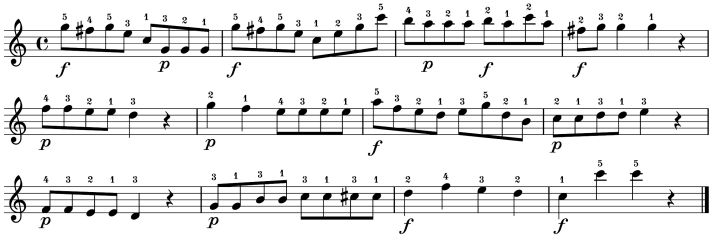
Articulation

- Legato/Staccato
- Smoothness of sound



Dynamics

- Forte/Piano
- Loudness of sound

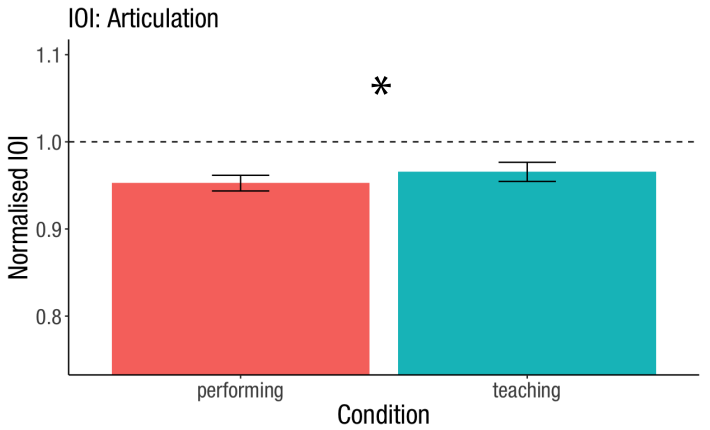


1. Do experts play more slowly when teaching than when performing?

Results (IOIs - tempo)

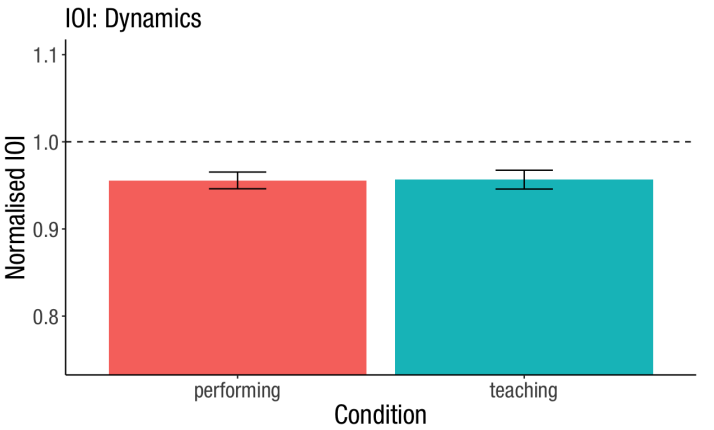
- Normalised IOIs (each IOI/ideal tempo - 100, 110, 120bpm)
- Error bars display the SEM

Articulation



- t = 2.47, df = 19, p = 0.023, Cohen's d = 0.27
- Participants **played slower** in the teaching (M = 0.97) than in the performing condition (M = 0.95).

Dynamics



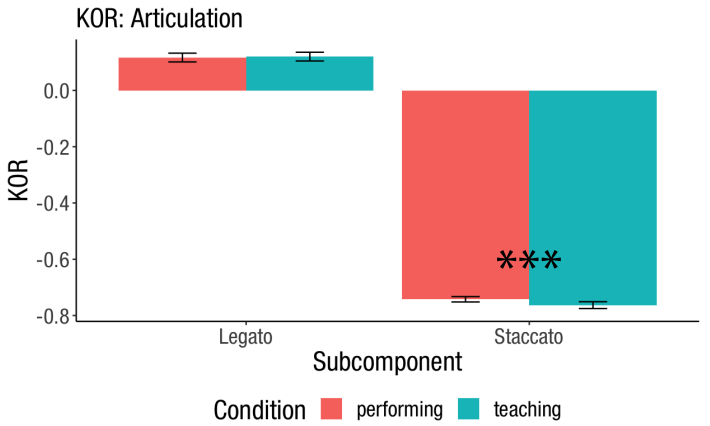
- t = 0.21, df = 19, p = 0.84, Cohen's d = 0.02
- Participants **did not** play slower while teaching dynamics.

