Le dialogue entre synchronie et désynchronie à de multiples échelles temporelles:
des interactions sensorimotrices à la créativité collective

Julien Laroche, Italian Institute of Technology (CTNSC, Ferrara, Italia)

ISTITUTO ITALIANO
DI TECNOLOGIA

Euromov Seminar – 02/05/2024

Le dialogue entre synchronie et désynchronie à de multiples échelles temporelles: des interactions sensorimotrices à la créativité collective

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Embodiment of intersubjective time: relational dynamics as attractors in the temporal coordination of interpersonal behaviors and experiences

May, 2014

Julien Laroche,[1,2,*] Anna Maria Berardi,[2] and Eric Brangier[2]

De-sync: Disruption of Synchronization as a Key Factor in Individual and

May, 2024

Collective Creative Processes Laroche, Bachrach & Noy (*accepted*, BMC Neurosciences)

ISTITUTO ITALIANO DI TECNOLOGIA
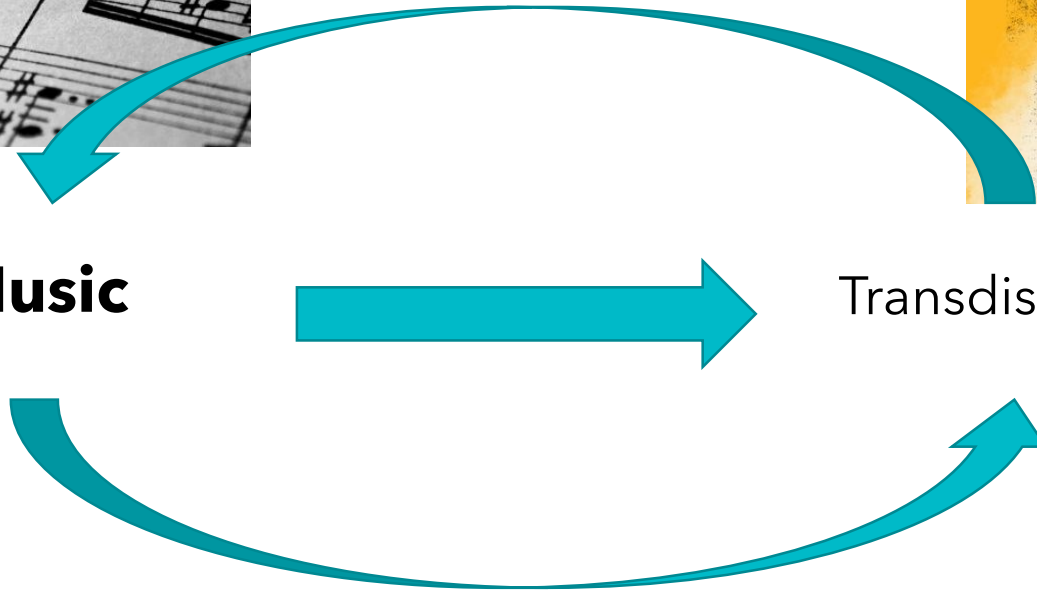
@UniFe

Doing & Knowing

Music → Transdisciplinary **Sciences**

Doing & Knowing

Perception

1st person experience ⟷ 3rd person observation

Action

From anecdotical musical insights to experimental psychology
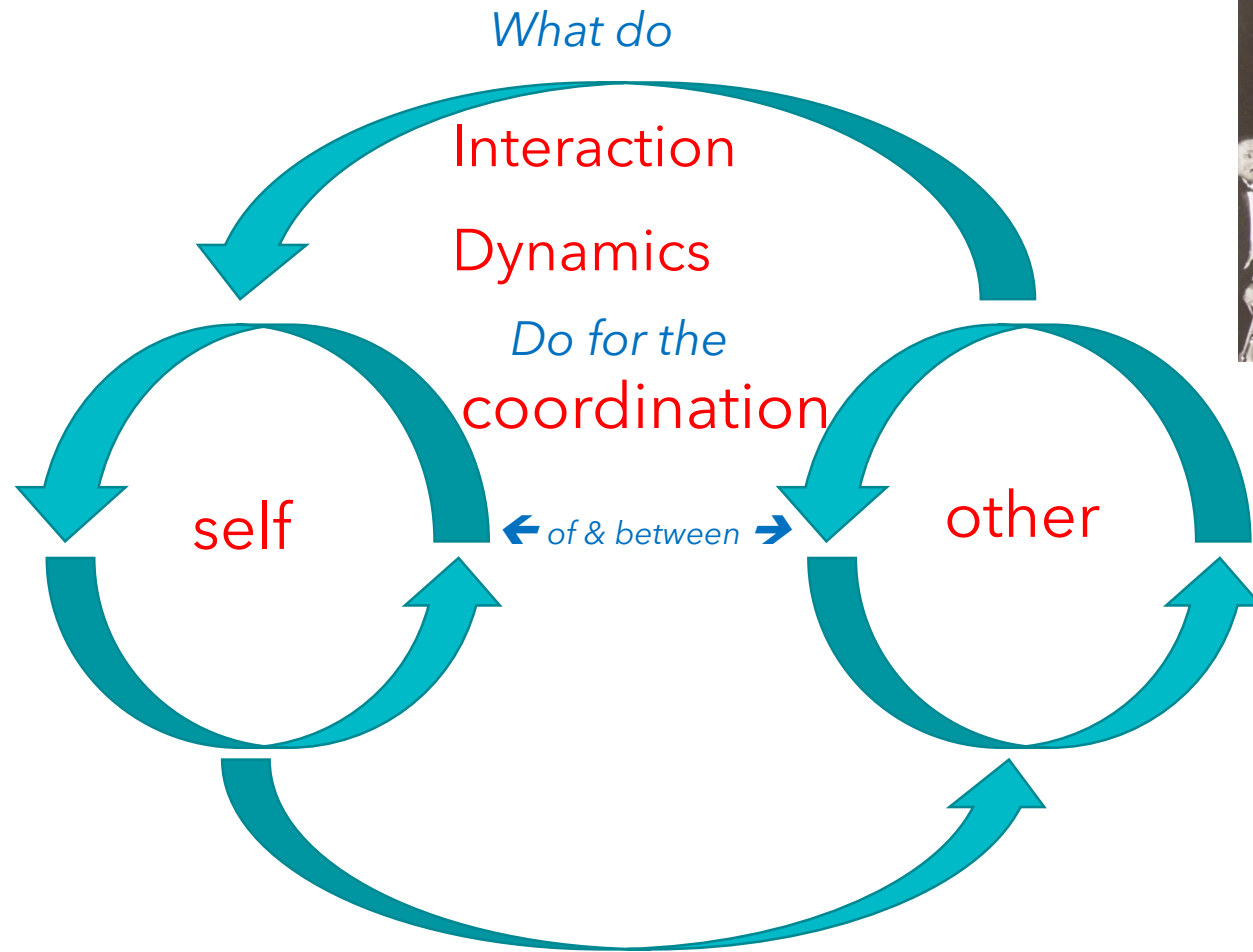
Time is multiscale, and scales are inter-related

Agency is distributed - e.g., when a group collapses

Rhythmic stability emerges from the reciprocal interactions between fluctuating components
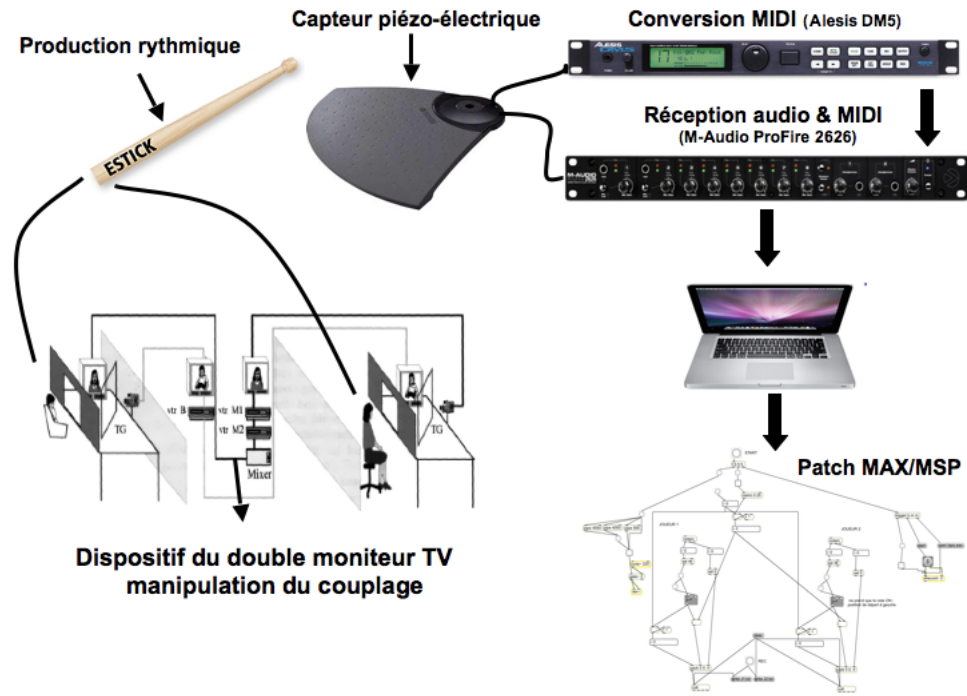
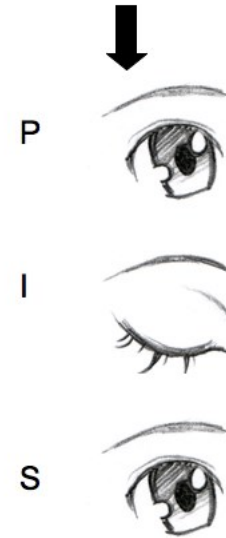# Multiscale multi-agent coordination

Thèse (2009-2013) --> Entimement (2019-2023)

What do

Interaction

Dynamics

Do for the

coordination

self ← *of & between* → other

Your body, my body, our coupling moves our bodies

Guillaume Dumas [1], Julien Laroche [2], Alexandre Lehmann [3]   *2014*

Share Pace
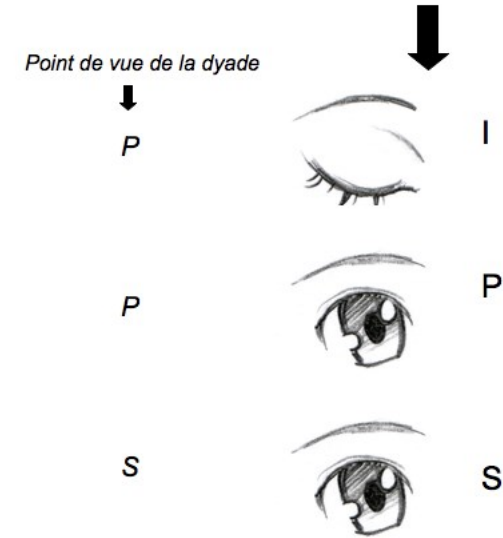
Laroche et al. (*in prep « for next year » since 2011*)

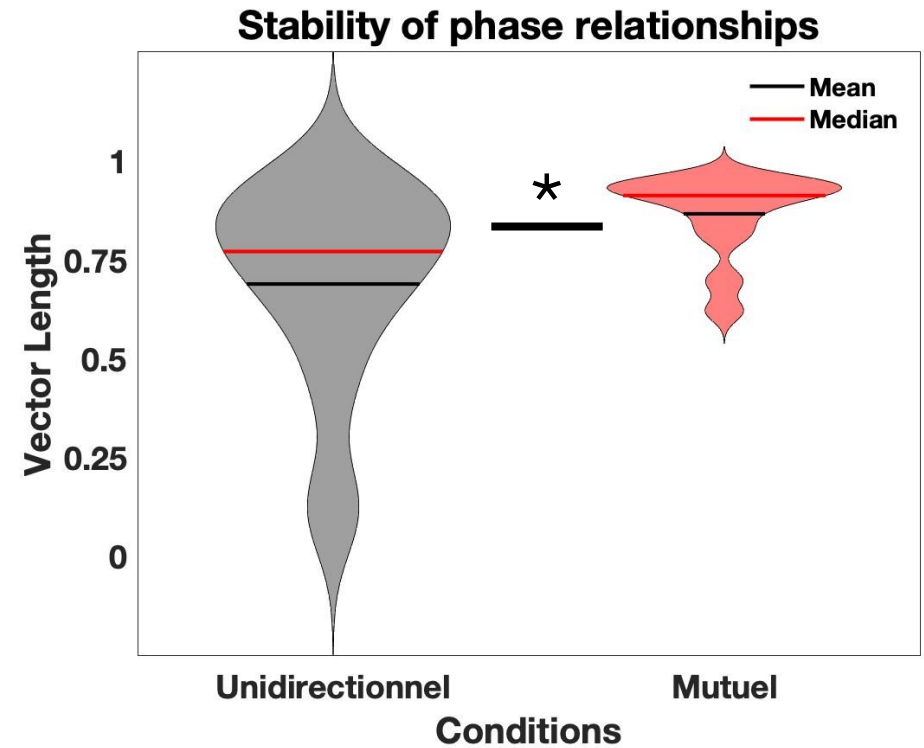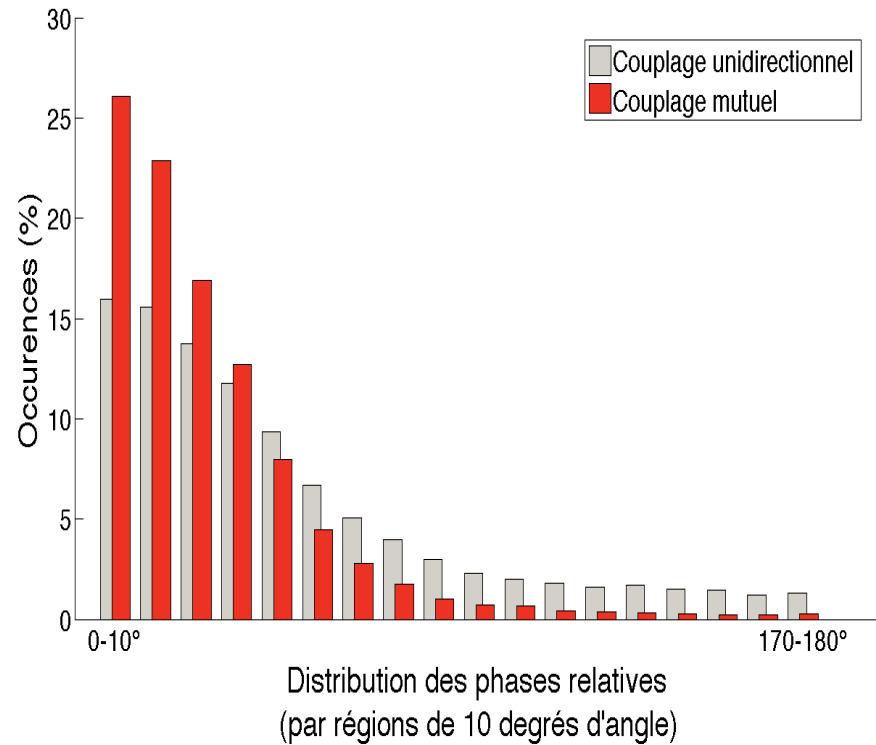I = Individuel / solo

P = pseudo-interaction / uidirectionnel

S = social / mutuel

Individual *stability* (short term)
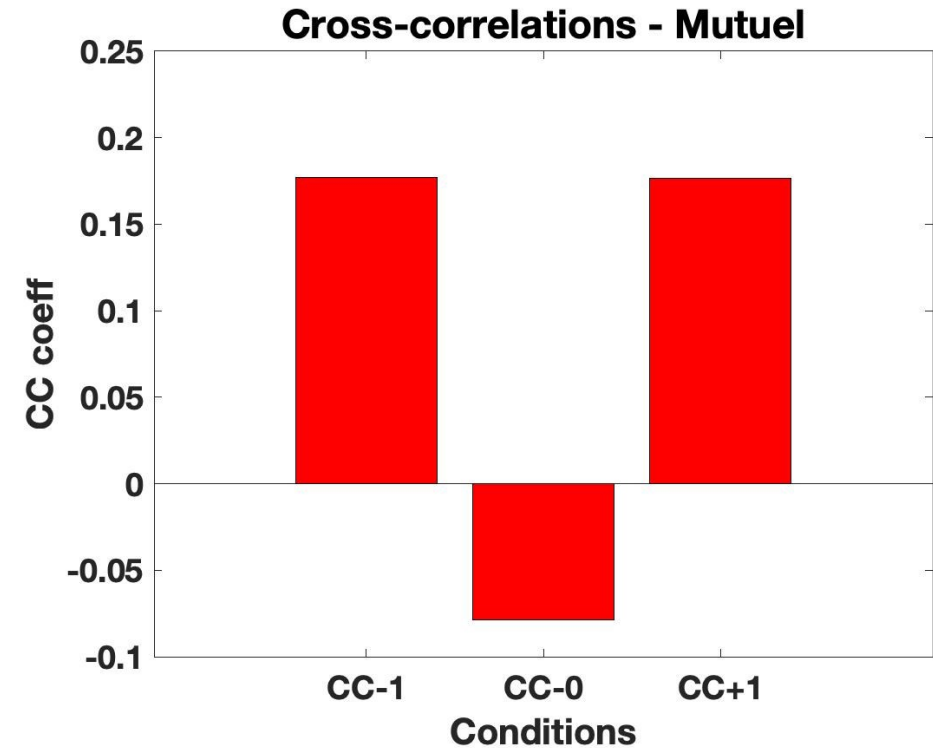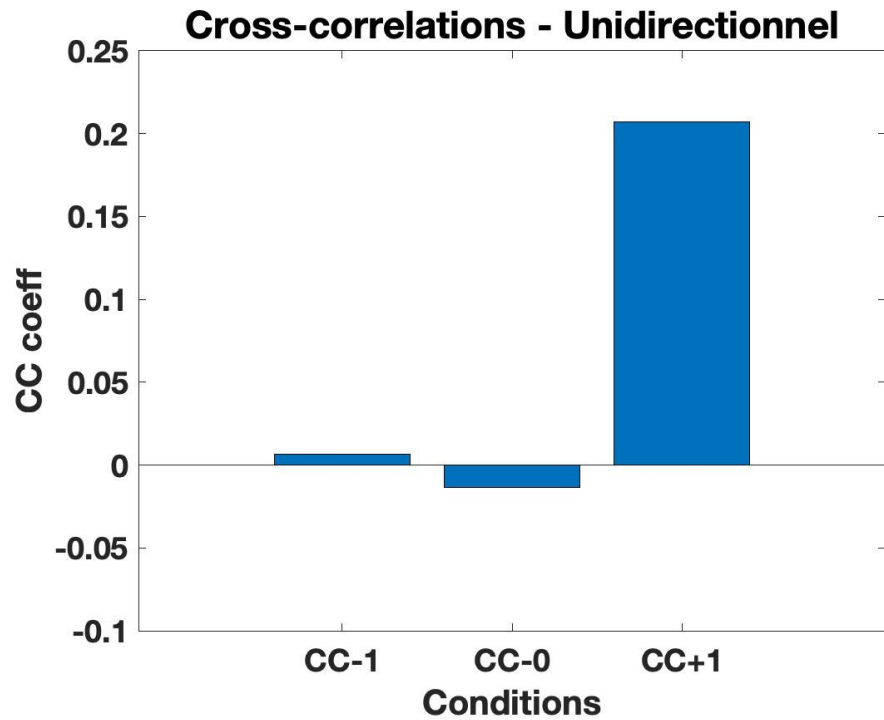

Local variance of tempo
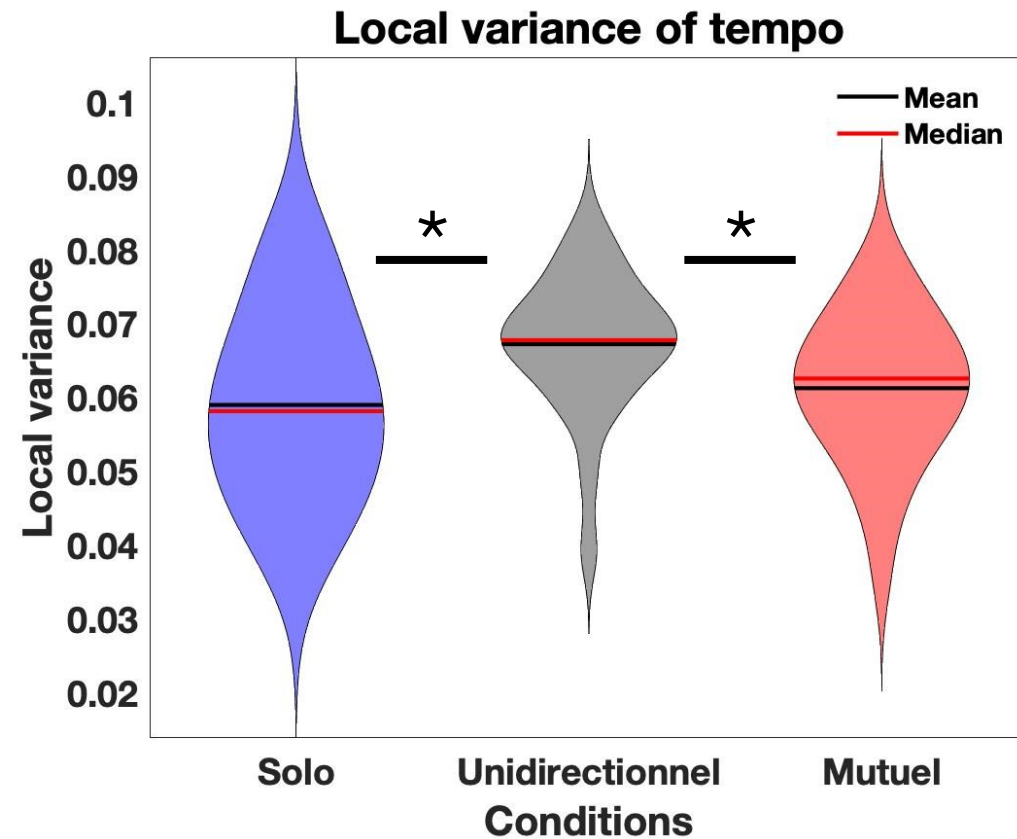
Interacting mutually has no cost !

