

Hugo Bell

# A Body Not Bound By The Same Limitations

For Ensemble, PPG Sensors & Participants

2023

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# A Body Not Bound By The Same Limitations

For Ensemble, PPG Sensors & Participants (2023)

c. 10 minutes

Flute

Oboe

B<sup>b</sup> Clarinet

Bassoon

Harp

Piano

Violin

Cello

8x participants with photoplethysmographic (PPG) sensors, Arduino microcontrollers and LED lights.

## Concept

The piece is driven by the heartbeats of eight audience participants through measuring their pulse rates using photoplethysmographic finger sensors (abbreviated to PPG) connected to Arduino microcontrollers. The pulse rates are displayed using LED lights which the musicians must follow throughout the piece and as a result, each part is played at a completely independent tempo.

A strong co-dependency is thus established; without the musicians there would be no performance but without the participants they would not be able to perform. The subtle variations between each of the pulse rates means that no two performances could ever be the same, with many different factors affecting the performance of the piece such as the audience's age, health or emotional state.

## Technical Notes - Arduino & LED setup

An Arduino and PPG station will be set up next to each musician. The Arduino will be powered by a 9V battery with an on/off switch. The LED light connected to the Arduino will be positioned within the eyeline of both the musician and the audience. The musician will be responsible for activating the light at the start of the piece and turning it off at the end as instructed in their part.

Before the performance, the 8 audience participants will be acquainted with the Arduino setup to ensure they are comfortable with it.

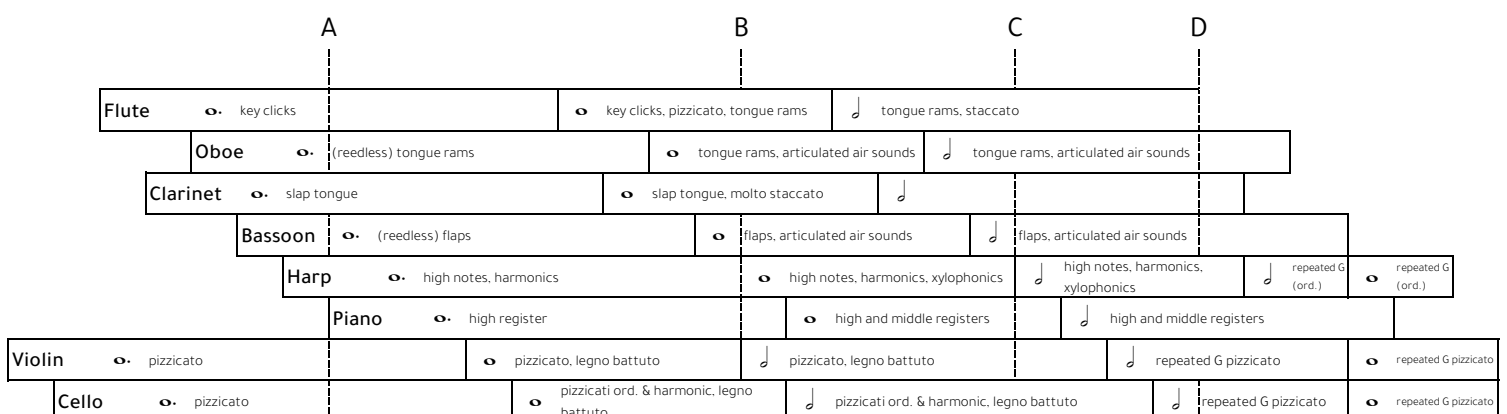
The LEDs will act as time keepers for the musicians, but exact synchronisation with them is not expected, nor possible. Musicians should not treat it as if it is a visual click-track due to the irregular nature of human heartbeats.

## Performance Notes - Commentary & Structure

The piece is built on a simple canonic structure with each of the 8 instruments entering one by one and independently navigating their way through their parts. The rhythmic language of the piece has been kept very simple in order to clearly articulate the heartbeats of each participant and to highlight the complex relationships which emerge between them.