2. Do experts exaggerate relevant properties of sound for teaching purposes?

Results (KOR - articulation)

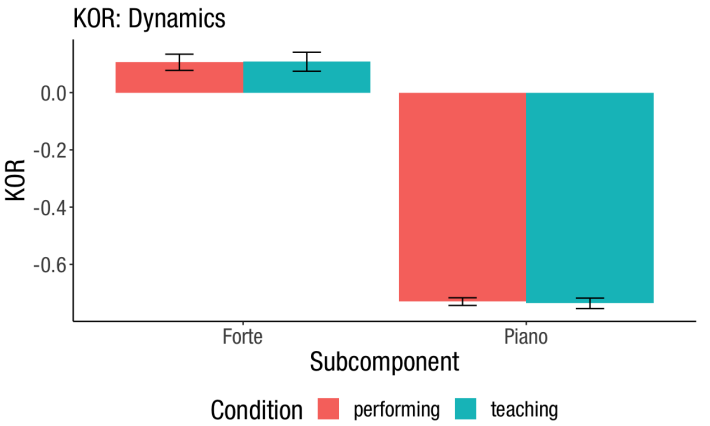
- 2Condition (teaching vs. performing) x 2Subcomponent (legato vs. staccato or forte vs. piano)

Articulation



- Subcomponent: *F(1,19)* = 2693, *p* < 0.0001, η^2 = 0.98
- Condition x Subcomponent: *F(1,19)* = 8.37, *p* = 0.009, η^2 = 0.01

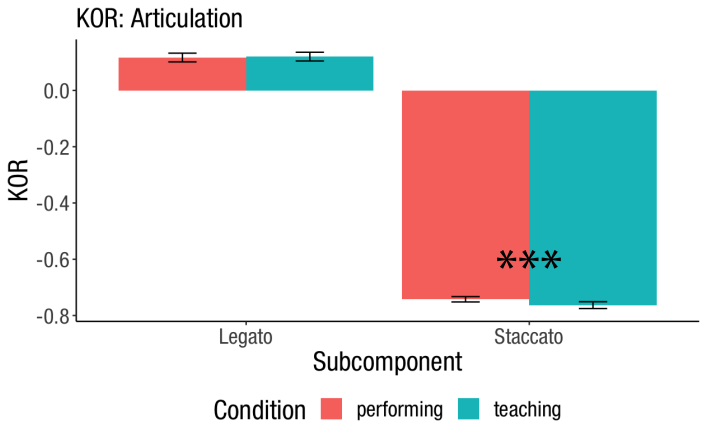
Dynamics



- Subcomponent: *F(1,19)* = 631, *p* < 0.0001, η^2 = 0.94

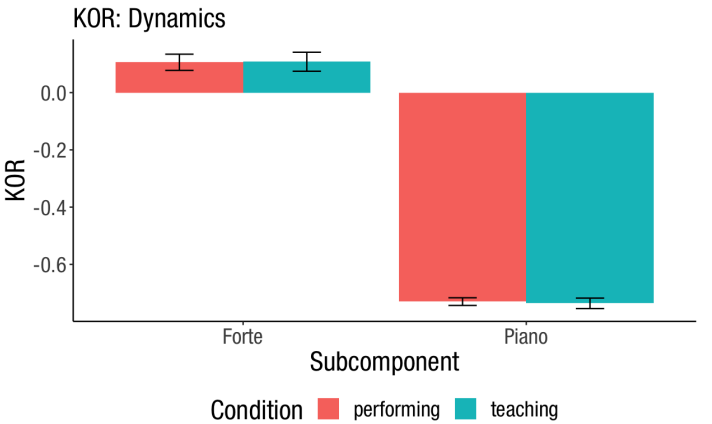
Results (KOR - articulation)

Articulation



- Participants **produced shorter staccato** in the teaching than the performing condition (but no difference in legato)
- Legato: t = 0.44, df = 19, p = 0.67, Cohen's d = 0.05
- **Staccato**: t = 4.4, df = 19, p = 0.0003, Cohen's d = 0.37

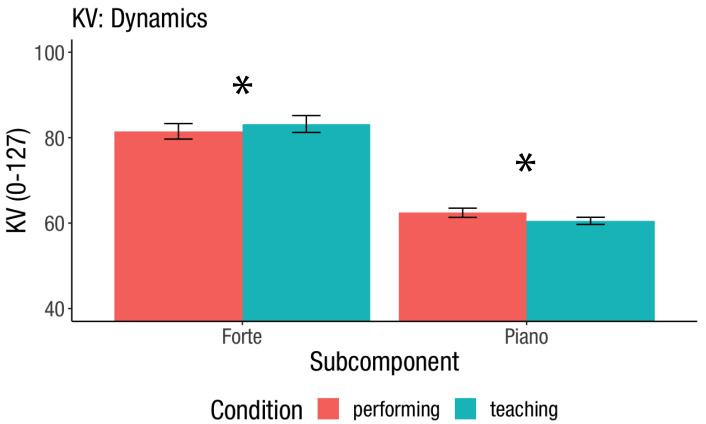
Dynamics



- Participants **did not play differently** between the teaching and performing condition while playing dynamics.