Collective Stability

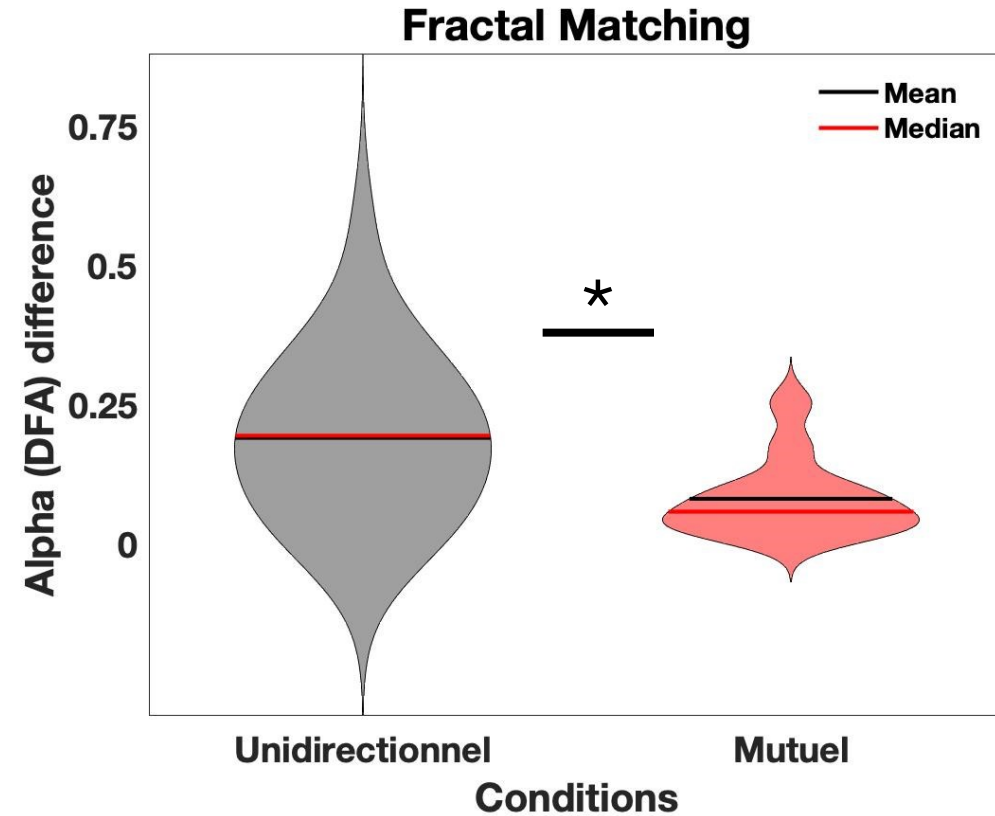
Mutual interactions = more synced (accuracy and stability)

Short term cross-correlations

Tracking the other at lag +1,

Slightly opposite velocities at lag-0

Long term correlations matching
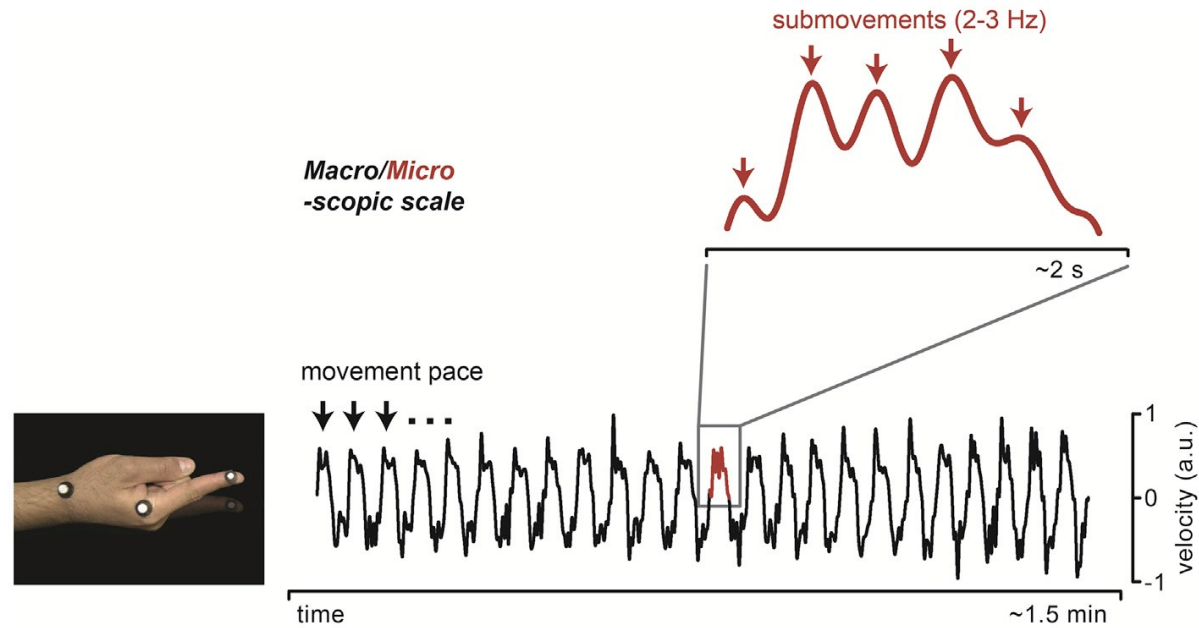
Alpha moyen = 0.78

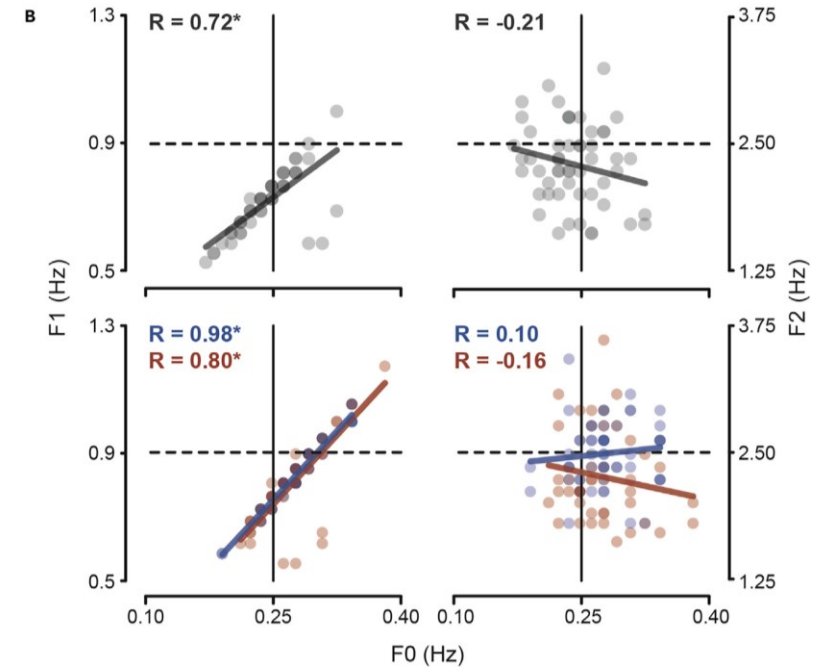
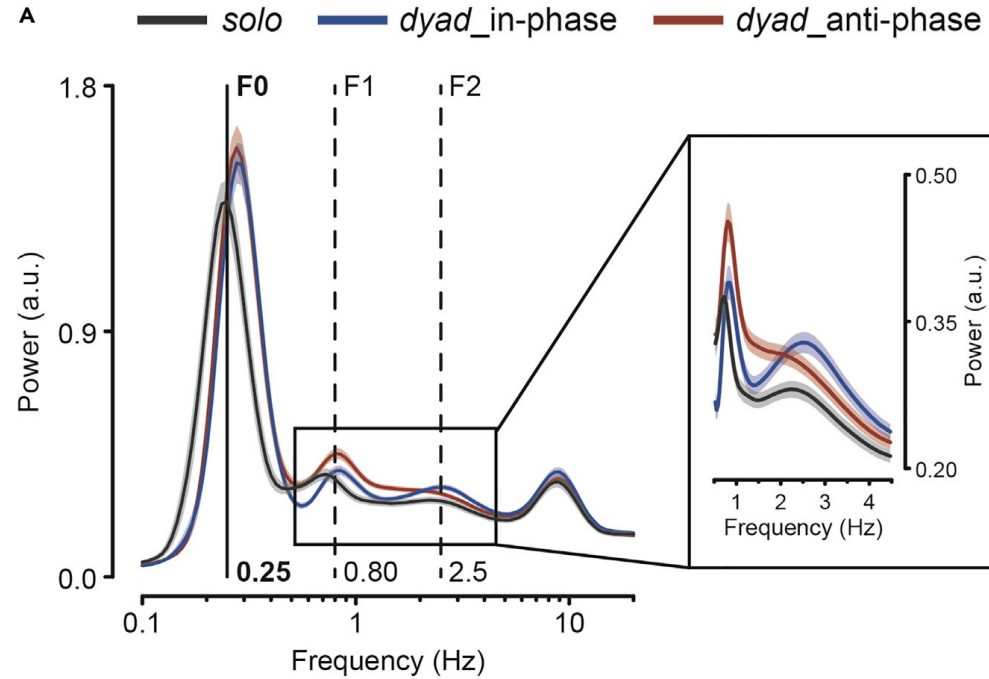Mutual = more complexity matching

Take home

Mutuality = **more** (collective & positive **effects**) for **less** (individual) **efforts** + **multiscale / complex** coordination

Submovement coordination

Movements are made of smaller sensorimotor units: submovements
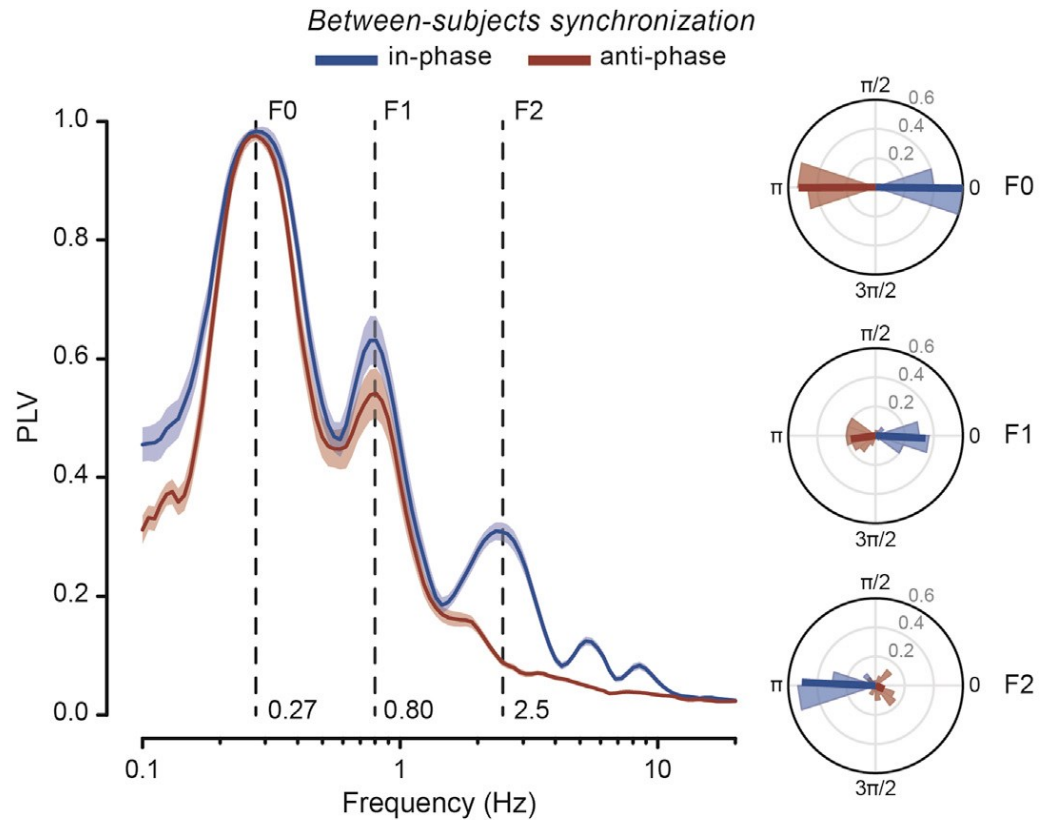
Submovements coordination

Slowing down the pace of movement eases the observation of their periodicity
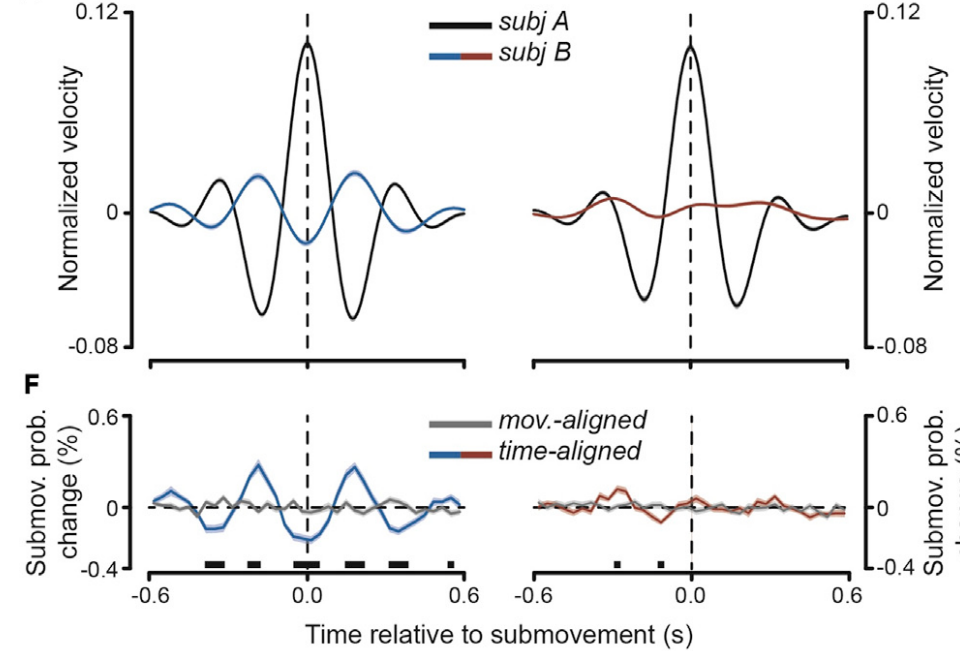
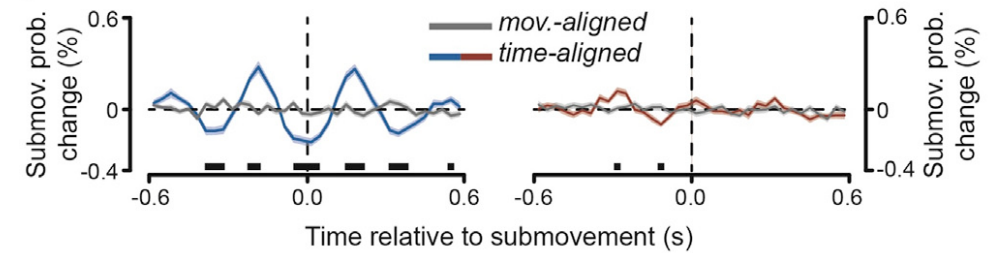Interpersonal synchronization
of movement intermittency

Alice Tomassini,[1,4,*] Julien Laroche,[1] Marco Emanuele,[1,2] Giovanni Nazzaro,[1,2] Nicola Petrone,[2]
Luciano Fadiga,[1,2,3] and Alessandro D'Ausilio[1,2,3]
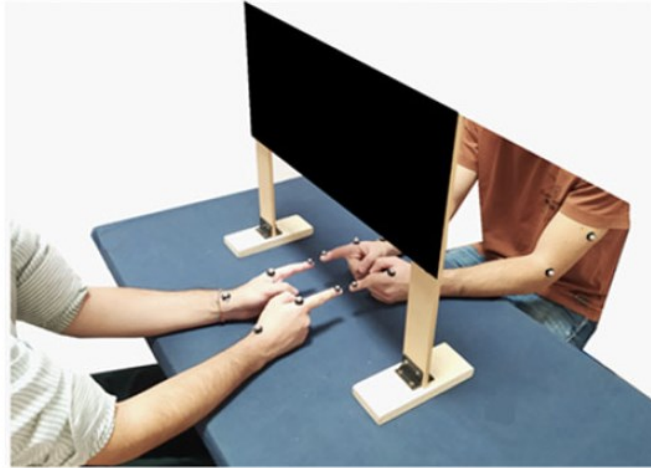
Submovements coordination

When 2 people coordinate (slow) movements in phase, they also coordinate their submovements.. in anti-phase
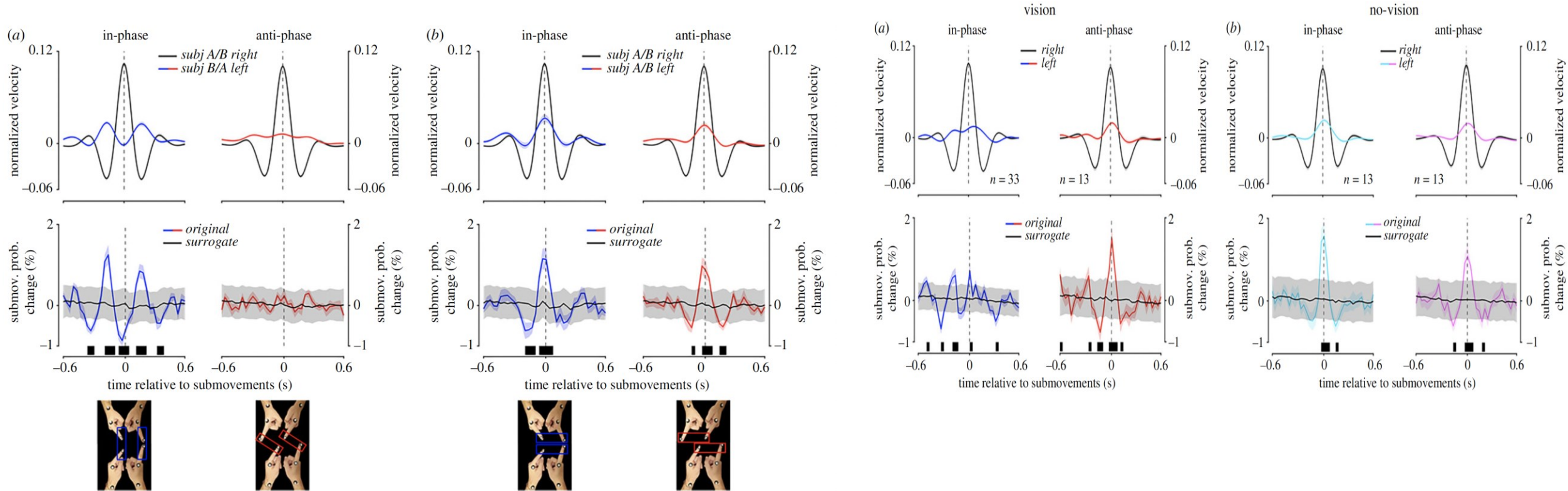
Submovements coordination

task

(a) dyadic

(c) solo

What about intrapersonal submovement coordination ?