The musical material is comprised of many discrete, *pointillistic* elements to allow for the influence of the participants to impact the performance as clearly as possible and short, percussive timbres are used across all the instruments throughout.

Due to the open nature of the piece, a full score is impossible to create. The diagram below gives a rough overview of the piece showing how each part develops, bearing in mind that the proportional relationships are entirely dependent on participant heartbeats:



## Performance Notes - Notation

- Rests have been omitted for visual clarity; the playing techniques used in this piece will naturally result in shorter notes.
- Conventional notation has been used for techniques such as tongue rams, flute pizzicati or slap tongues, but they may look unclear when applied to note lengths larger than a quarter note.
- The piece uses three different note lengths throughout - 6-beat, 4-beat and 2-beat notes.
- The LED changes state after every heartbeat, meaning that on the first beat it will be **on** and on the second beat it will be **off**.
- Rehearsal marks have been included for practicality but are not definitive structural markers.

## Performance Notes - Dynamics & Balance

- The piece has been composed so that unexpected interactions between parts can emerge from the combinations of different tempi. Dynamic markings would potentially establish a textural hierarchy undermining this goal and have therefore been omitted, with the exception of starting dynamics and some end dynamics.
- The piece should begin and end very softly as indicated, but the overall dynamics should evolve organically in response to the changing densities of the texture. Strategies can be explored and worked on during the rehearsal process.
- Players should aim to balance equally with one another throughout. The use of octave displacement across several of the parts means that some notes will naturally draw more attention than others.

## Performance Notes - By Instrument

### Flute

- The method to produce the pizzicati with either the tongue or lip is at the discretion of the player.
- The upper note of the tongue ram indicates the fingering whilst the lower note indicates the sounding pitch.
- [b/d/p] indicates that the player can choose freely between the three consonants for articulation. Notes should be articulated with as little excess air as possible.

## Oboe

- The oboist plays without the reed & staple throughout the piece.
- Tongue rams (or slap tongues) are as described in Peter Veale's *The Techniques of Oboe Playing* (p.143, slap tongue).
- Air sounds should have a clear attack and a fast decay of about 500ms, similar to the decay of a stopped pizzicato on violin.

## B<sup>b</sup> Clarinet

- Slap tongues shouldn't be too forceful.
- Ordinary notes should always be *molto staccato* and stopped with the tongue.

## Bassoon

- The bassoonist plays without the reed throughout the piece.
- 'Reedless flaps' are as described in Pascal Gallois' *The Techniques of Bassoon Playing* (p.49). Flaps generally don't need to be too forceful as the bassoon is the only instrument occupying the low register for most of the piece.
- Air sounds should have a clear attack and a fast decay of about 500ms, similar to the decay of a stopped pizzicato on violin. The sound should be focused down the crook with no excess air escaping from the corners of the mouth.

## Harp

- All harmonics are written at playing positions (i.e. sounding an octave higher than written) and should be played *Laissez Vibrer* throughout.
- Xylophonic technique is abbreviated to 'xyl.' throughout.
- Horizontal technique lines only apply to the staff they are above, not to both staves.

## Piano

- The pedal should be held throughout the piece and only released once all the PPG lights have been turned off at the end.

## Violin

- Pizzicati should only be played on open strings when explicitly stated to do so.
- All open string pizzicati are *Laissez Vibrer* throughout. Open string pizzicati should be played at the midpoint of the string above the first harmonic for optimal resonance.

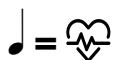
- String indications have been included at certain points to avoid damping the open strings.
- *Col Legno Battuto* is abbreviated to c.l.b throughout. The position of the bow can be varied freely so long as it falls between the edge of the fingerboard and the bridge.

## Cello

- Pizzicati should only be played on open strings when explicitly stated to do so.
- All open string pizzicati are Laissez Vibrer throughout. Open string pizzicati should be played at the midpoint of the string above the first harmonic for optimal resonance.
- String indications have been included at certain points to avoid damping the open strings.
- Col Legno Battuto is abbreviated to c.l.b throughout. The position of the bow can be varied freely so long as it falls between the edge of the fingerboard and the bridge.