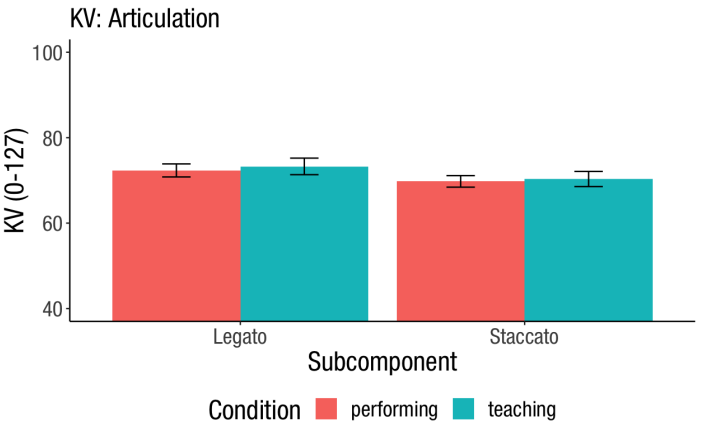
Results (KV - dynamics)

Dynamics



- Subcomponent: *F(1,19)* = 131, *p* < 0.0001, η^2 = 0.72
- Condition x Subcomponent: *F(1,19)* = 6.12, *p* = 0.02, η^2 = 0.02

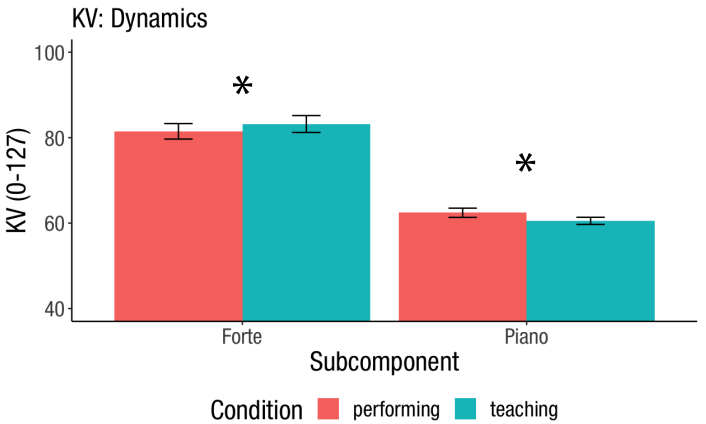
Articulation



- Subcomponent: *F(1,19)* = 8.02, *p* = 0.02, η^2 = 0.034

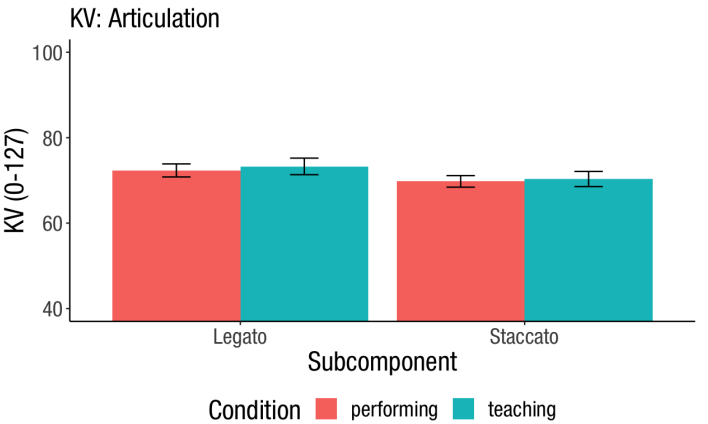
Results (KV - dynamics)

Dynamics



- Participants **produced louder forte and smaller piano** in the teaching than the performing condition
- **Forte**: t = 2.52, df = 19, p = 0.02, Cohen's d = 0.19
- **Piano**: t = 2.13, df = 19, p = 0.04, Cohen's d = 0.42

