

# Studying Interdependencies in Music Performance:

## An Interactive Tool

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### Summary

We developed a tool, with which users can manipulate multiple performance features in a synthetic performance interactively. In research with an Analysis-by-Synthesis character, the participant is freed from a choice between a few presets. This allows an insight into fine grained differences as well as into interdependencies between different performance features.

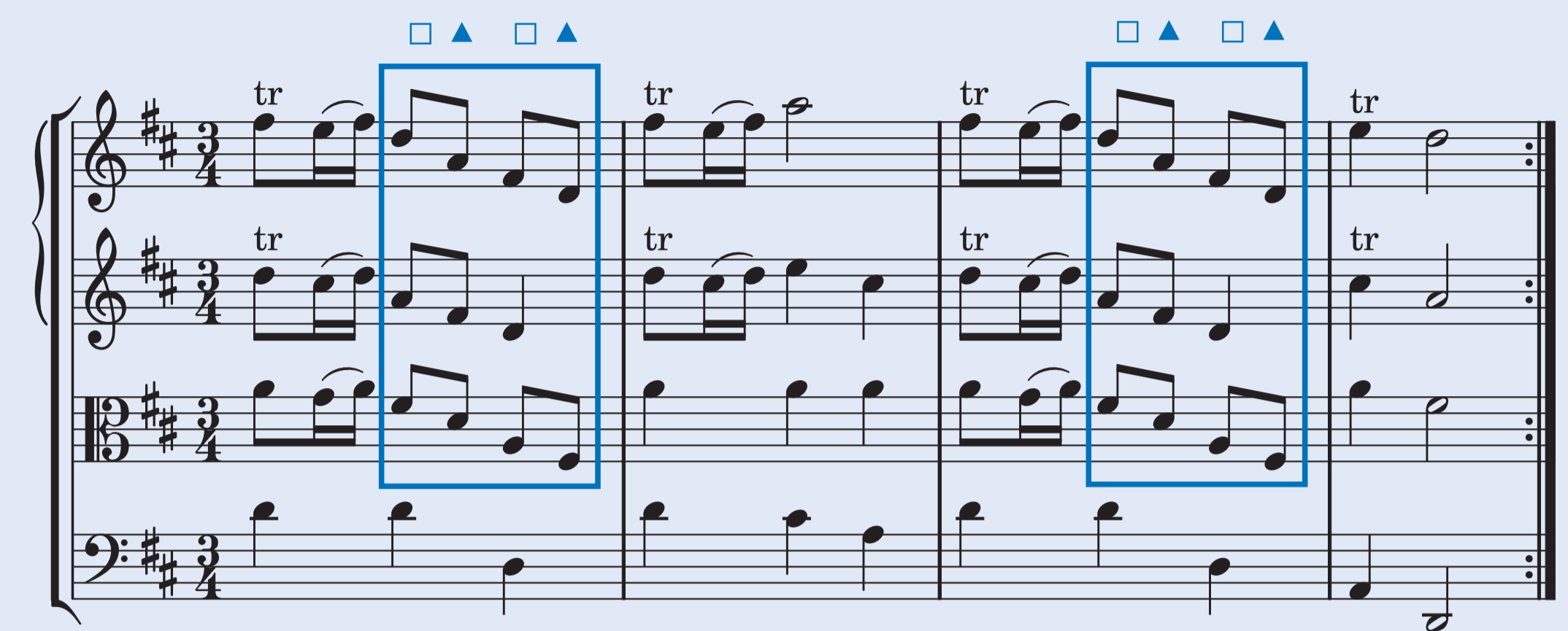
In a study we used this tool to analyse *inégalité* in eighth notes performances. The term commonly refers to Baroque timing, but in the meaning of an unequal shaping of notes, it includes timing, loudness, and duration, and is therefore essential in today's performance practises.

We could show that:

- experts and non-experts prefer *inégalité* over perfect equality of eighth notes
- all parameters *timing*, *loudness*, and *duration* are used to make eighth notes *inégal*
- many participants are not aware of the particular parameters they use
- loudness and timing are negatively correlated.

The last point in particular is an indication for a cumulative effect in so far as the increase of both loudness and time interval are affecting the impression of emphasis. If a note is played louder, it is not necessary to lengthen it, or it can even get necessary to shorten it to avoid an «overstressing», and vice versa.

**Background:** Eighths notes are normally played unequally. This means that eighths notes on the beats get an emphasis. This can be achieved by lengthening the first eighth note (*timing*), by playing it louder (*loudness*) or articulating it differently, e.g. by manipulating the *duration* of a note. In Baroque music, the prominent term «*inégalité*» refers to a distinct lengthening of eighths notes on the beat. However, today musicians emphasise notes intuitively by modifying their movements on the instrument. By doing this, they manipulate multiple parameters. But is this reflected in listener's preferences?



**Figure 1:** With an arrow up key, the first eighth (□) was emphasised; with the arrow down key the second eighth (▲), respectively.