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Activate PPG light after 6 cello notes

key click

*pp* starting dynamic

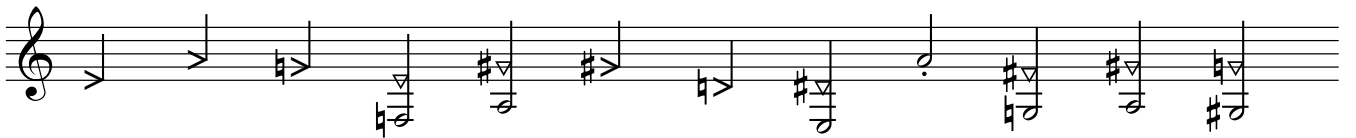
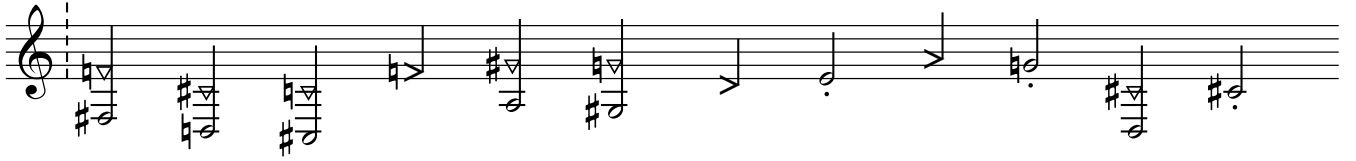
A

pizz. tongue ram

[note values equal to ♩]



C

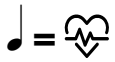


D



# A Body Not Bound By The Same Limitations

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Activate PPG light after 6 clarinet notes

'tongue ram' without reed & staple

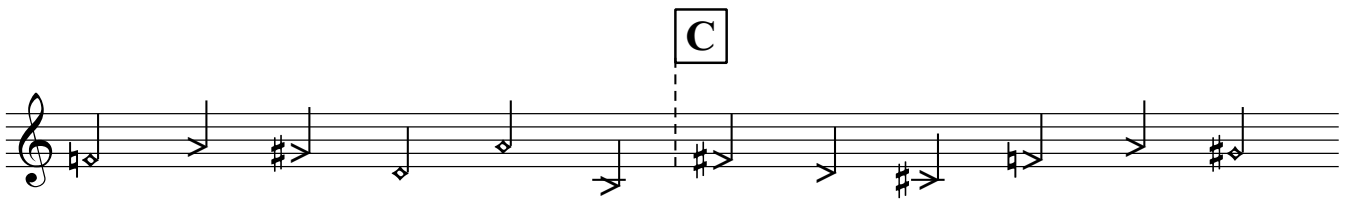
[note values equal to  $\circ$ .]  
*p* starting dynamic