Articulation



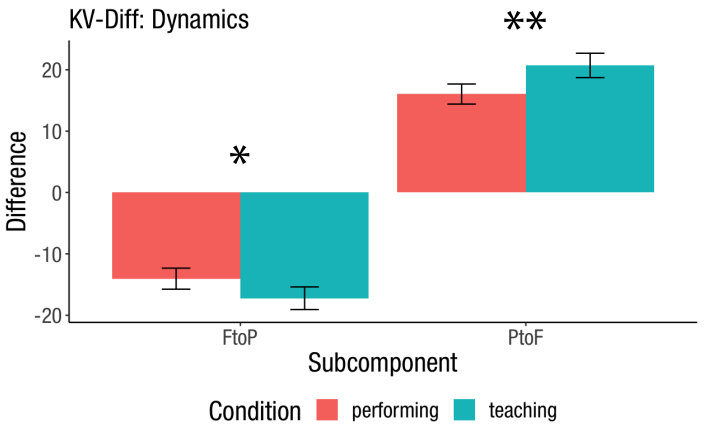
- Participants **did not play differently** between the teaching and performing condition while playing articulation.

3. Do experts would make a larger contrast between forte and piano?

Results (KV difference - contrast)

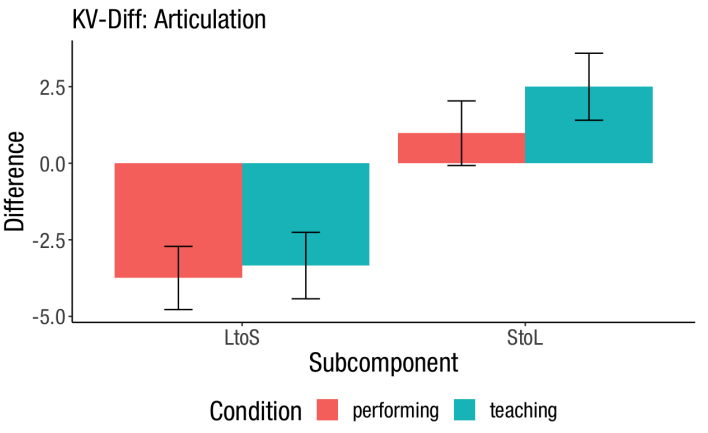
- Calculate the differece between forte and piano to see a contrast

Dynamics



- Subcomponent: *F(1,19)* = 123, *p* < 0.0001, η^2 = 0.82
- Condition x Subcomponent: *F(1,19)* = 9.15, *p* = 0.007, η^2 = 0.06

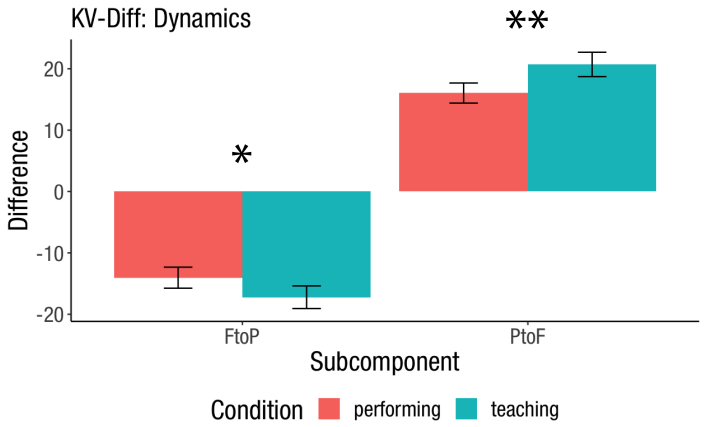
Articulation



- Subcomponent: *F(1,19)* = 11.30, *p* = 0.003, η^2 = 0.24

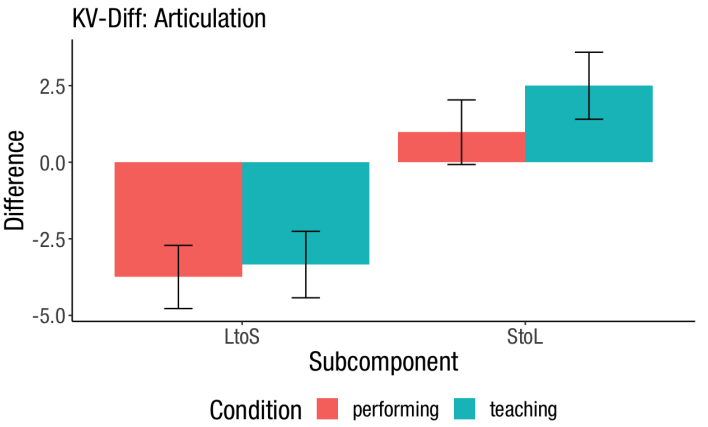
Results (KV difference - contrast)

Dynamics



- Participants **made a larger contrast between forte and piano** in the teaching than the performing condition
- **FtoP**: t = 2.36, df = 19, p = 0.02, Cohen's d = 0.40
- **PtoF**: t = 3.35, df = 19, p = 0.003, Cohen's d = 0.56

Articulation



- Participants **did not play differently** between the teaching and performing condition while playing articulation.