The stimulus comprised the first bars of a «Polonoise» from the Overture «La Gaillarde», TWV 55:D13, for strings & B.C. by G.P. Telemann.

## Test I: Separate Adjustment and Identification

### Participants

- 36 western socialised adults, including
  - 10 professional musicians
  - 16 with a degree in music
  - 20 playing an instrument for more than 10 years

### Methodology

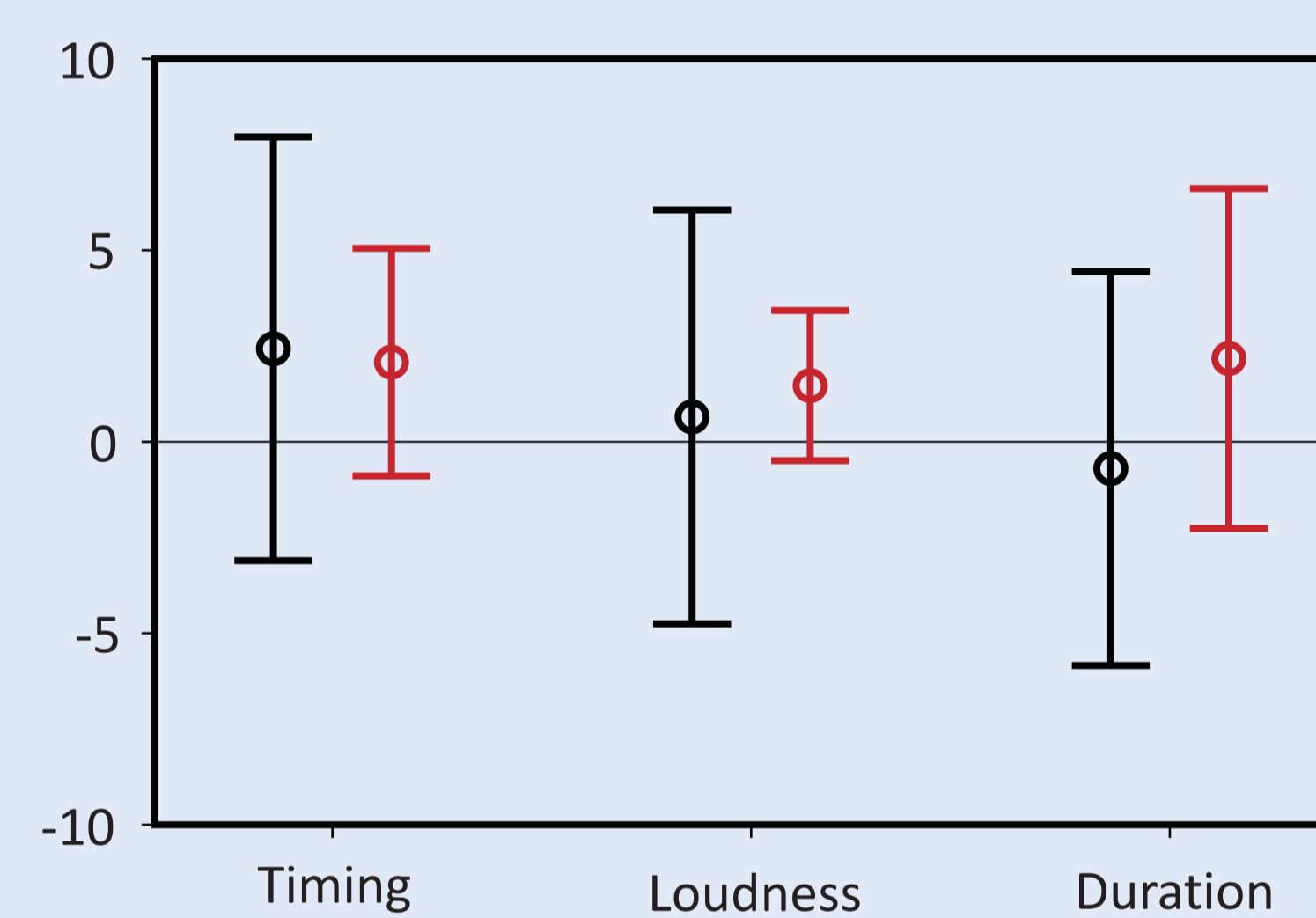
- Participants were asked to adjust the eighths notes by pressing arrow up/down keys until the stimulus sounds as proper as possible. In three tasks they adjusted timing, loudness, and duration.
- Additionally, they had to identify the parameter they are manipulating (open answer).
- Controller values were: -10=strong emphasis of note between the beat (▲)  
0=equal shaping/flat performance; 10=strong emphasis of the eighth note on the beat (□).

### Results

- many participants had difficulties in identifying the parameters
- the mean value of every parameter was above zero
- no significant differences between mean values
- significant decreased variance for participants identifying parameters correctly

	Timing	Loudness	Duration
Correct	28	17	24
Incorrect	8	19	12

**Table 1:** Amount of participants identifying timing, loudness, and duration correctly and incorrectly.



**Figure 2:** Distribution of adjusted parameter values for participants identifying the parameters correctly (red bars) or incorrectly (black bars). Bars indicate  $\pm 1SD$ . Differences of variance were significant for loudness and timing.