Submovements coordination

Own submovements are coordinated in phase in solo without vision or when interacting with an Other. In solo with vision: mixed patterns (in & anti-phase)

Anti-phase patterns of submovements = vision-based motor coordination by intermittent correction. In-phase patterns = motor control of one's individual effectors not based on visual feedback.
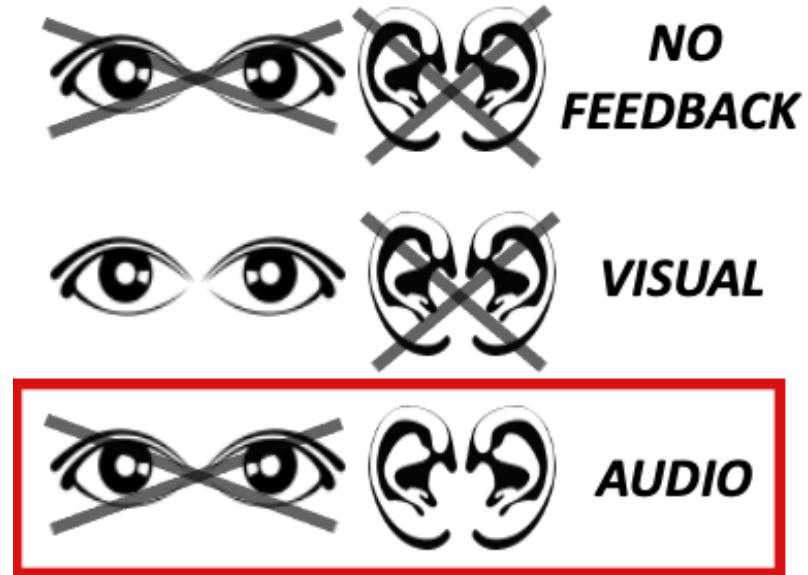
Audiomotor submovements coordination

40.2 cm

Is submovement coordination a consequence of visuo-motor processes ? Or is it a domain-general feature ?
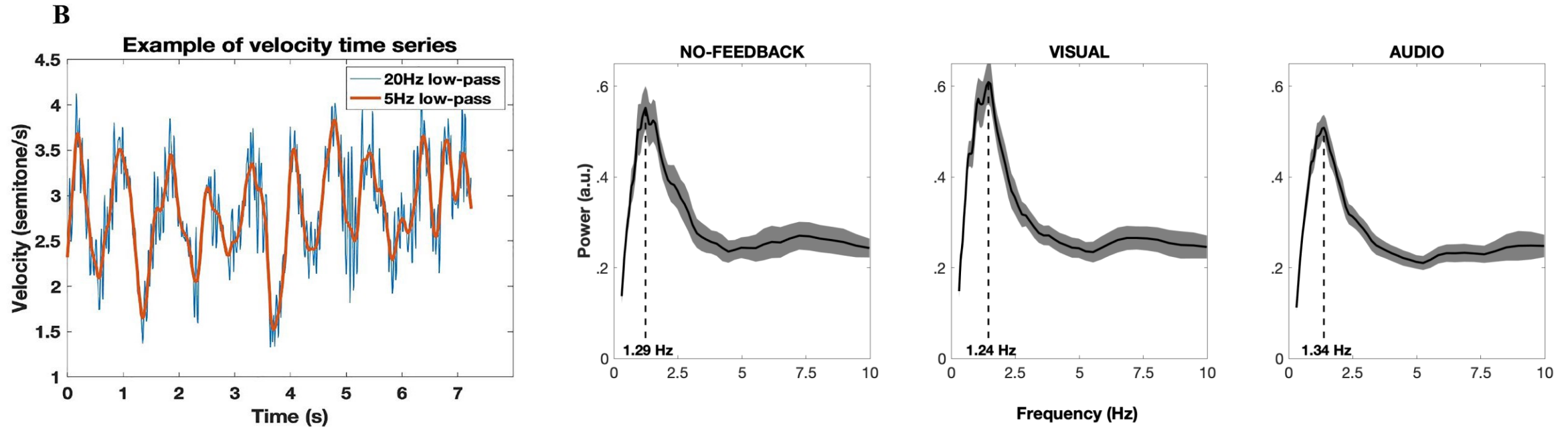
Let's try with audiomotor control..

Submovements across modalities

MODALITY

But first.. are submovement properties modality-specific at all ?
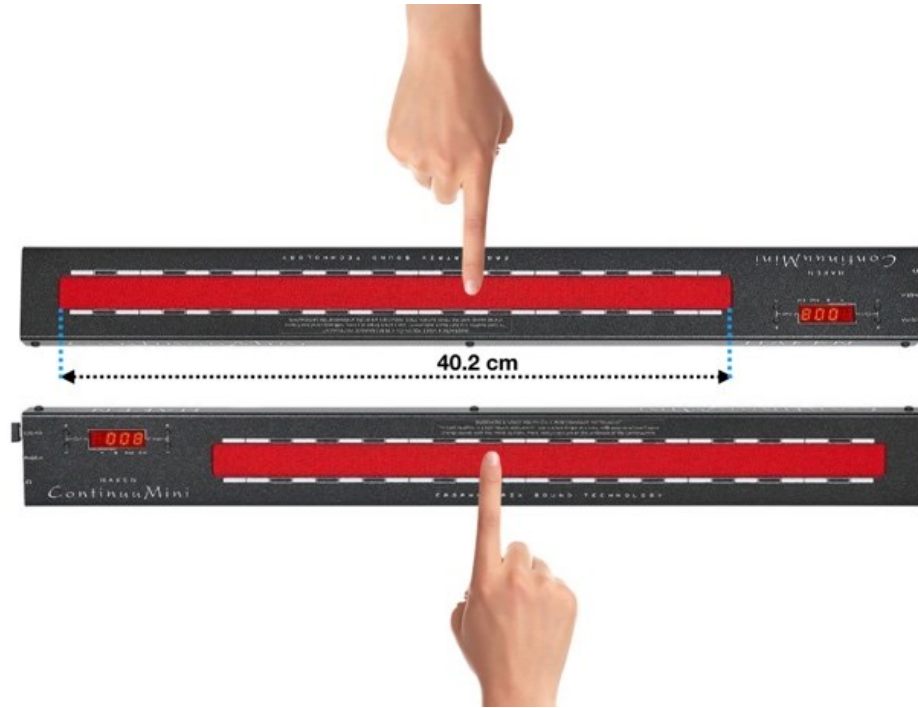
Audiomotor submovements coordination

Submovements appear clearly in audiomotor control

But they are not modality specific at all (or specific to task constraints)
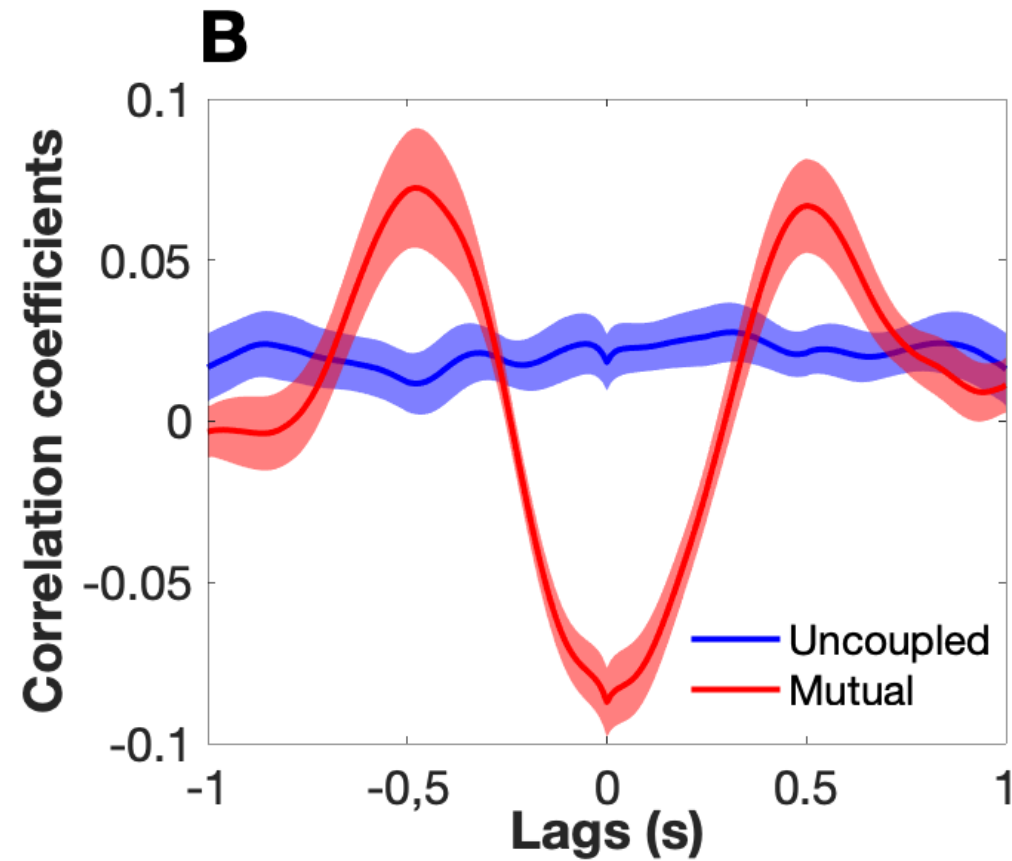
Audiomotor submovements
Interpersonal coordination
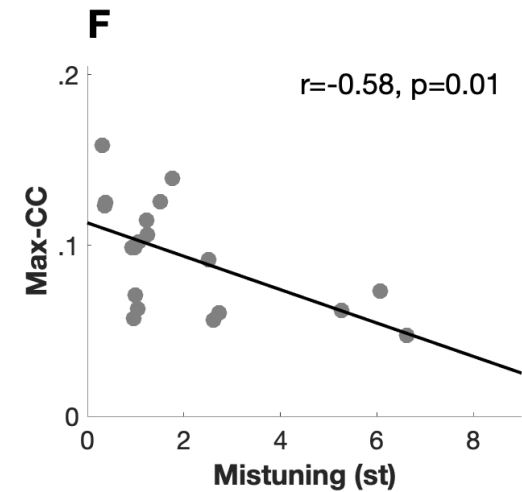
40.2 cm
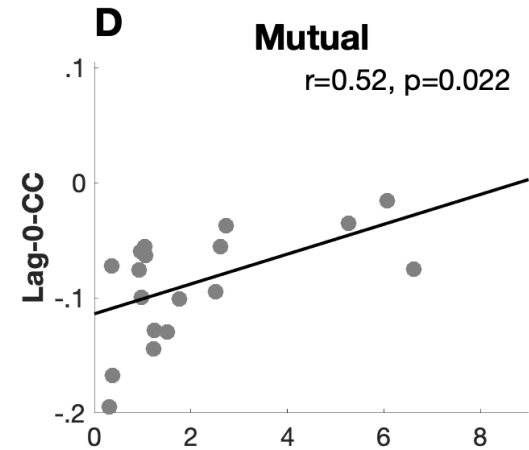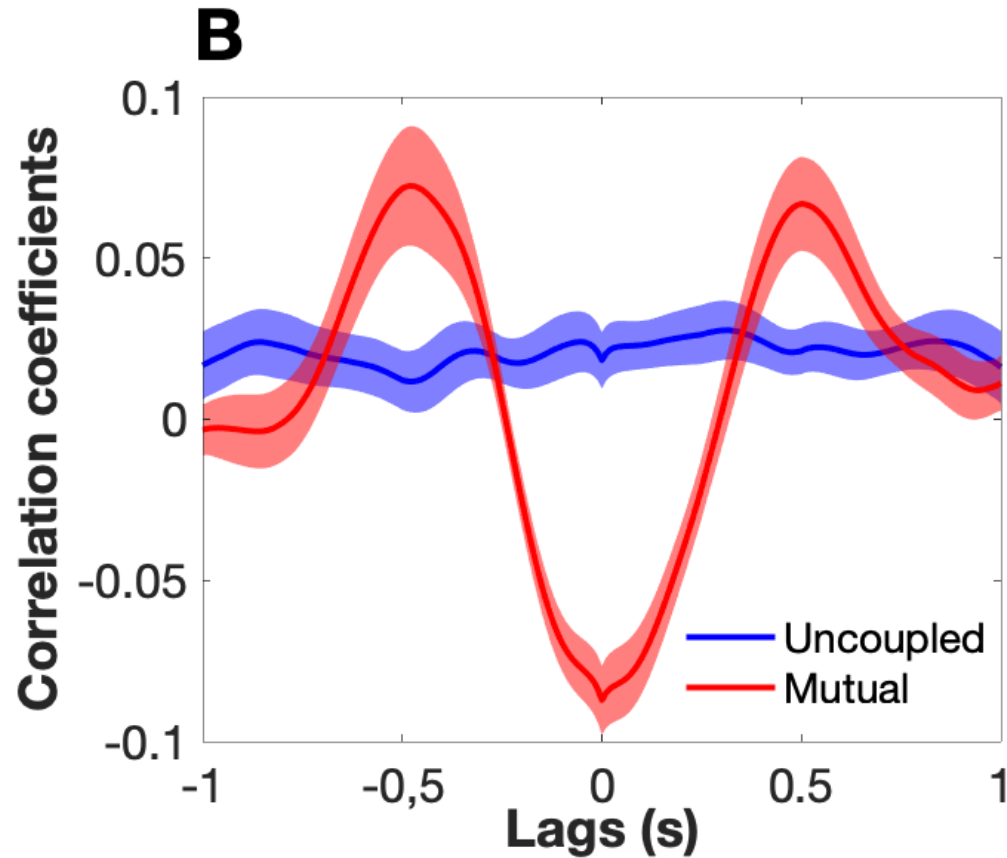
Can't transpose from visual to auditory..

novel task: stabilizing the feedback of the relation itself

Audiomotor submovements coordination

Anti-phase submovement coordination across persons

Audiomotor submovements coordination

Anti-phase submovement coordination across persons

The more pronounced the submovement pattern, the more in tune they were at the movement level

Sensorimotor coordination in the jazz studio

The art of participatory time making

And the practice of the dialectic between sync & desync

Sensorimotor coordination in the jazz studio

Evans (2011), Gratier et al. (2017), Laroche et al. (*in prep*)

Sensorimotor coordination in the jazz studio

Evans (2011), Gratier et al. (2017), Laroche et al. (*in prep*)

	DRUM	BASS	
TAKE 1	☠️	❤️	Dreamy vs Tempo wandering + errors
TAKE 2	❤️	☠️	Tight vs not finding each other
TAKE 3	☠️	☠️	Tense
TAKE 4	❤️	❤️	YES