Discussion

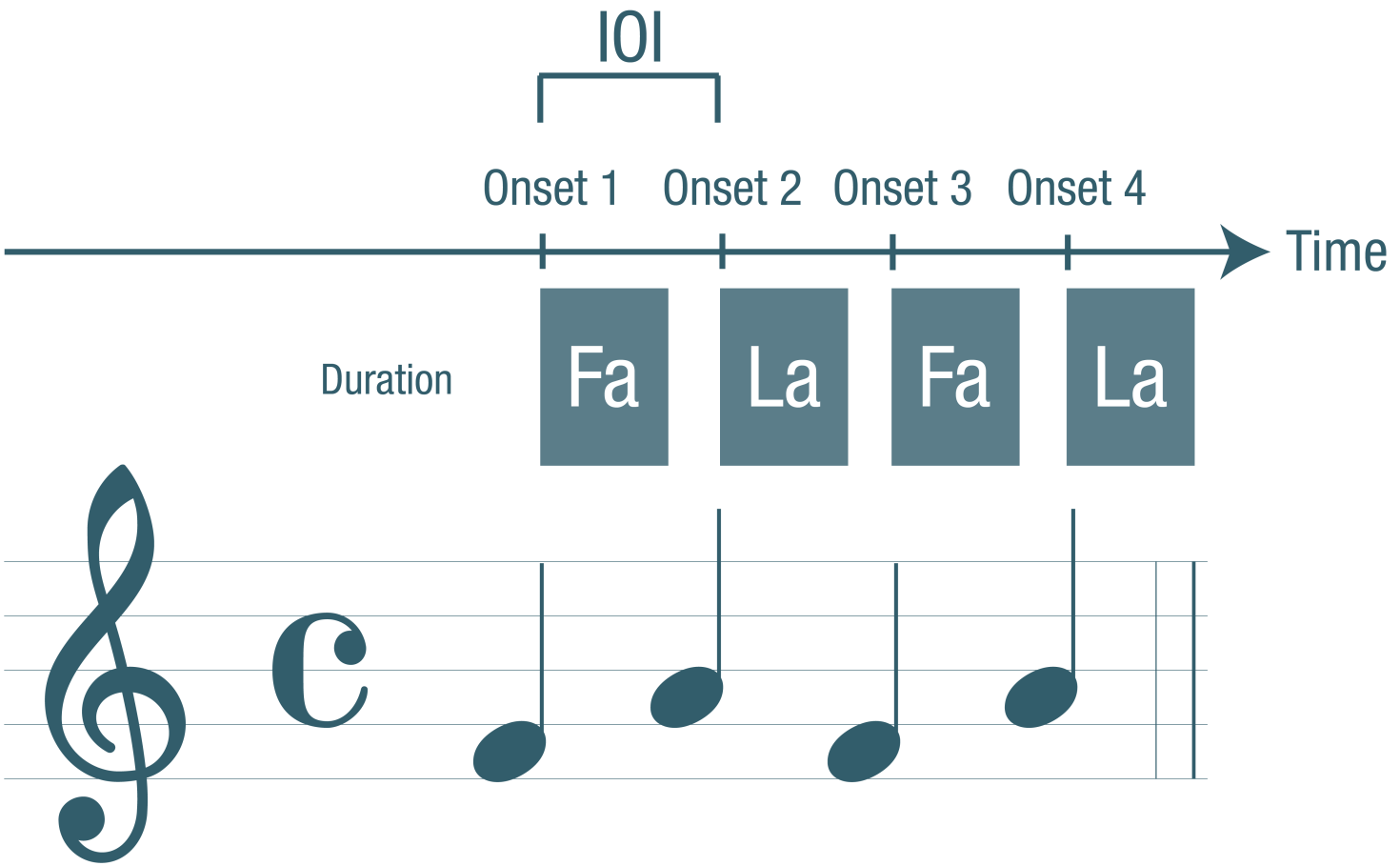
Summary

- Experts played slower during teaching articulation.
- Experts exaggerated relevant properties of sound for teaching purposes.
  - Shorter staccato but no difference in legato
  - Louder forte and smaller piano
- Experts made a larger contrast between forte and piano during teaching.
- Replicated our previous study with a simple piece.