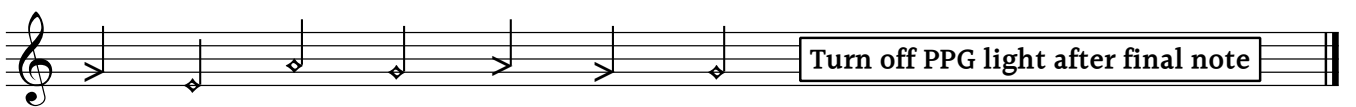
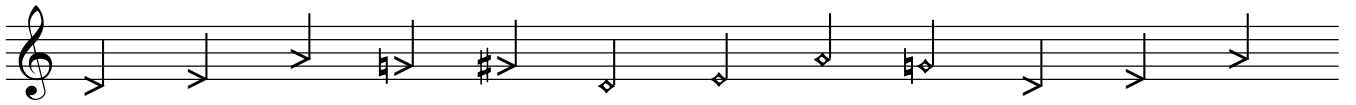
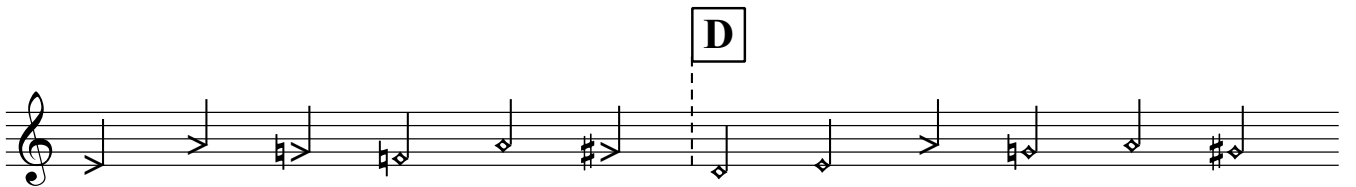
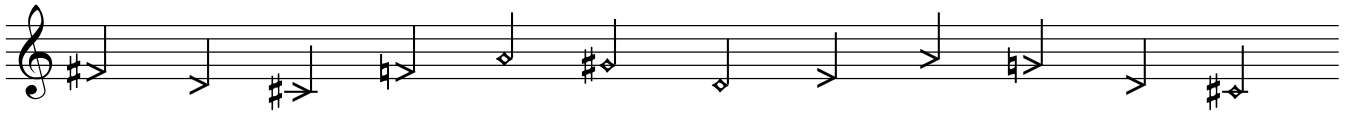
A

air

[note values equal to  $\circ$ ]

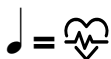
B





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Activate PPG light after 2 flute notes

slap tongue

[note values equal to  $\circ$ .]  
*pp* starting dynamic

A

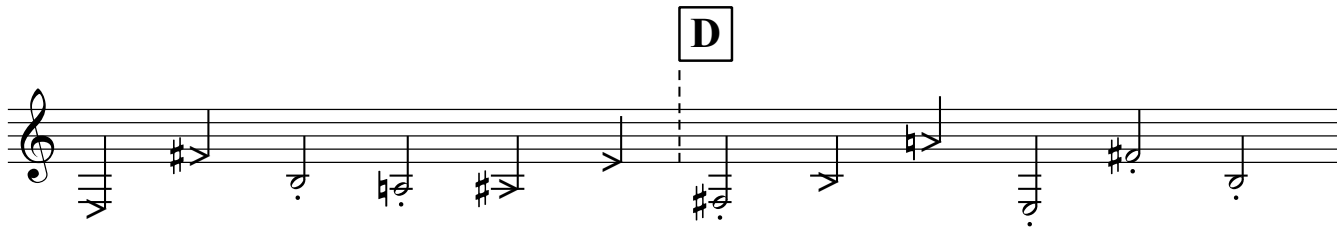
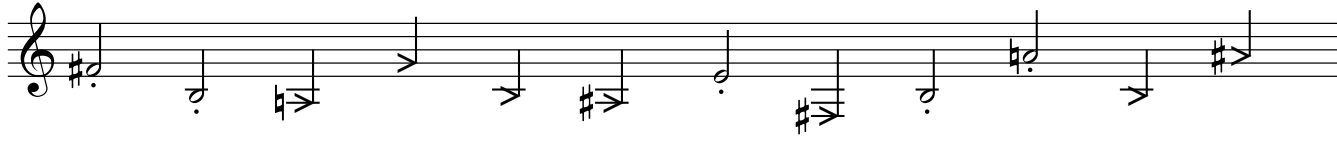
*molto staccato*,  
stopping with tongue

[note values equal to  $\circ$ ]

**B**

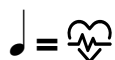
[note values equal to  $\frac{1}{2}$ ]

**C**



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Activate PPG light after 2 oboe notes