Tense discussion on the relational timing between bass and drum: verbal then musical negotiation
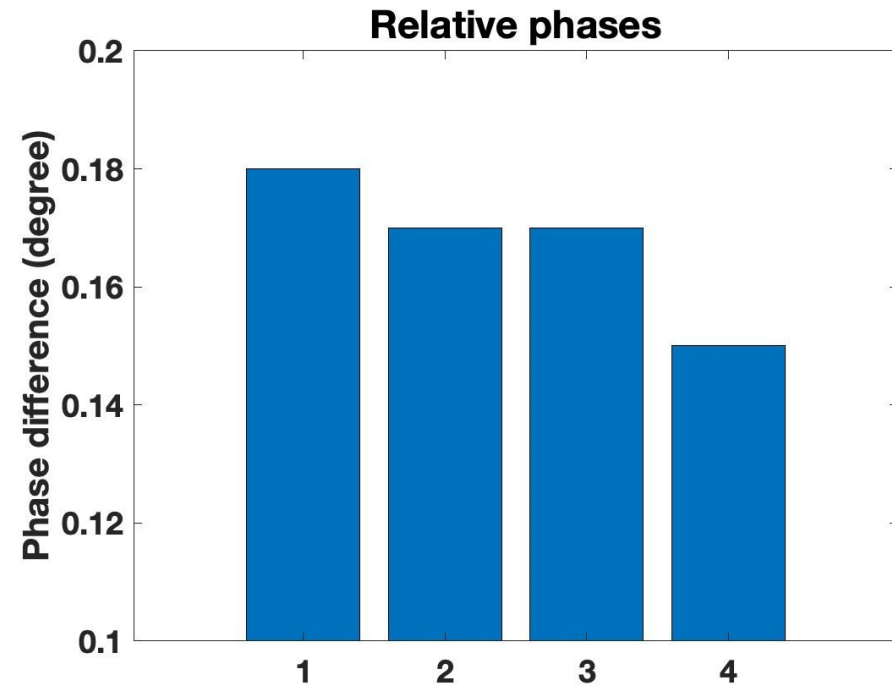
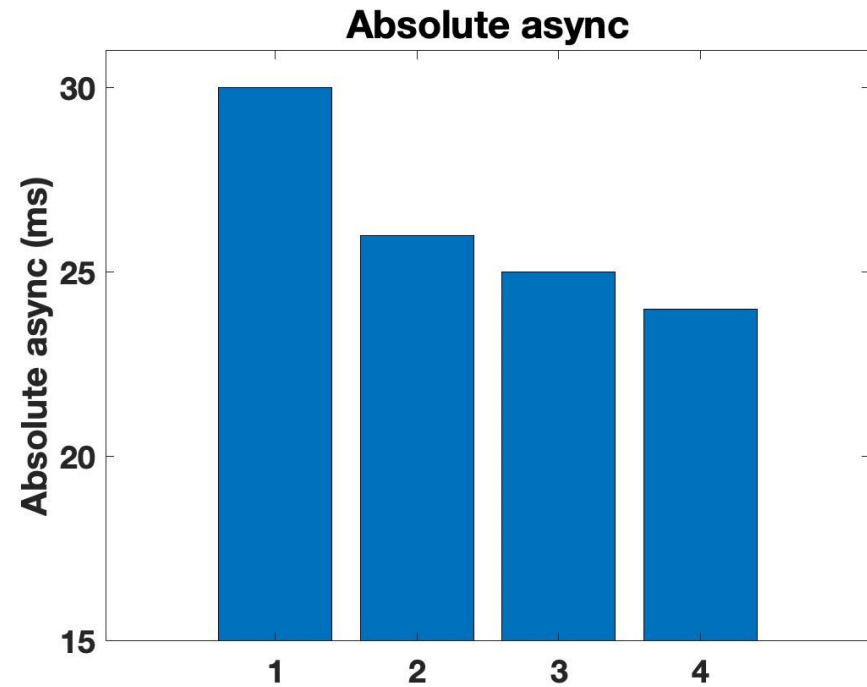# Gobal tempo fluctuations
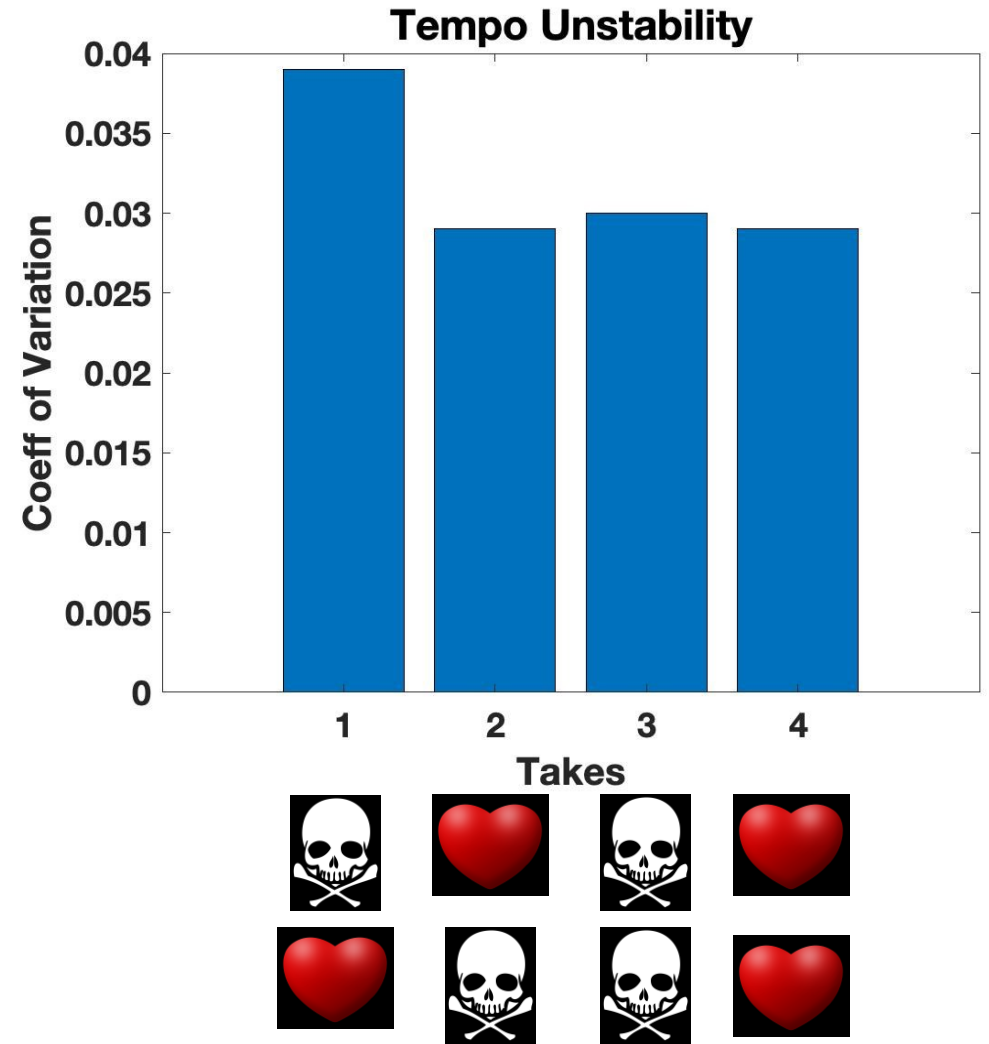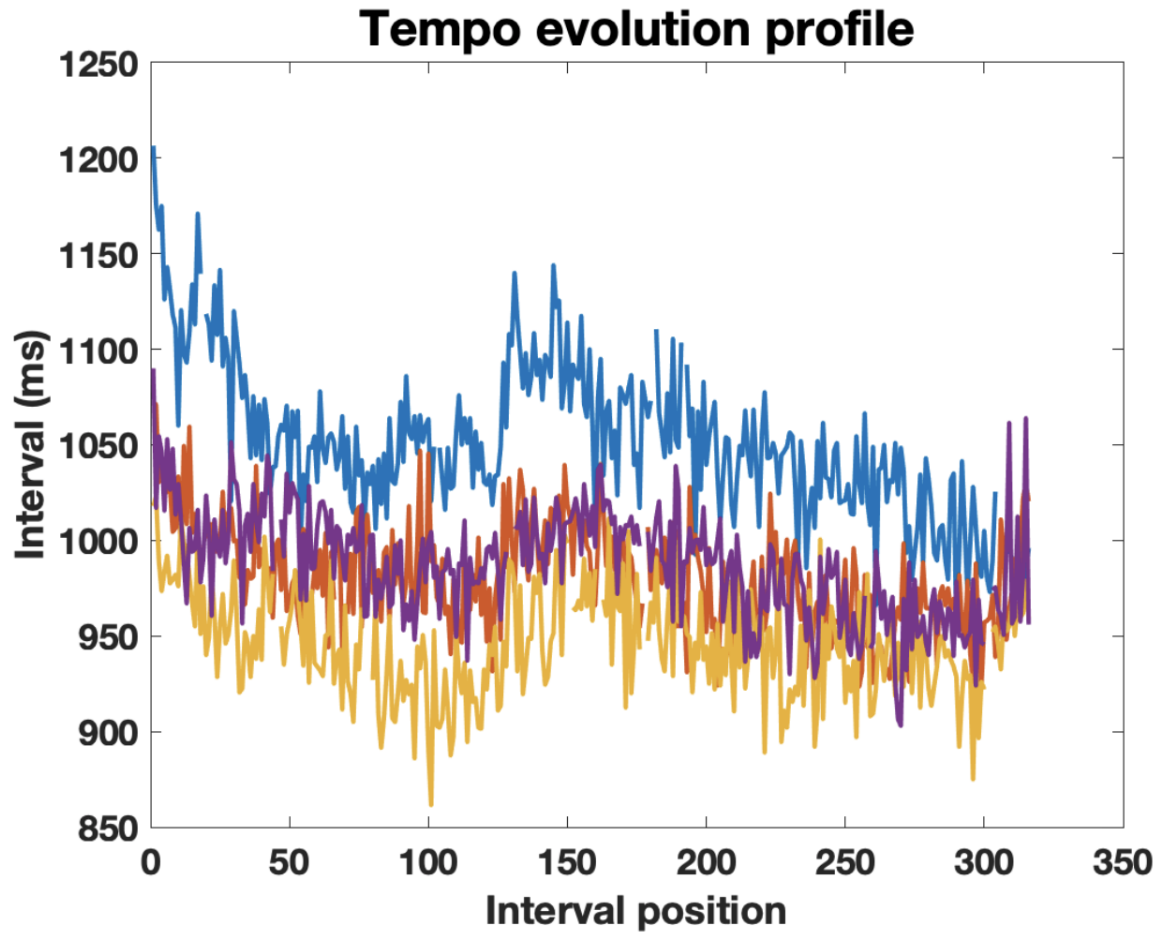
Take 1 = more global fluctuations indeed

Local + cross-scale tempo fluctuations
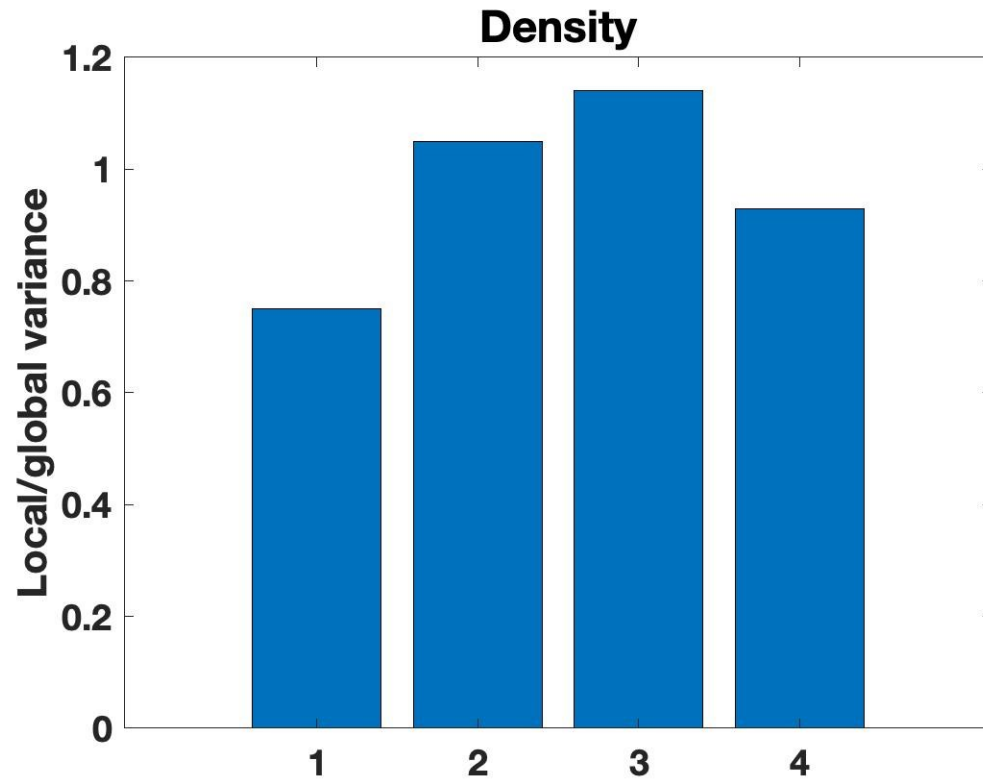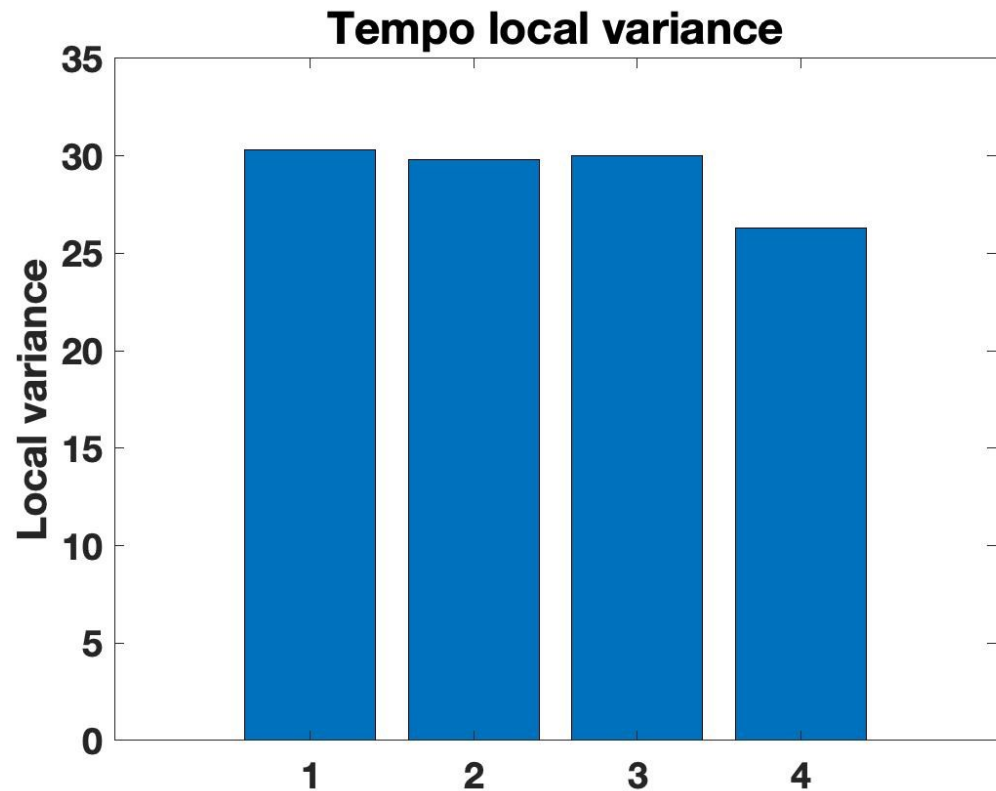
Take 1 fluctuations timing lives in the long term,

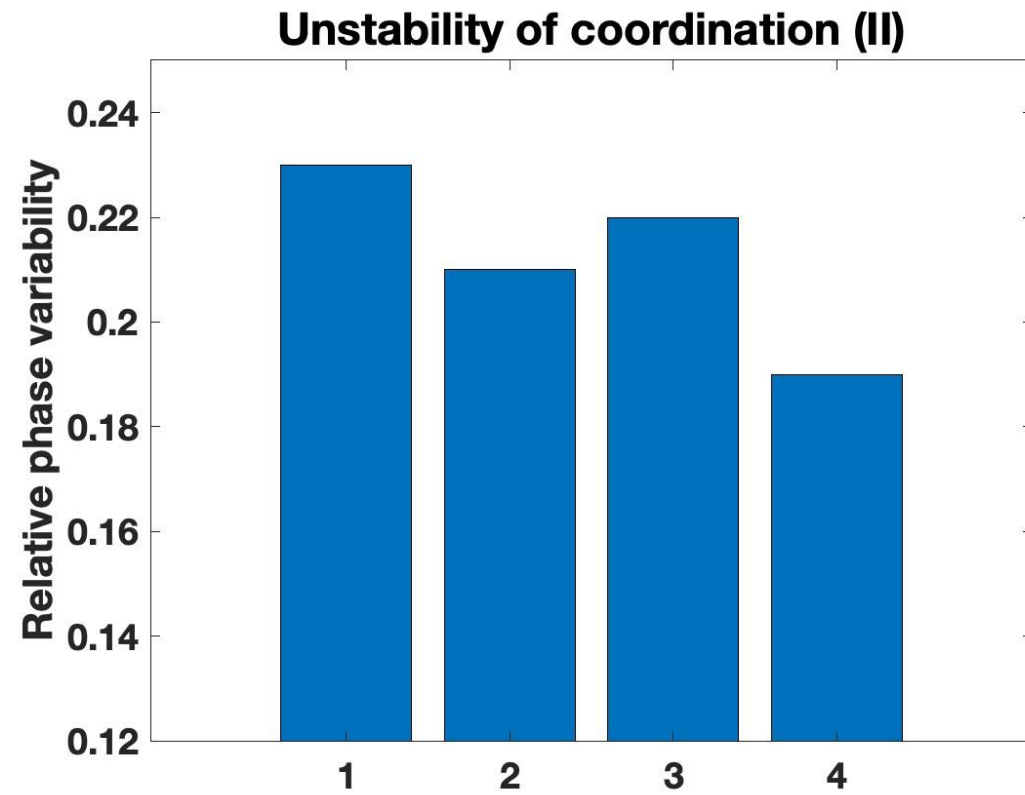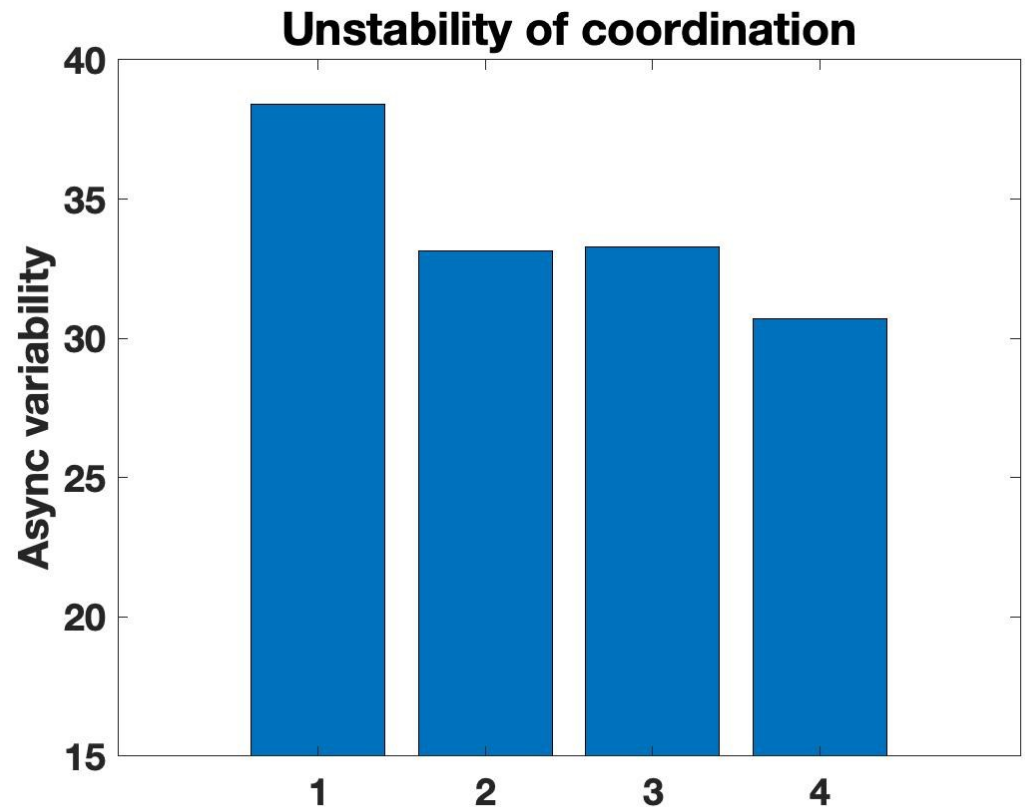Take 3 in the short term, take 4 in the in between
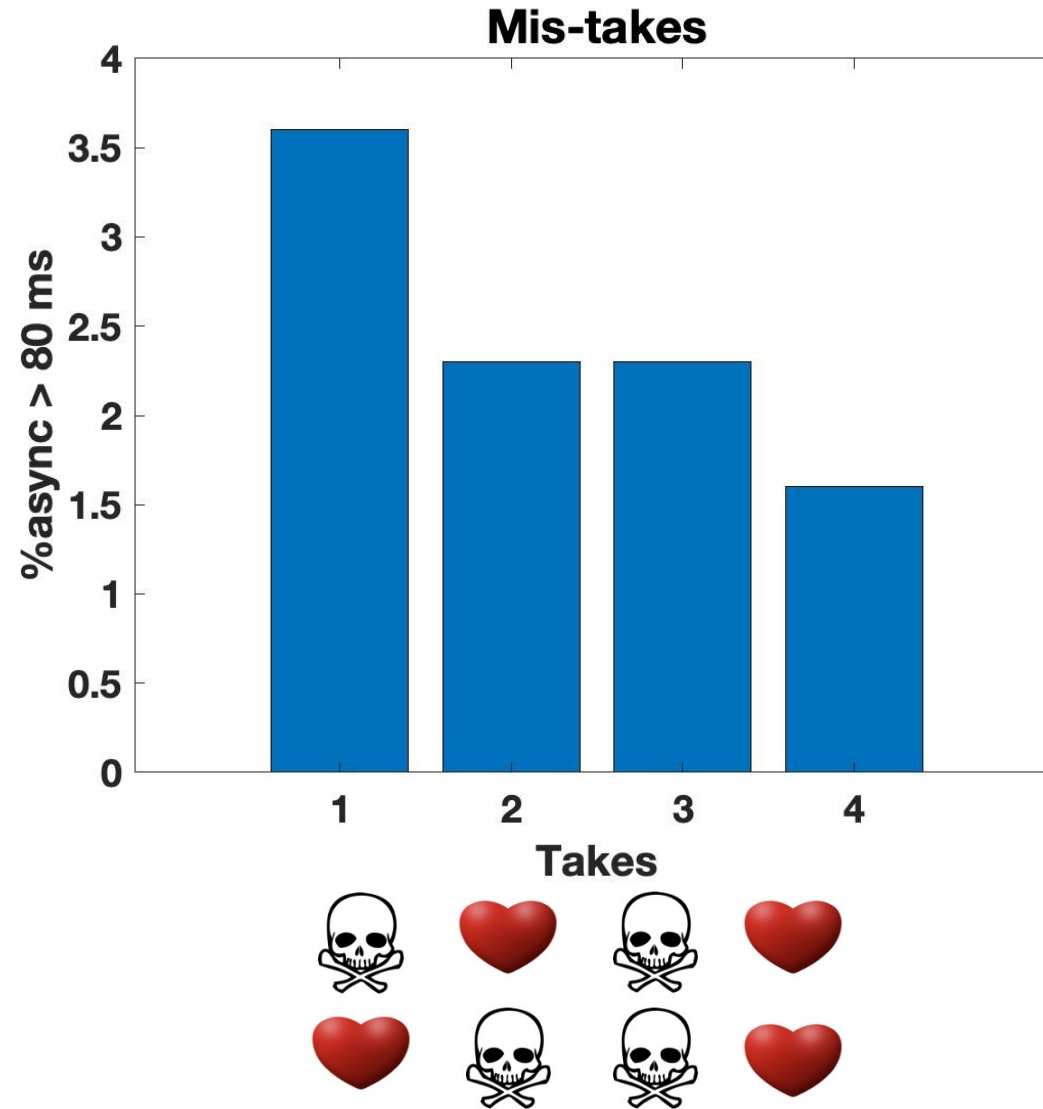
Degree of synchronicity (beat level)