Levine statistics  
loudness:  $F=13.831$ ;  $p=0.001$   
timing:  $F=5.478$ ;  $p=0.026$

## Test II: Combined Parameters and Correlation

### Participants

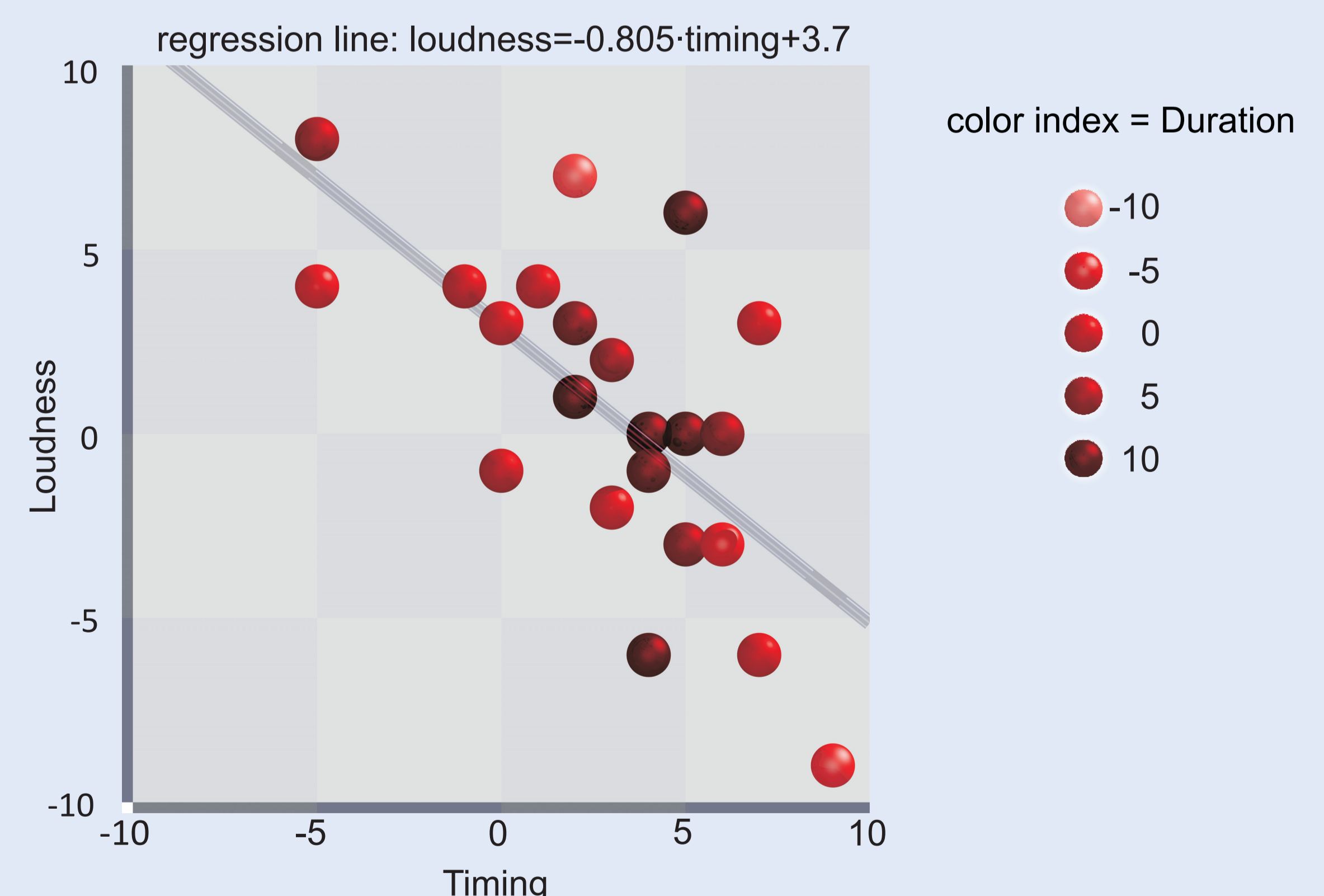
- 25 participants of the first task
  - 10 professional musicians
  - 15 with a degree in music
  - 19 playing an instrument for more than 10 years

### Methodology

- Participants were asked to adjust timing, loudness, and duration by pressing three pairs of arrow up/down keys.
- The keys were labeled.

### Results

- no difference in mean values between first and second test
- timing and loudness are negatively correlated with a high significance



**Figure 3:** An increase of the timing parameter caused a larger time interval from the onset of the eighth on the beat (□) to the eighth between the beats (▲). The more the participants increased the timing controller, the more they decreased the loudness (and vice versa). Correlation coefficient  $r=-0.653$ ; significance:  $p=0.001$

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