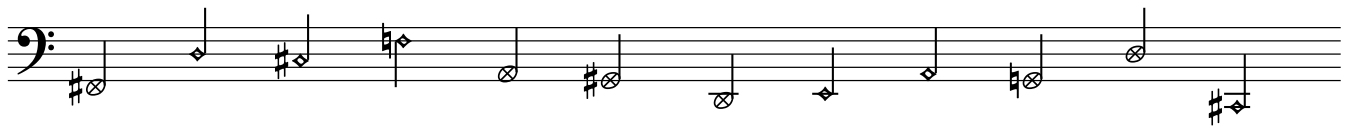
reedless flaps

*pp* starting dynamic

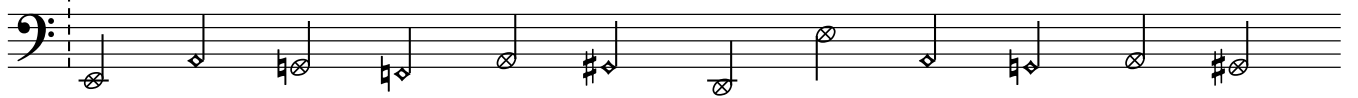
air

B



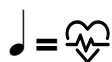


D



# A Body Not Bound By The Same Limitations

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Activate PPG light after 6 bassoon notes

A

*pp* starting dynamic

E, F#, G#, A  
D, C#, B

8<sup>va</sup> ord. xyl. 8<sup>va</sup> ord. xyl. 8<sup>va</sup> ord. xyl. 8<sup>va</sup> ord.

**B** 8<sup>va</sup> ord. xyl. ord. xyl. 8<sup>va</sup> ord. xyl.

8<sup>va</sup> xyl. ord. ord. xyl. ord. xyl.

xyl.

xyl. C

xyl.

xyl.

D  
xyl.

xyl. \_\_\_\_\_

xyl. \_\_\_\_\_

ord., L.V.

Repeat Gs until all wind instruments have turned their PPG lights off, then increase note length to 4 beats.

Repeat until only the harp, violin & cello are left playing the repeated G, then stop playing immediately and turn PPG light off.

*ppp*

PPG light off

Piano

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A

Activate PPG light after 2 harp notes

15<sup>ma</sup>

Ped. →  
(held throughout)

15<sup>ma</sup>

15<sup>ma</sup>

15<sup>ma</sup>-----

**B**

15<sup>ma</sup>-----

15<sup>ma</sup>-----

15<sup>ma</sup>-----

C

15<sup>ma</sup>

The first system of music features a treble and bass clef. The treble clef staff contains a sequence of notes: C4, D4, E4, F#4, G4, A4, B4, C5, D5, E5, F#5, G5, A5, B5, C6. The bass clef staff contains notes: C3, G2, F#2, E2, D2, C2, B1, A1, G1, F#1, E1, D1, C1, B0, A0, G0, F#0, E0, D0, C0, B-1, A-1, G-1, F#-1, E-1, D-1, C-1, B-2, A-2, G-2, F#-2, E-2, D-2, C-2, B-3, A-3, G-3, F#-3, E-3, D-3, C-3, B-4, A-4, G-4, F#-4, E-4, D-4, C-4, B-5, A-5, G-5, F#-5, E-5, D-5, C-5, B-6, A-6, G-6, F#-6, E-6, D-6, C-6, B-7, A-7, G-7, F#-7, E-7, D-7, C-7, B-8, A-8, G-8, F#-8, E-8, D-8, C-8, B-9, A-9, G-9, F#-9, E-9, D-9, C-9, B-10, A-10, G-10, F#-10, E-10, D-10, C-10, B-11, A-11, G-11, F#-11, E-11, D-11, C-11, B-12, A-12, G-12, F#-12, E-12, D-12, C-12, B-13, A-13, G-13, F#-13, E-13, D-13, C-13, B-14, A-14, G-14, F#-14, E-14, D-14, C-14, B-15, A-15, G-15, F#-15, E-15, D-15, C-15, B-16, A-16, G-16, F#-16, E-16, D-16, C-16, B-17, A-17, G-17, F#-17, E-17, D-17, C-17, B-18, A-18, G-18, F#-18, E-18, D-18, C-18, B-19, A-19, G-19, F#-19, E-19, D-19, C-19, B-20, A-20, G-20, F#-20, E-20, D-20, C-20, B-21, A-21, G-21, F#-21, E-21, D-21, C-21, B-22, A-22, G-22, F#-22, E-22, D-22, 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*15<sup>ma</sup>*-----