Absolute async

Absolute async (ms) — Takes

Relative phases

Phase difference (degree) — Takes

Take 1 is less synchronized

(This is what the bass player like – and the drummer hates)
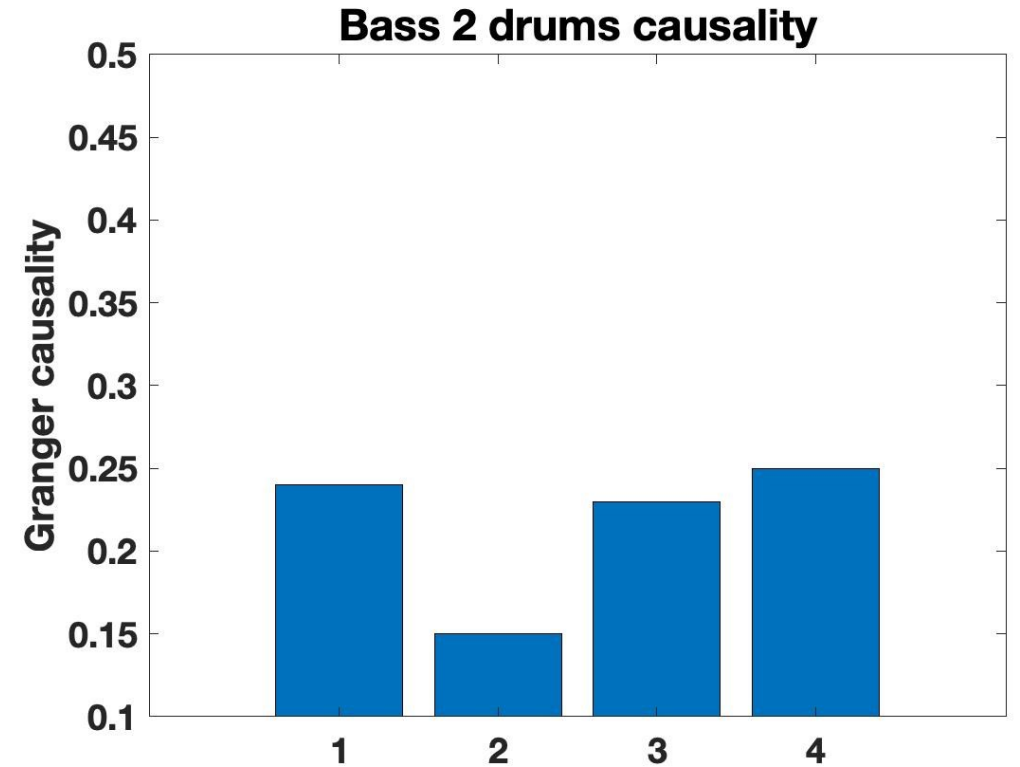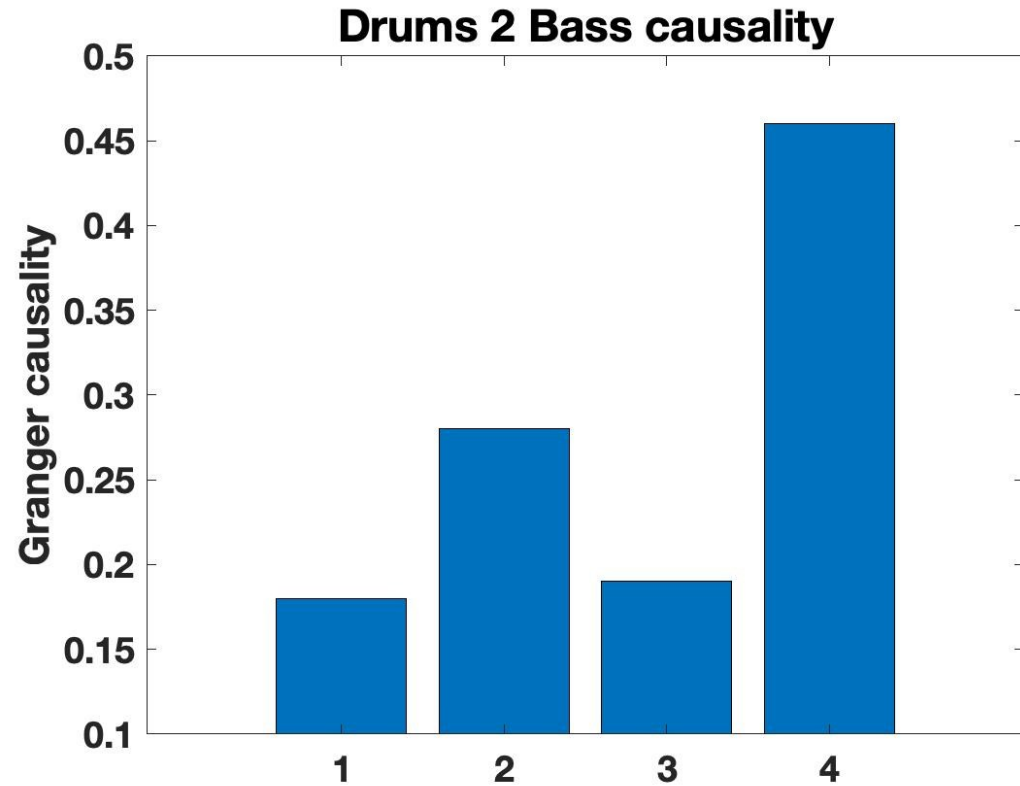
Beat coordination stability

Take 1 is less stable (take 4 a bit more ?)

Amount of mistakes

Mis-takes

%async > 80 ms vs Takes

More in take 1, les in tke 4

Influences between players

Drums 2 Bass causality

Bass 2 drums causality
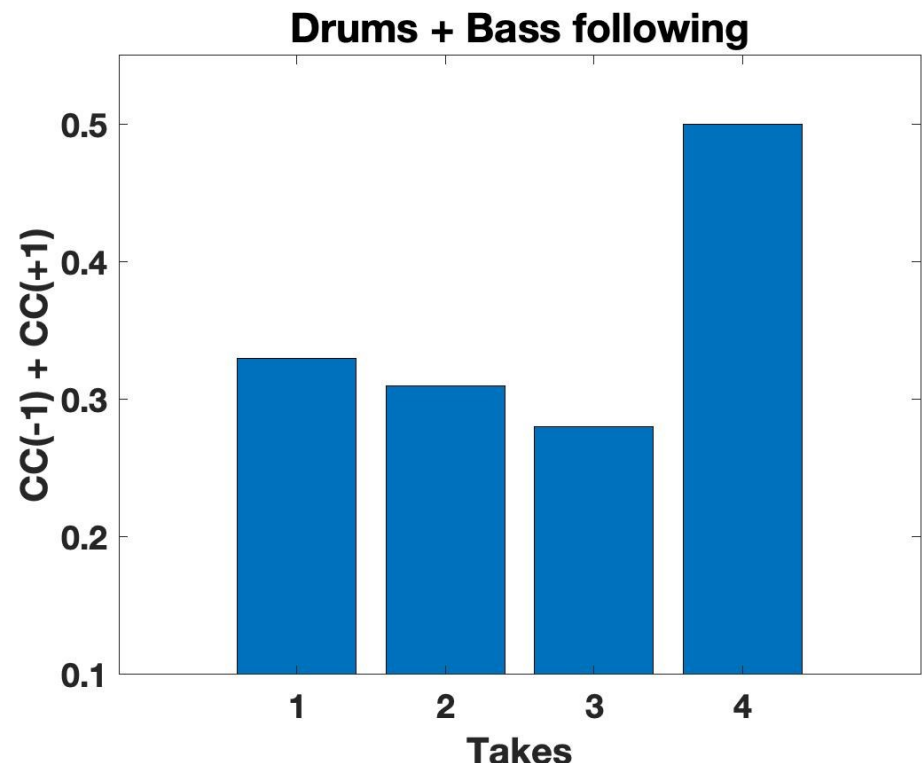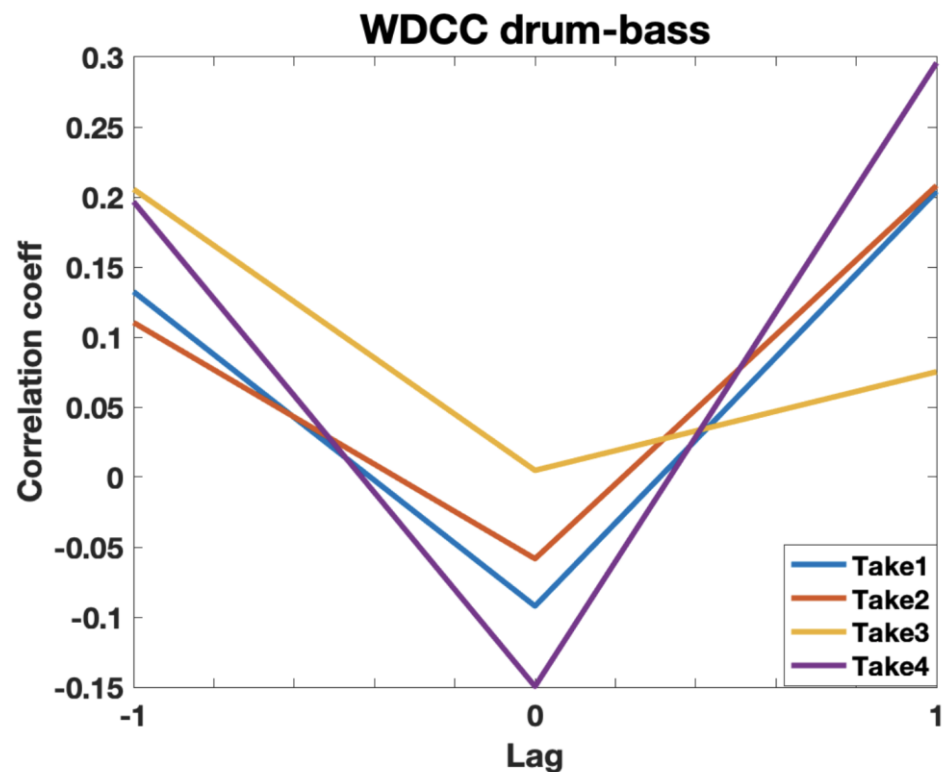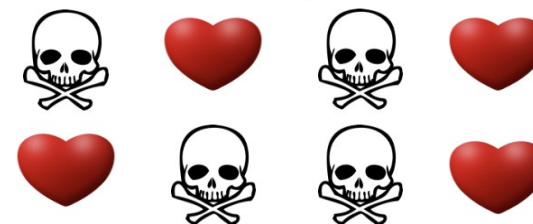
Drummer likes to be followed

Bass player does not like not being followed

Listening / following each other

Drums <- Follow -> Bass

Overall, way more following in take 4, and more negative correlation in real-time

Take (5) home

Synchrony, as a product, (unsurprisingly) matters

But

Synchronization, as a process, matters even more

De-sync and entropy: resources, not problems !

Creativity

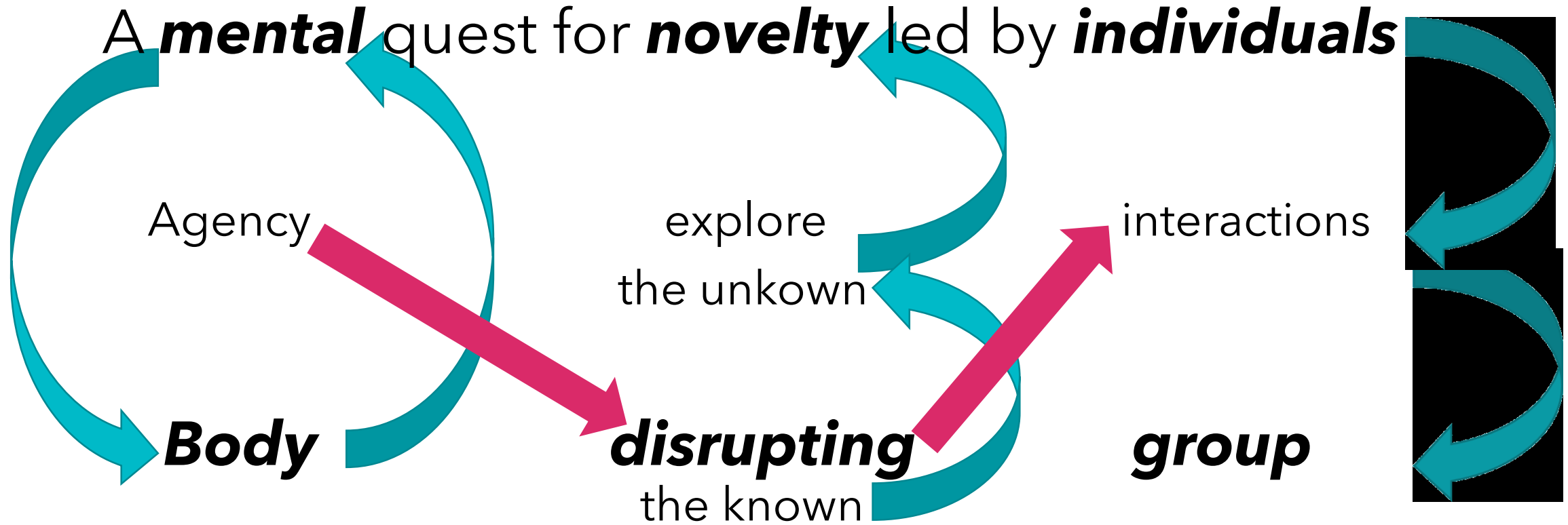## A *mental* quest for *novelty* led by *individuals* ?

Redefining creativity

A *mental* quest for *novelty* led by *individuals*

Agency

explore the unkown

interactions

Body

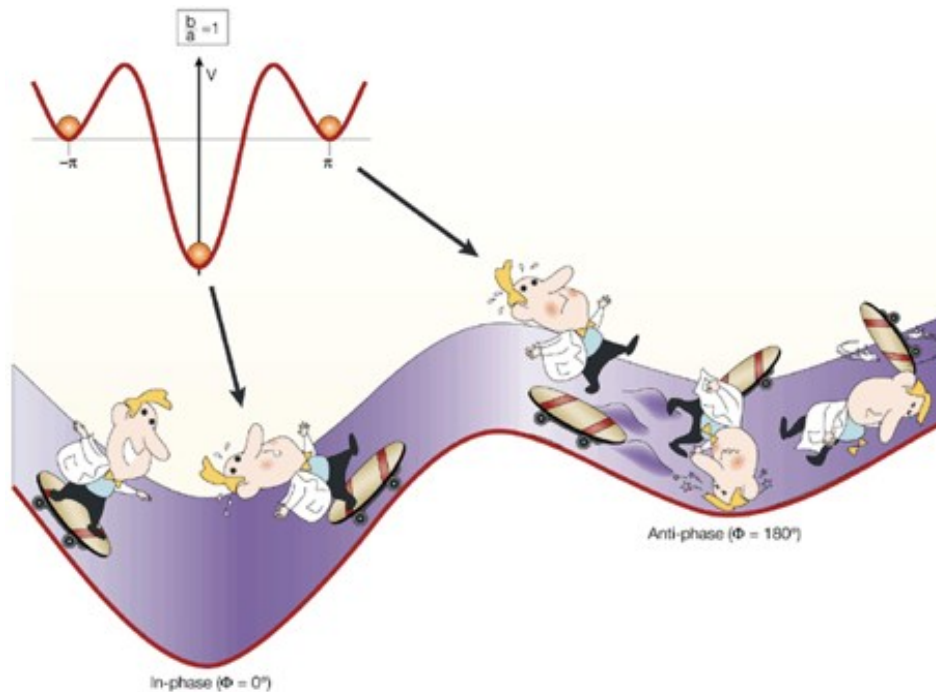**disrupting** the known

group

The exploitation of uncertainty by a group of agents though their embodied interactions

Established paths

Established paths

b/a = 1

In-phase (Φ = 0°)

Anti-phase (Φ = 180°)

Breaking away

b/a = 1

In-phase (Φ = 0°)