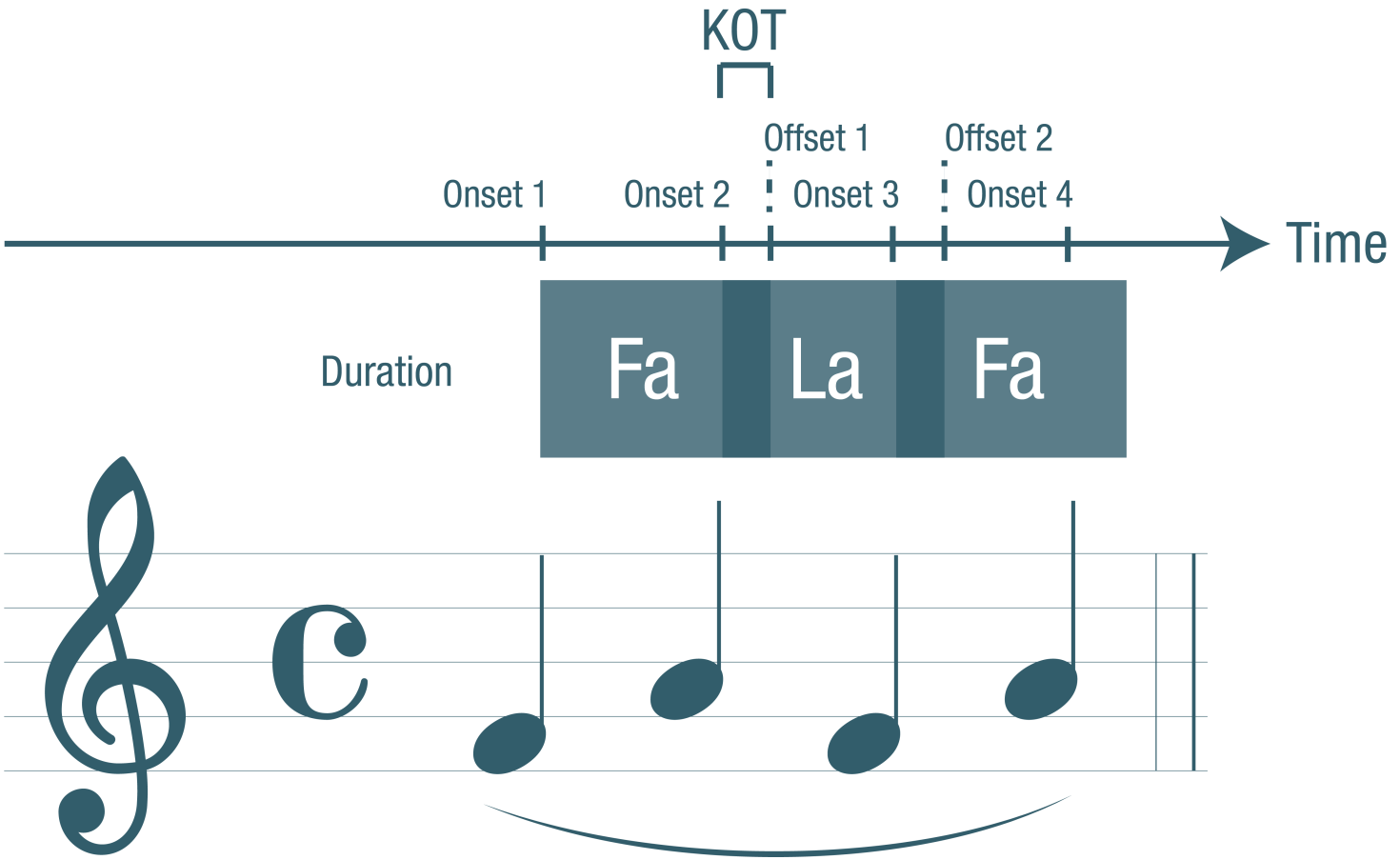
Future research

- How do experts show these trends in a more interactive setting?
- Effects on learning? (e.g., novices' attention, recognition, memory)

IOIs - interonset intervals



Legato - Key-Overlap Time (Ratio)



Staccato - Key-Overlap Time (Ratio)