The first system of music consists of two staves. The upper staff is in treble clef and contains a sequence of notes: G4, A4, B4, C5 (with a sharp sign), D5, E5, F5 (with a flat sign), G5, A5, B5, C6, D6, E6, F6, G6. The lower staff is in bass clef and contains notes: G2, A2, B2, C3, D3, E3, F3, G3, A3, B3, C4, D4, E4, F4, G4.

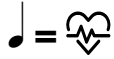
*15<sup>ma</sup>*-----|

The second system of music also consists of two staves. The upper staff is in treble clef and contains notes: G4, A4, B4, C5. The lower staff is in bass clef and contains notes: G2, A2, B2, C3, D3, E3, F3, G3, A3, B3, C4, D4, E4, F4, G4. A text box is overlaid on the right side of the system, containing the following instructions:

Turn off PPG light after the final note has been played. Release pedal after all the other PPG lights are off.

# A Body Not Bound By The Same Limitations

Hugo Bell  
2023



Activate PPG light to begin piece (violin is first entry)

pizz.

*pp* starting dynamic



c.l.b. 0 pizz. 0 c.l.b. 0 pizz. (IV) c.l.b. 0 pizz. c.l.b. 0 pizz.

0 (IV) 0 c.l.b. 0 pizz. 0 c.l.b. 0

**C**

(IV) 0 pizz. c.l.b. pizz. 0 0 0 c.l.b. 0 pizz. 0

0 (IV) 0 0 0 (IV) 0

c.l.b. pizz. c.l.b. pizz. c.l.b. pizz. c.l.b. pizz. c.l.b.

pizz. 0 0 c.l.b. pizz.

**D**

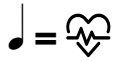
Repeat Gs until all wind instruments have turned their PPG lights off, then increase note length to 4 beats.

Repeat until the harp player has turned their PPG light off, then stop playing immediately and turn PPG light off.

*ppp* PPG light off

# A Body Not Bound By The Same Limitations

Hugo Bell  
2023



Activate PPG light after 6 violin notes

pizz.

*pp* starting dynamic

pizz. c.l.b. pizz. 0 (II) pizz. c.l.b. pizz. h. pizz.

pizz. c.l.b. pizz. 0 (II) pizz. c.l.b. **B**

pizz. c.l.b. pizz. c.l.b. pizz. c.l.b. h. pizz. c.l.b. pizz. c.l.b. —

0 pizz. c.l.b. pizz. c.l.b. pizz. c.l.b. 0 (II) pizz. c.l.b. —

0 pizz. c.l.b. pizz. c.l.b. —

pizz. c.l.b. h. pizz. 0 pizz. (III) c.l.b. pizz. #♯ 0 c.l.b. \_\_\_\_\_

pizz. c.l.b. pizz. c.l.b. pizz. c.l.b. 0 pizz. h. pizz. c.l.b. pizz.

c.l.b. 0 pizz. c.l.b. pizz. c.l.b. \_\_\_\_\_

**C** pizz. 0 c.l.b. h. pizz. h. pizz. pizz. 0 c.l.b. pizz.

c.l.b. 0 pizz. c.l.b. pizz. 0 c.l.b. 0 pizz.

c.l.b. ————— pizz. c.l.b. h. pizz. pizz. <sup>0</sup> c.l.b. h. pizz. pizz.

**D**  
 c.l.b. ————— <sup>0</sup> pizz. <sup>0</sup> c.l.b. ————— <sup>0</sup> pizz. h. pizz.

Repeat Gs until all wind instruments have turned their PPG lights off, then increase note length to 4 beats.

Repeat until the harp player has turned their PPG light off, then stop playing immediately and turn PPG light off.

*ppp*

PPG light off