Anti-phase (Φ = 180°)
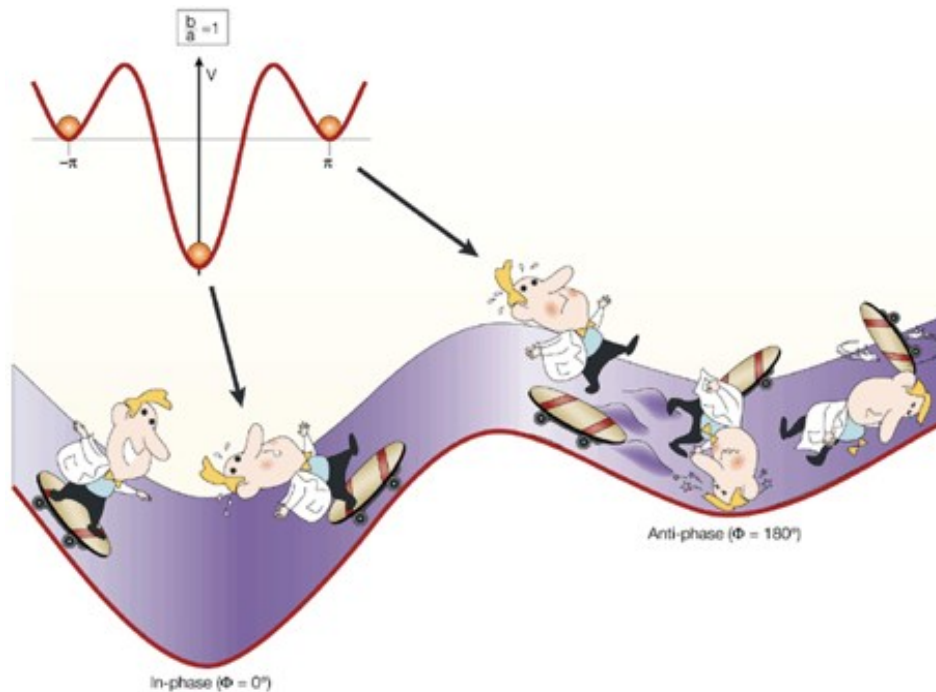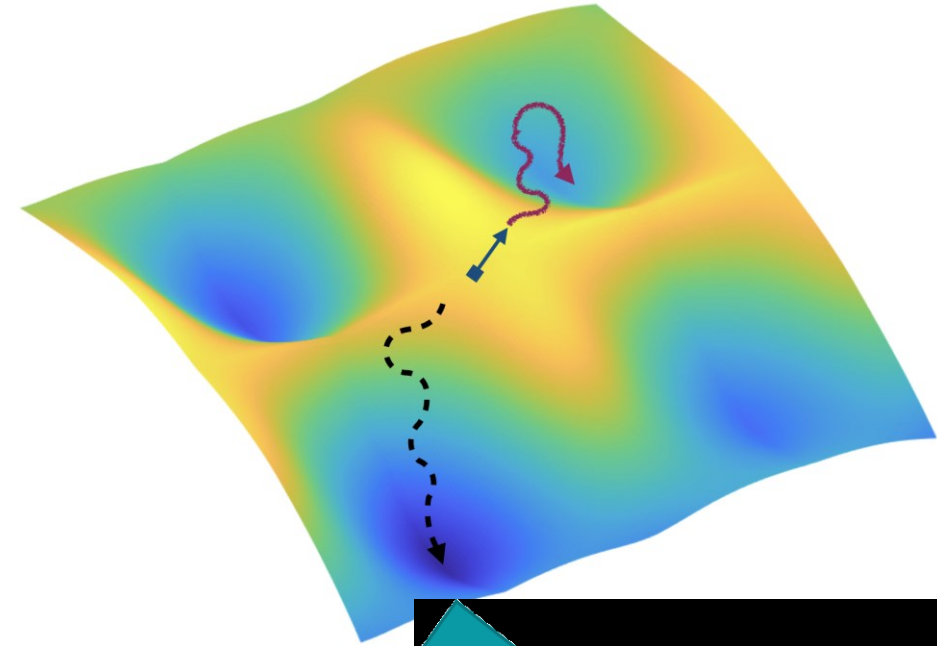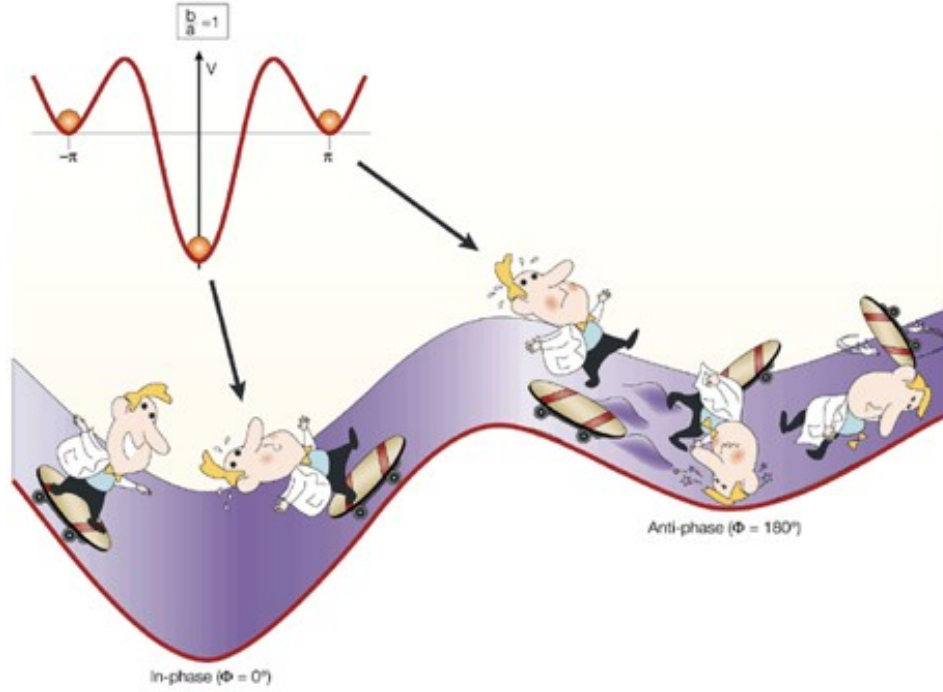
The traps of stability

Conjuring uncertainty
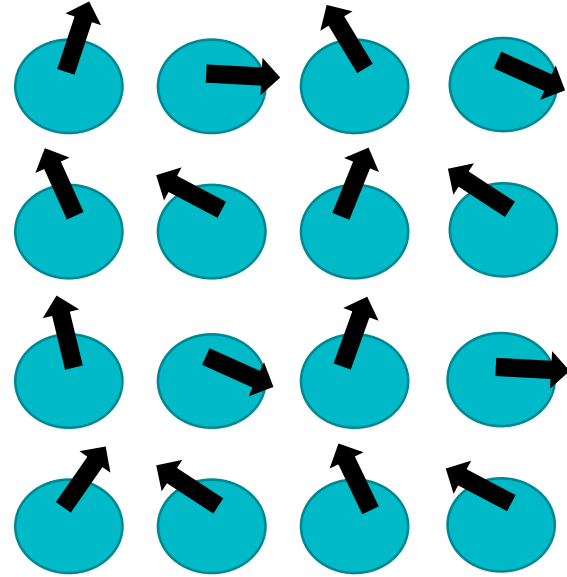
Creative reorganization
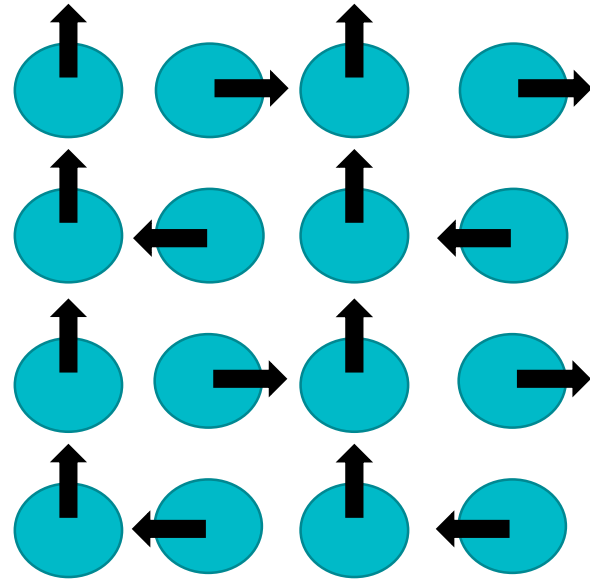
Agency & disruption in improvisation

To disrupt familiar paths

Høffding & Satne, 2021;

Ravn & Høffding, 2022

Agency & disruption in improvisation

To disrupt familiar paths

Let lose
on control

Høffding & Satne, 2021;

Ravn & Høffding, 2022

Agency & disruption in improvisation
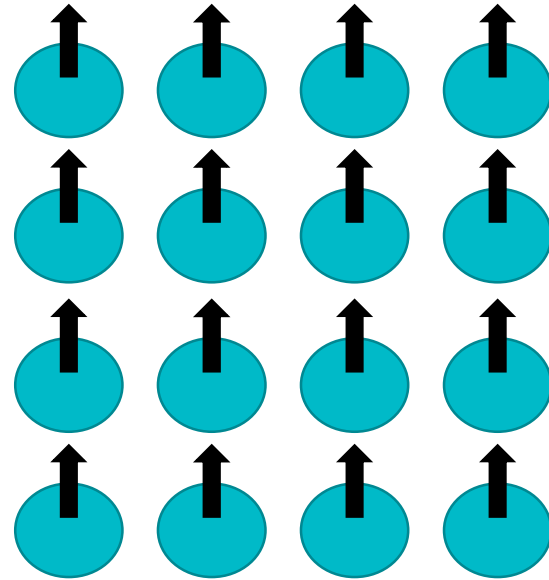
To disrupt familiar paths

Let lose

on control

Take it back creatively

Høffding & Satne, 2021;

Ravn & Høffding, 2022

Creative agency
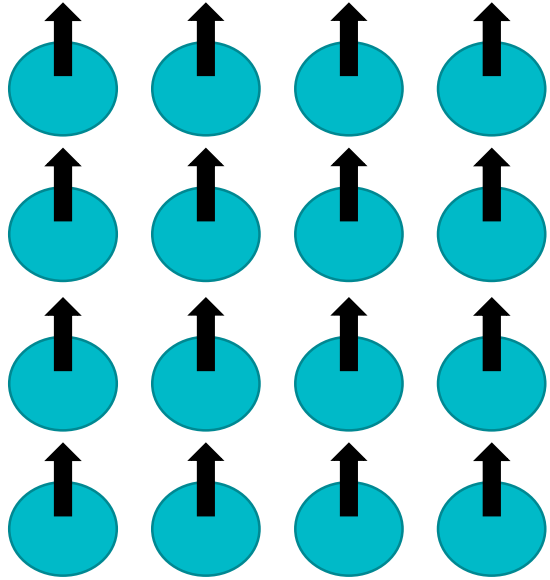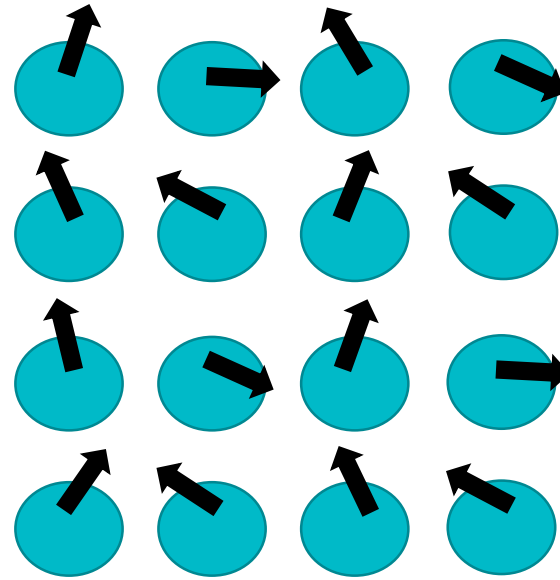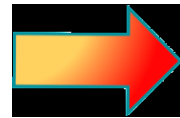
INTERACTION → **DISRUPTION** → **REORGANIZATION**

De-sync: Disruption of Synchronization as a Key Factor in Individual and Collective Creative Processes Laroche, Bachrach & Noy (*accepted*, BMC Neurosciences)

What's the plan ?? No Plan ?! Great plan !! *(Laroche et D'Ausilio, in prep)*

Creativity & learning in Music Improvisation

Kaddouch Music School

Spontaneous, established pattern

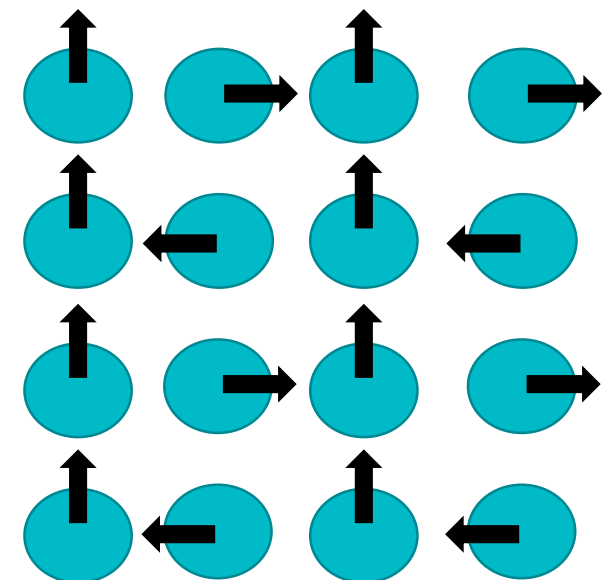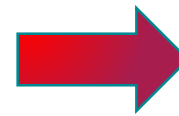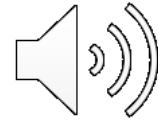**Enacting teaching and learning in the interaction process: "Keys" for developing skills in piano lessons through four-hand improvisations**

Julien Laroche, Ilan Kaddouch

Spontaneous preferences and core tastes: embodied musical personality and dynamics of interaction in a pedagogical method of improvisation

Julien Laroche*   Ilan Kaddouch

(2014, 2015)

Stable patterns ➔ disrupting interaction ➔ uncertainty ➔ creative reorganization

Enacting teaching and learning in the interaction process: "Keys" for developing skills in piano lessons through four-hand improvisations
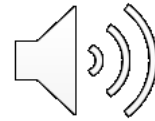
Julien Laroche, Ilan Kaddouch

Spontaneous preferences and core tastes: embodied musical personality and dynamics of interaction in a pedagogical method of improvisation

Julien Laroche* Ilan Kaddouch

(2014, 2015)

Hindering, uncertainty, creativity

🔊 **Hindering**

🔊 **Uncertainty**

🔊 **Creativity**

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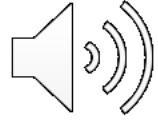Julien Laroche*   Ilan Kaddouch

(2014, 2015)

Reconfiguring habits

🔊 **Habitual patterns**

🔊 **Reconfigured habits**

Enacting teaching and learning in the interaction process: "Keys" for developing skills in piano lessons through four-hand improvisations

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Spontaneous preferences and core tastes: embodied musical personality and dynamics of interaction in a pedagogical method of improvisation
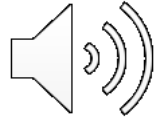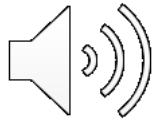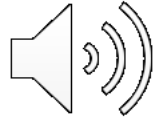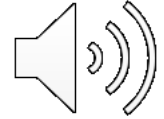
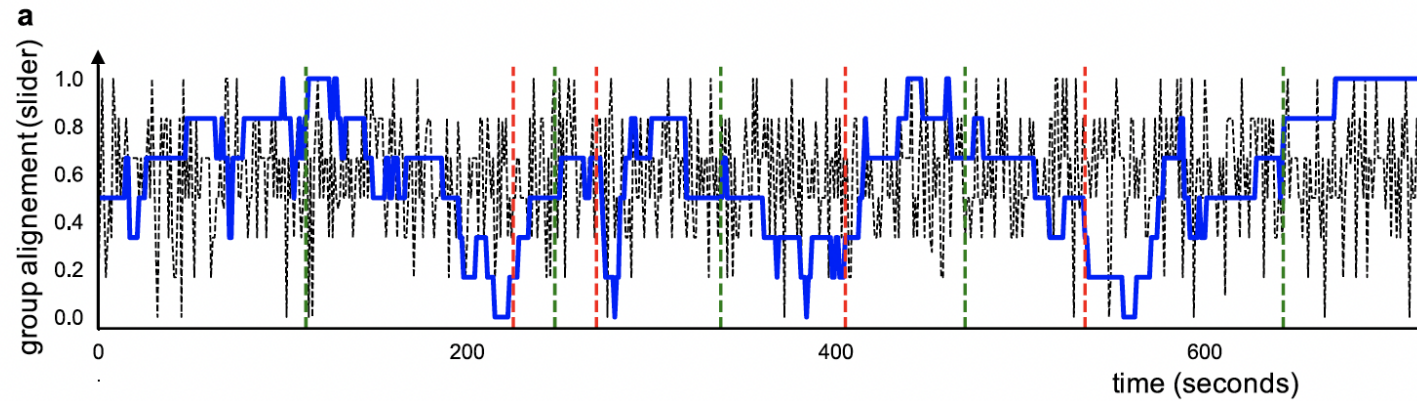Julien Laroche*   Ilan Kaddouch

(2014, 2015)

Creativity & the renewable ecology of habits

Problem ~~solving~~ ← ~~finding~~ ← making

Musical coordination, creative dissensus

(Goupil et al., 2021; Wolfe et al., 2023)

De-sync: Disruption of Synchronization as a Key Factor in Individual and Collective Creative Processes Laroche, Bachrach & Noy (*accepted*, BMC Neurosciences)

Improvisation:
object of study or epistemic model ?

Ilan Kaddouch (Kaddouch School, France)

MUSIC

Asaf Bachrach (ArTec, CNRS, France)
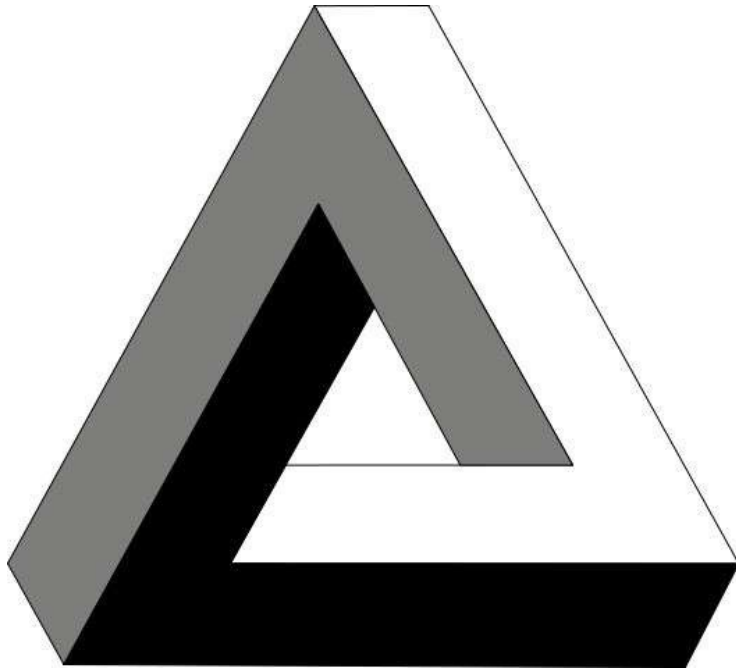
DANCE

Lior Noy (Ono Academic College, Israel)

THEATER

Shifting perspectives

« **WE** »

Interaction

« **I** »

1st person

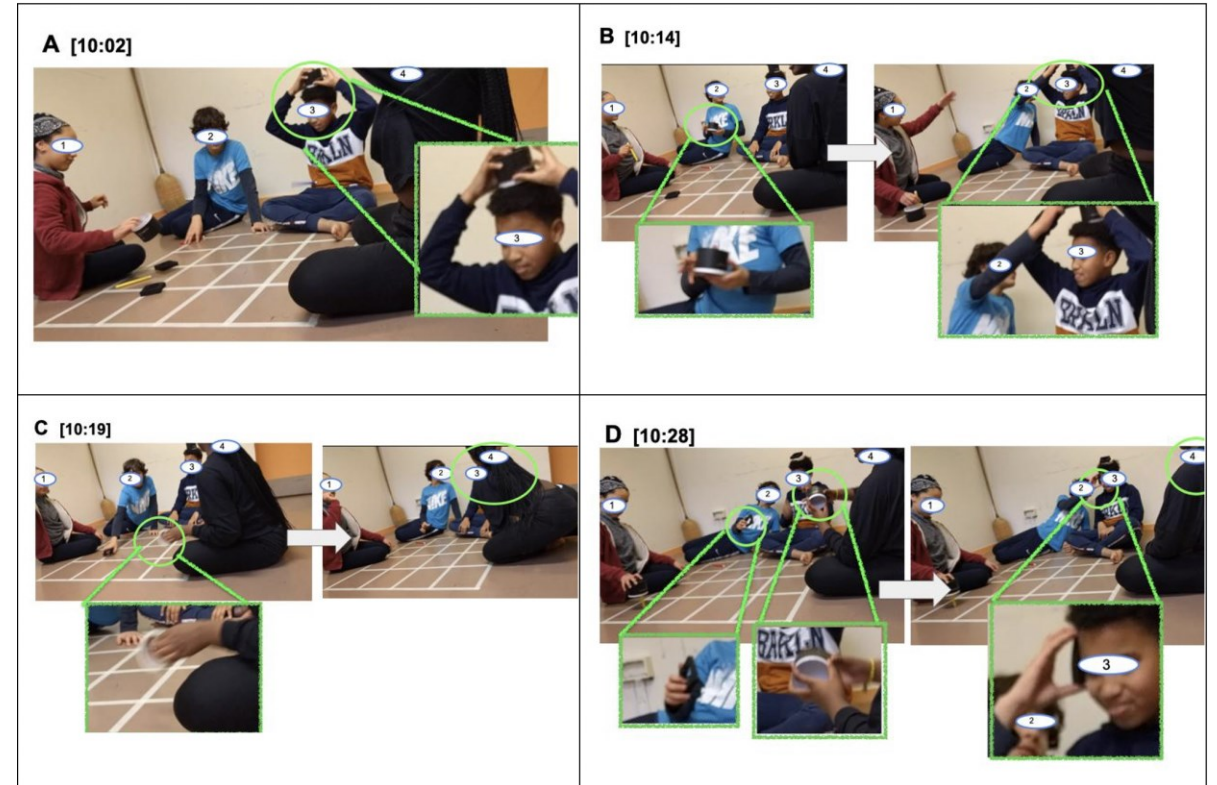pragmatic experience

« **THEY** »

3rd person

observation

Dancers researching / Researchers dancing

Making sense together: dance improvisation as a framework for a collaborative interdisciplinary learning

Nelson Lisa, Laroche Julien, Figueiredo Nara, Fiadeiro João, Dumit Joe, Bachrach Asaf

(in rejection)

GIGs (group improvisation games)

e.g., J. Fiadeiro « real-time composition » inspired the Grid Game

A distributed model of collective creativity in free play (2022)
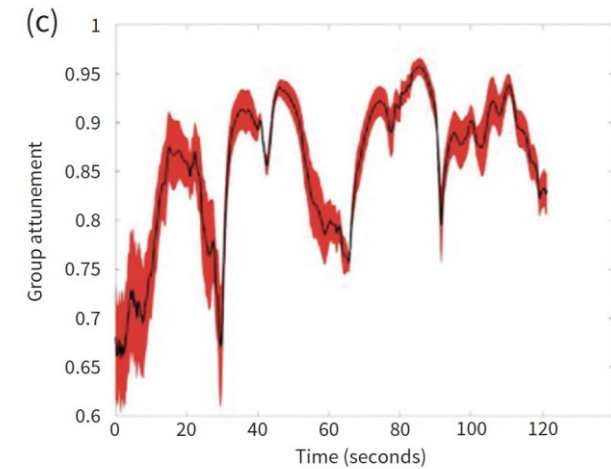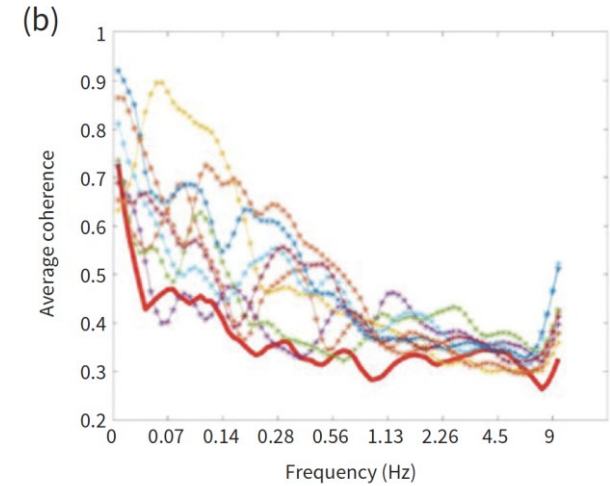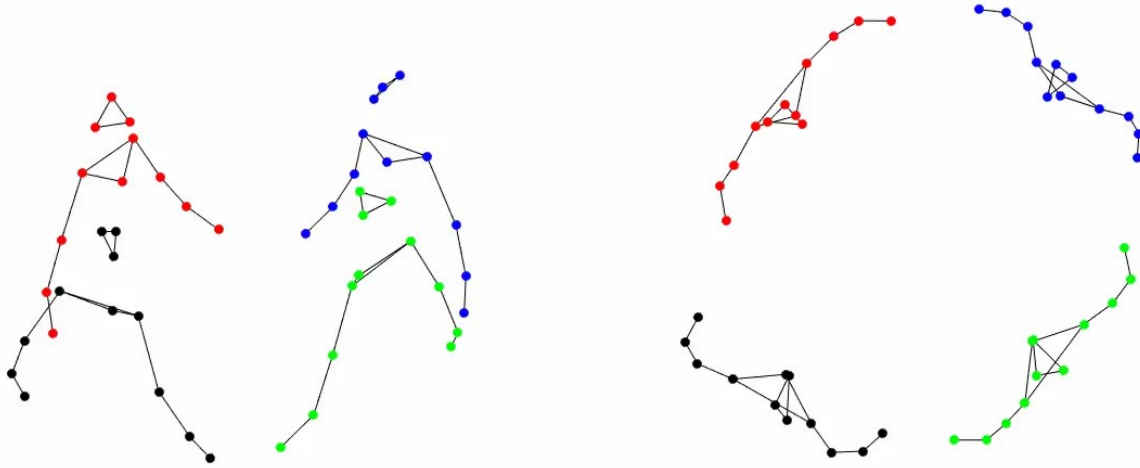
Juliette Kalaydjian[1†]   Julien Laroche[2*†]   Lior Noy[3‡]   Asaf Bachrach[4‡]

Mirror game: sync, exit, re-sync

Coordinated Interpersonal Behaviour in Collective Dance Improvisation: The Aesthetics of Kinaesthetic Togetherness (2018)

Making Time Together: An Exploration of Participatory Time-Making Through Collective Dance Improvisation
Julien Laroche, Tommi Himberg, and Asaf Bachrach (2023)

Tommi Himberg [1,2] , Julien Laroche [2,3], Romain Bigé [2,4] , Megan Buchkowski [1,2,5] and Asaf Bachrach [2,6,*]

Shared diminished reality

Shared Diminished Reality: A New VR Framework for the Study of Embodied Intersubjectivity
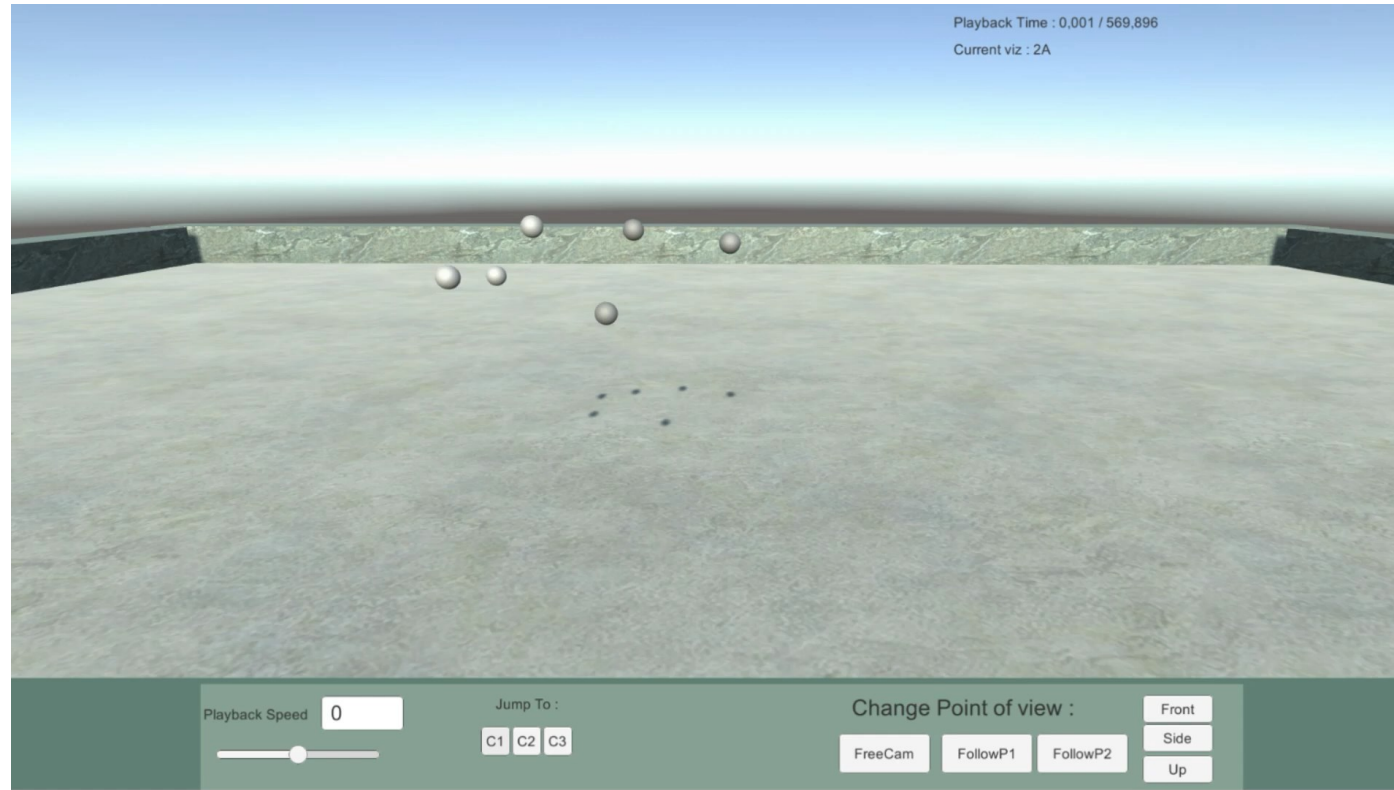
Loup Vuarnesson[1,2*†]   Dionysios Zamplaras[1,3*†]   Julien Laroche[4,5]   Joseph Dumit[6]   Clint Lutes[7]   Asaf Bachrach[5,8‡]   Francois Garnier[1‡]

[Re]moving Bodies – A Shared Diminished Reality Installation for Exploring Relational Movement

(2021)

Julien Laroche[1,2*]   Loup Vuarnesson[3,4]   Alexandra Endaltseva[5,6]   Joseph Dumit[7†]   Asaf Bachrach[2]

Shared diminished reality

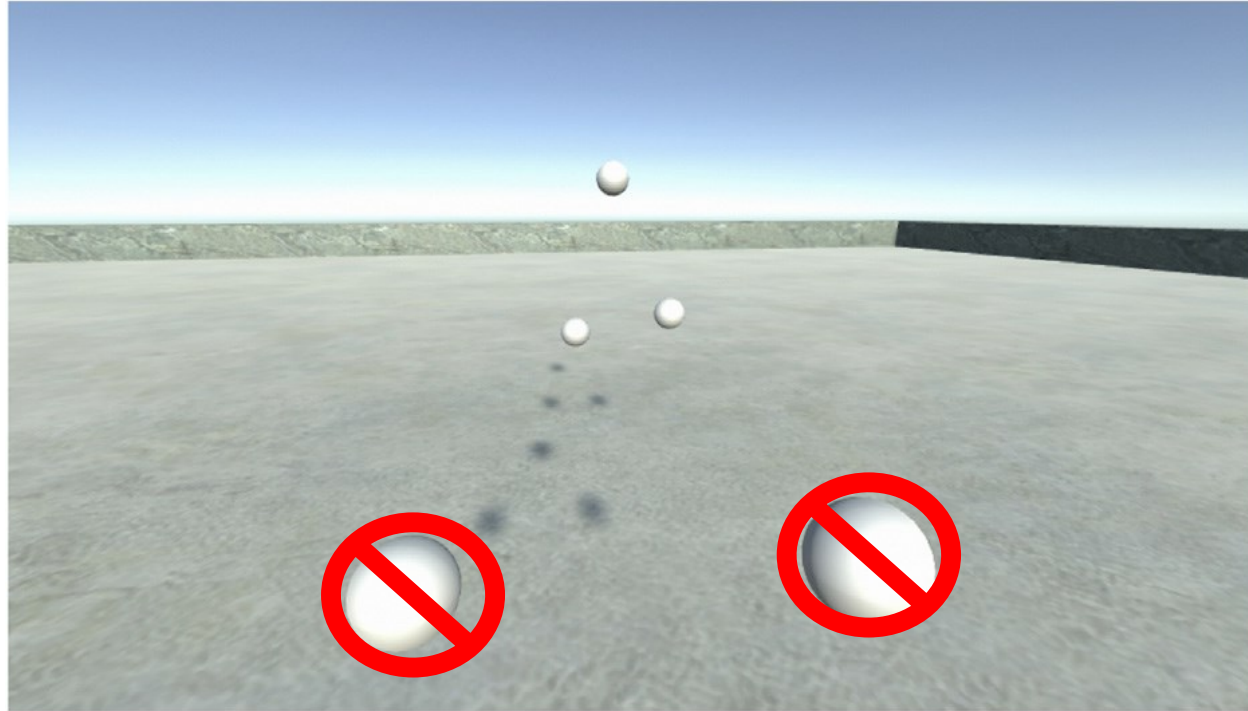Shared Diminished Reality: A New VR Framework for the Study of Embodied Intersubjectivity

Loup Vuarnesson[1,2*†]   Dionysios Zamplaras[1,3*†]   Julien Laroche[4,5]   Joseph Dumit[6]   Clint Lutes[7]   Asaf Bachrach[5,8‡]   Francois Garnier[1‡]

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(2021)

Shared diminished reality

Motion Cross-Correlation between hands velocity

Relation between the feeling of closeness and Relative Head Velocity - NO-HAND condition

Shared Diminished Reality: A New VR Framework for the Study of Embodied Intersubjectivity
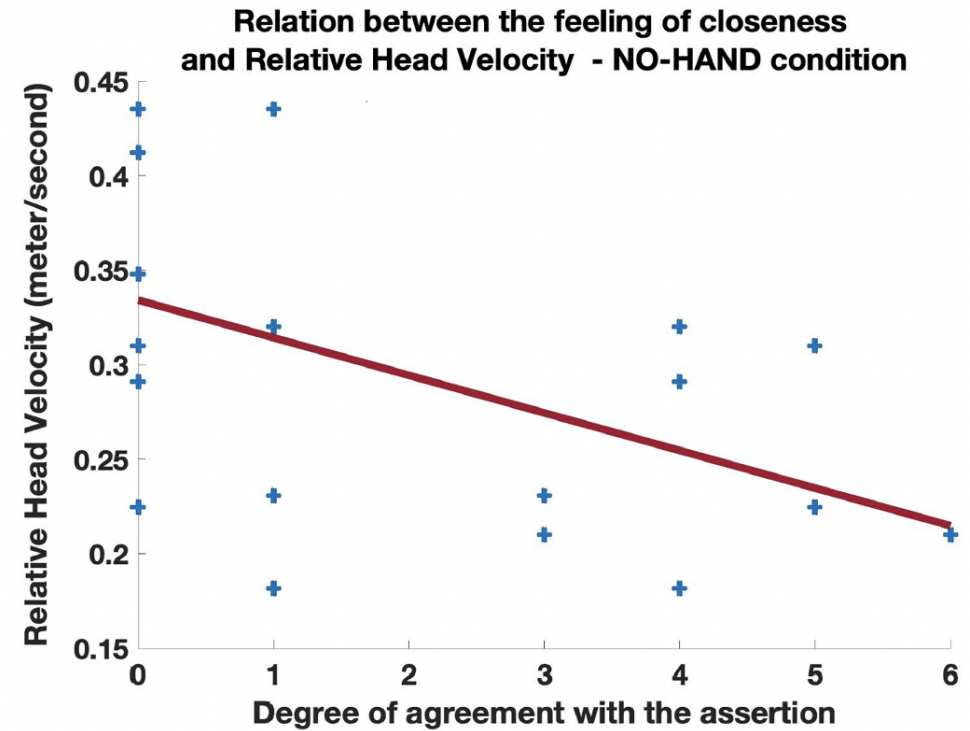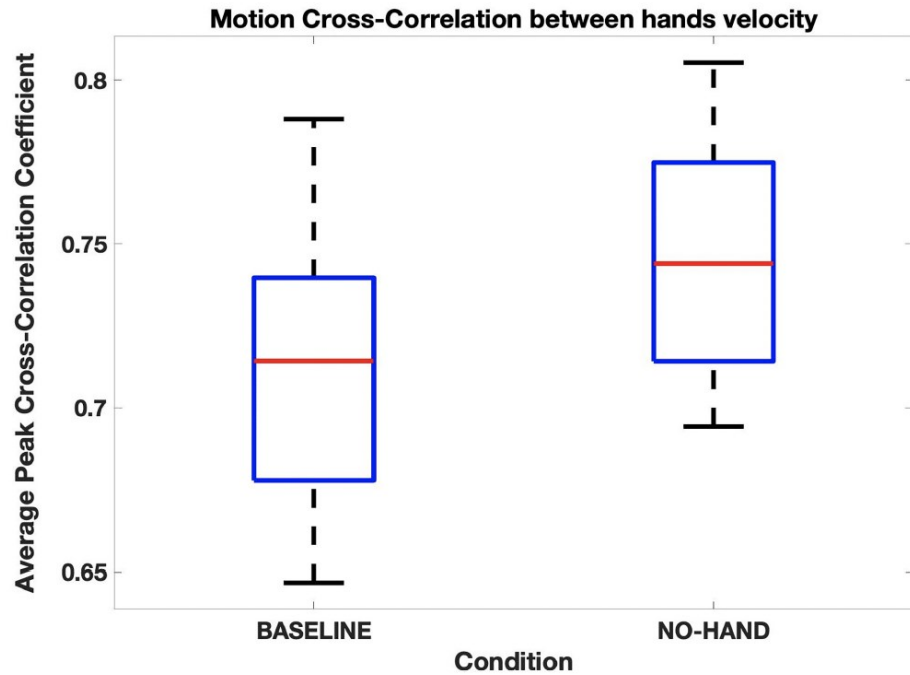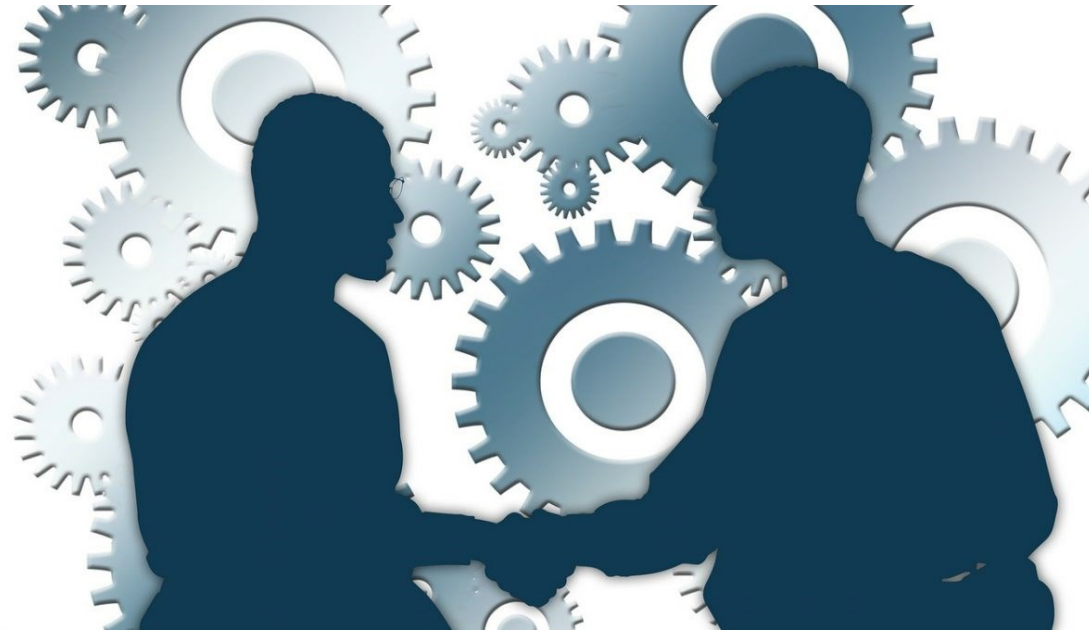
Loup Vuarnesson[1,2*†]   Dionysios Zamplaras[1,3*†]   Julien Laroche[4,5]   Joseph Dumit[6]   Clint Lutes[7]
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[Re]moving Bodies – A Shared Diminished Reality Installation for Exploring Relational Movement

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Julien Laroche[1,2*]   Loup Vuarnesson[3,4]   Alexandra Endaltseva[5,6]   Joseph Dumit[7†]   Asaf Bachrach[2]
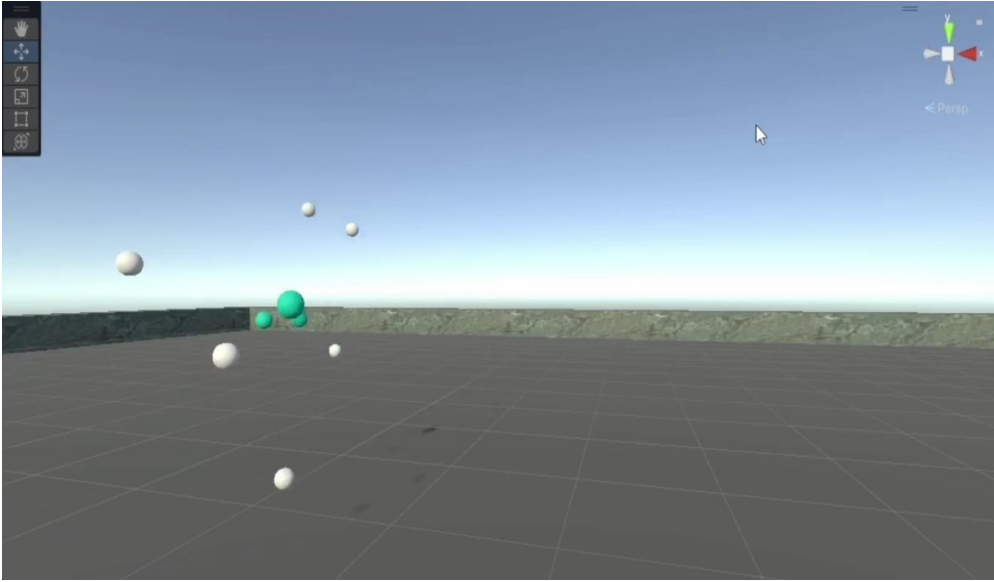
Sharing agency (over interactions)

Materializing Interactions

«Le **médian**»

Focusing on the interaction process and the sharing of agency

To study associated experiences & mechanisms of co-regulation

YUMI model

H: blurring the agency we respectively exert and share over the product of our interaction makes us more creative

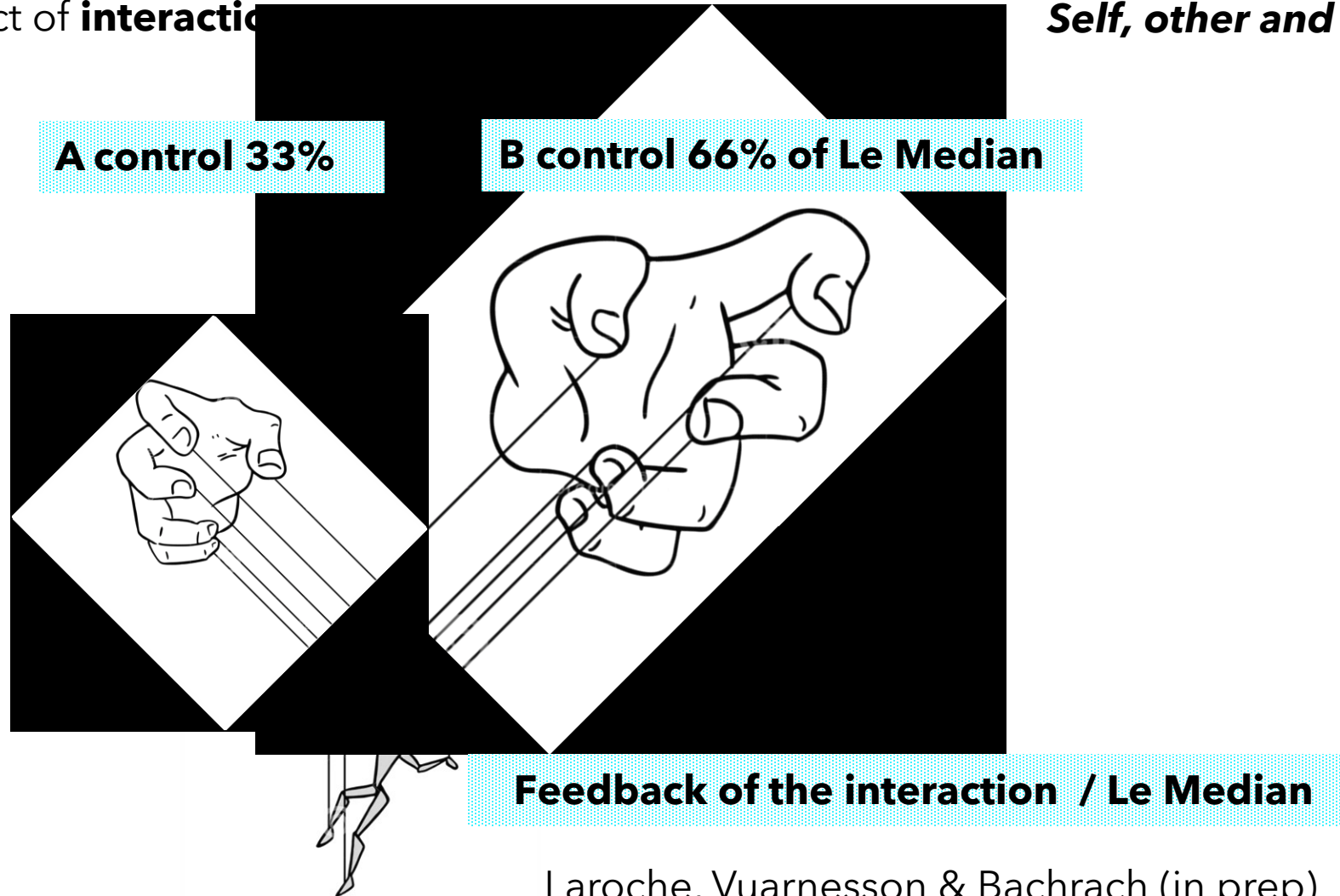Collaborative Creativity in Shared Diminished Reality

(Vuarnesson, Laroche & Bachrach, *in prep*)

Questionning agency

Varying the **distribution** of objective **control**

over the product of **interacti**

1st & 3rd person perspective
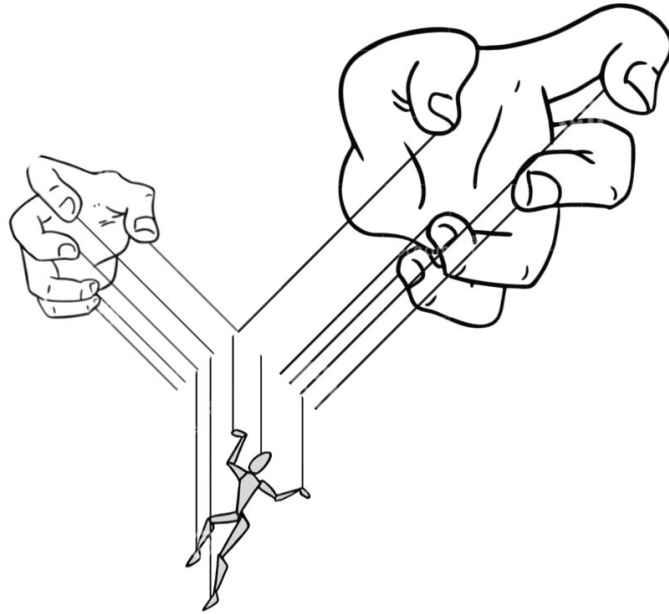
Self, other and shared agency

A control 33%

B control 66% of Le Median

Feedback of the interaction / Le Median

Laroche, Vuarnesson & Bachrach (in prep)

Same vs different perspectives

A (33%)   B (66%)

A (33%)   B (66%)

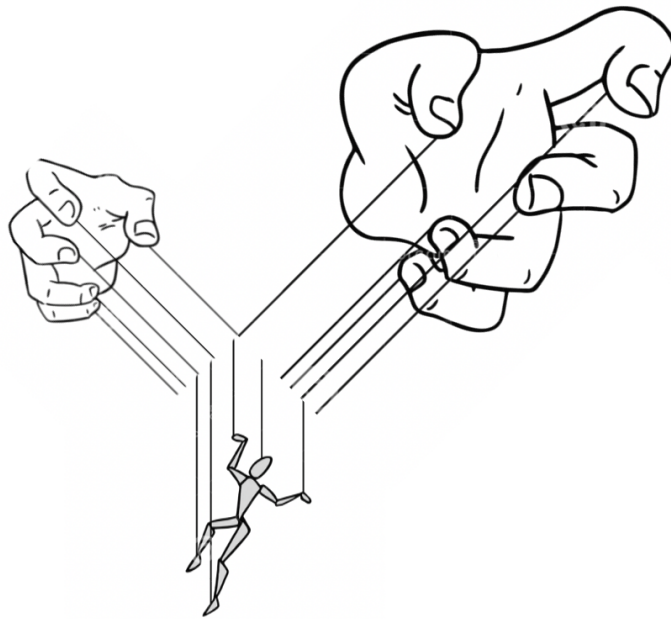AVATAR perçu par A
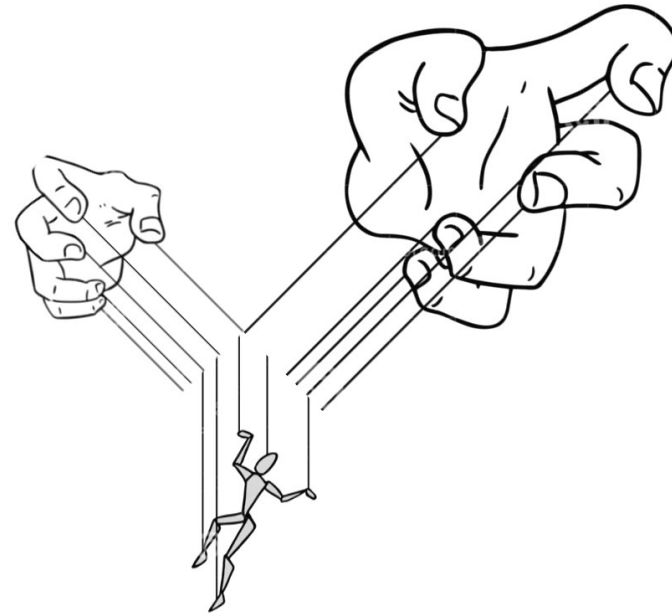
AVATAR perçu par B

Same vs different perspectives
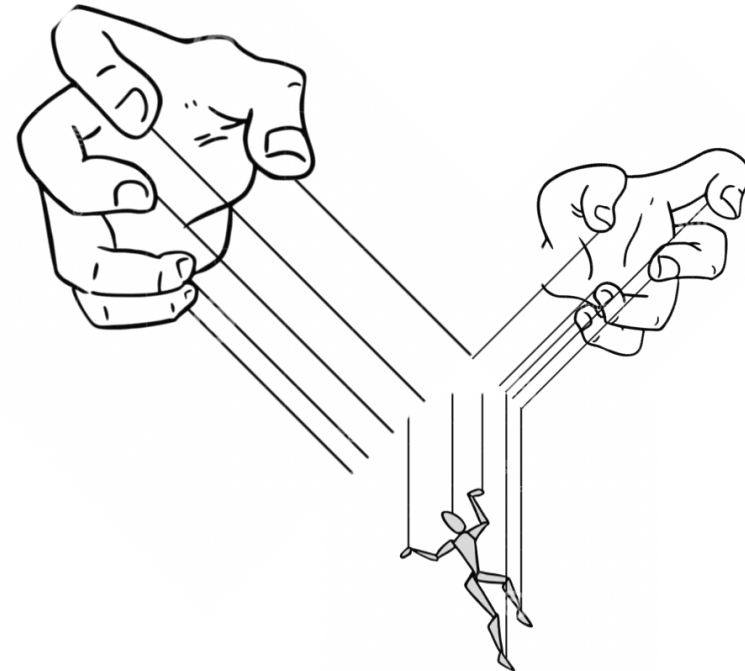

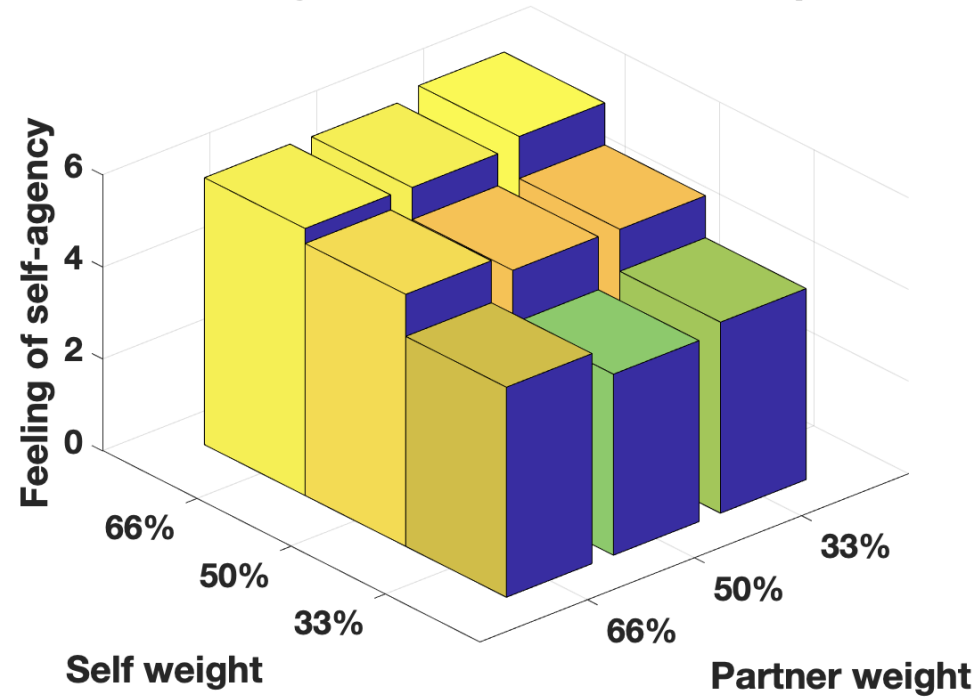A (33%)   B (66%)   A (66%)   B (33%)

AVATAR perçu par A   AVATAR perçu par B

Self-agency

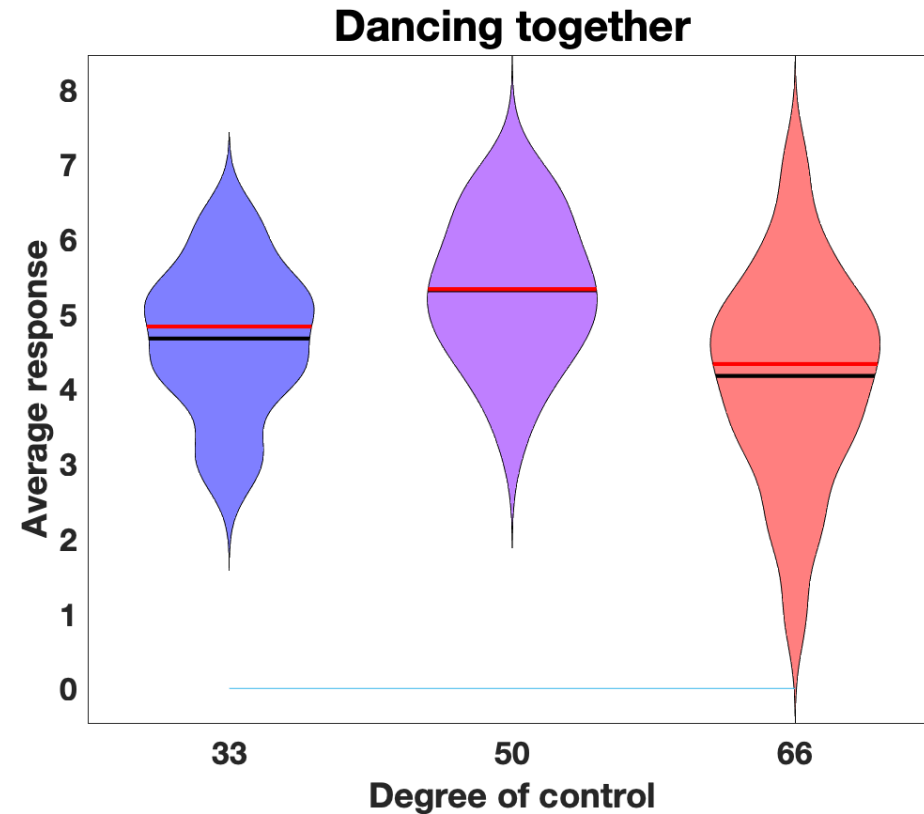**Effect of my own movement on the spheres**

The more control I have, the more I feel my agency over the interaction

BUT

My agency is also enhanced by the control you exert, irrespectively of my perception of that control
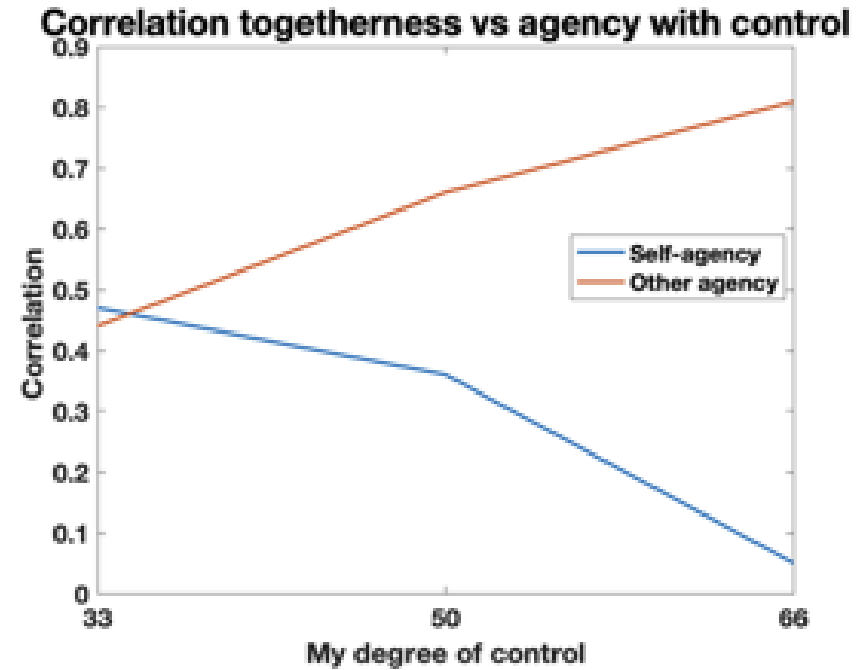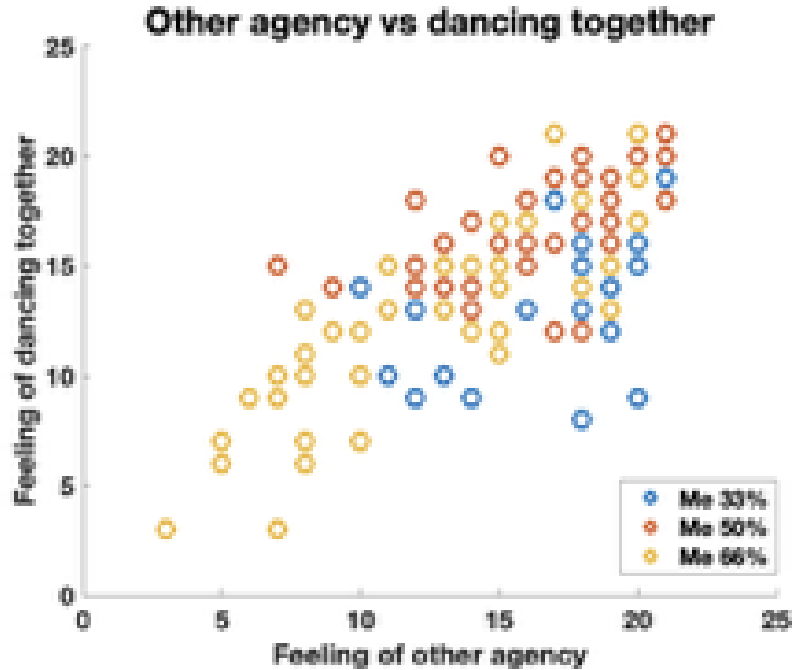
Shared agency / Togetherness

Dancing together

More togetherness when control is equally shared

Less when I have more control than you have

Shared agency & other agency

Feeling your agency matters more than mine to experience agential togetherness

Thanks for syncing, feel free to disrupt