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GÖTTINGEN

From Visual Salience to Bodily Signal

A Movement Science Approach to Gesture, Discourse and Prominence

Šárka Kadavá

ProDiGe workshop, Cologne, December 2025

Today's agenda

- i. Theoretical foundation
- ii. Dimensions of movement
- iii. (Rather quick) intro to motion tracking
- iv. Hands-on tutorial

What is gesture?

„actions that have the features of manifest deliberate expressiveness“ (Kendon 2004)

„utterance dedicated visible bodily action“ (Kendon 2016)

„motion that embodies a meaning relatable to the accompanying speech“ (McNeill, Enc)

„communicative tools that can enhance or alter the recipient’s understanding of spoken utterances (de Ruiter 2003)

„a movement of the hands, arms, or head, etc. to express an idea or feeling“ (CambDic)

“communicative movements of the hands and arms, which, similar to language are used to express the thoughts, feelings, and intentions of a speaker” (Müller 1998)

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Definition shapes annotation



Gesture as meaningful

← what is the meaning?

iconic, metaphoric, deictic, pragmatic, ...

Gesture relates to speech

← how?

synchrony with prosodic peaks, lexical affiliates, ...

Gesture is (somewhat) movement

← articulatory phases

preparation, **stroke (and apex)**, hold, retraction, ...

Problem I: theory

Meaning emerges from movement...

Iconicity is expressed through shape, velocity, trajectory, direction, etc. (Spruijt et al., 2025)

Beats derive their function from rhythmic, dynamic movement qualities

Emphasis emerges from acceleration, amplitude (and effort)

Trajectory and endpoint position of pointing gesture (i.e., the precision) matter for reference

Movement is continuous

Gesture phases simplify; hide variations, and cannot represent the dynamic nature of gesture; also stroke is not the only meaning-bearing part (Obermeier et al., 2011)

Gesture is not abstract concept, it is a physical mass

Moving with arm is differently costly than moving with wrist only

Timing is only one layer of multimodal coordination

Also: spatial alignment, amplitude, effort distribution, rhythm; Prominence can be distributed across modalities in complex ways; it is not only important when but also how

Problem II: practice



Resources (esp. time)



Problem II: practice

„Reliability“



Language & Communication

Volume 105, November 2025, Pages 22-36

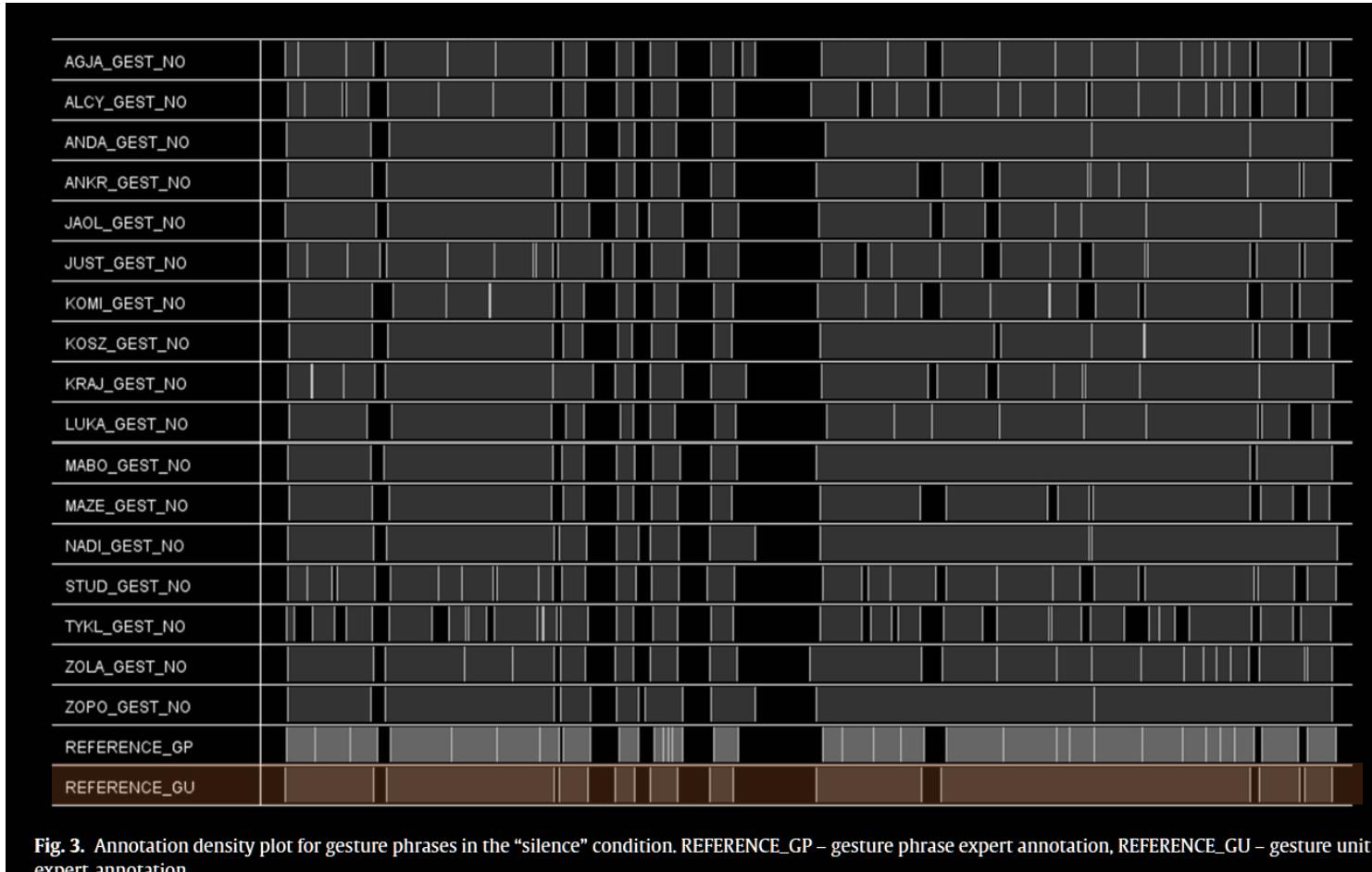


Boundaries of gestures: Naive segmentation
of the stream of human hand movements

Ewa Jarmołowicz-Nowikow Maciej Karpiński

„Researchers frequently use video annotation software to facilitate this process, leveraging features like multiple playback speeds, slow-motion, and reverse playback. However, many spatial and visual aspects of annotating videos on a computer screen differ markedly from real-life communicative contexts. These differences include the size and visibility of the observed individual on the screen, the absolute distance from the person, the absence of a fully three-dimensional perspective, and the potential for either more restricted or more expansive access to the communicative situation. Such disparities may influence the annotator’s focus, leading to prioritizing different phenomena or aspects of behavior during the annotation process.“

What is actually gesture in a stream of behavior?



What is gestural prominence?

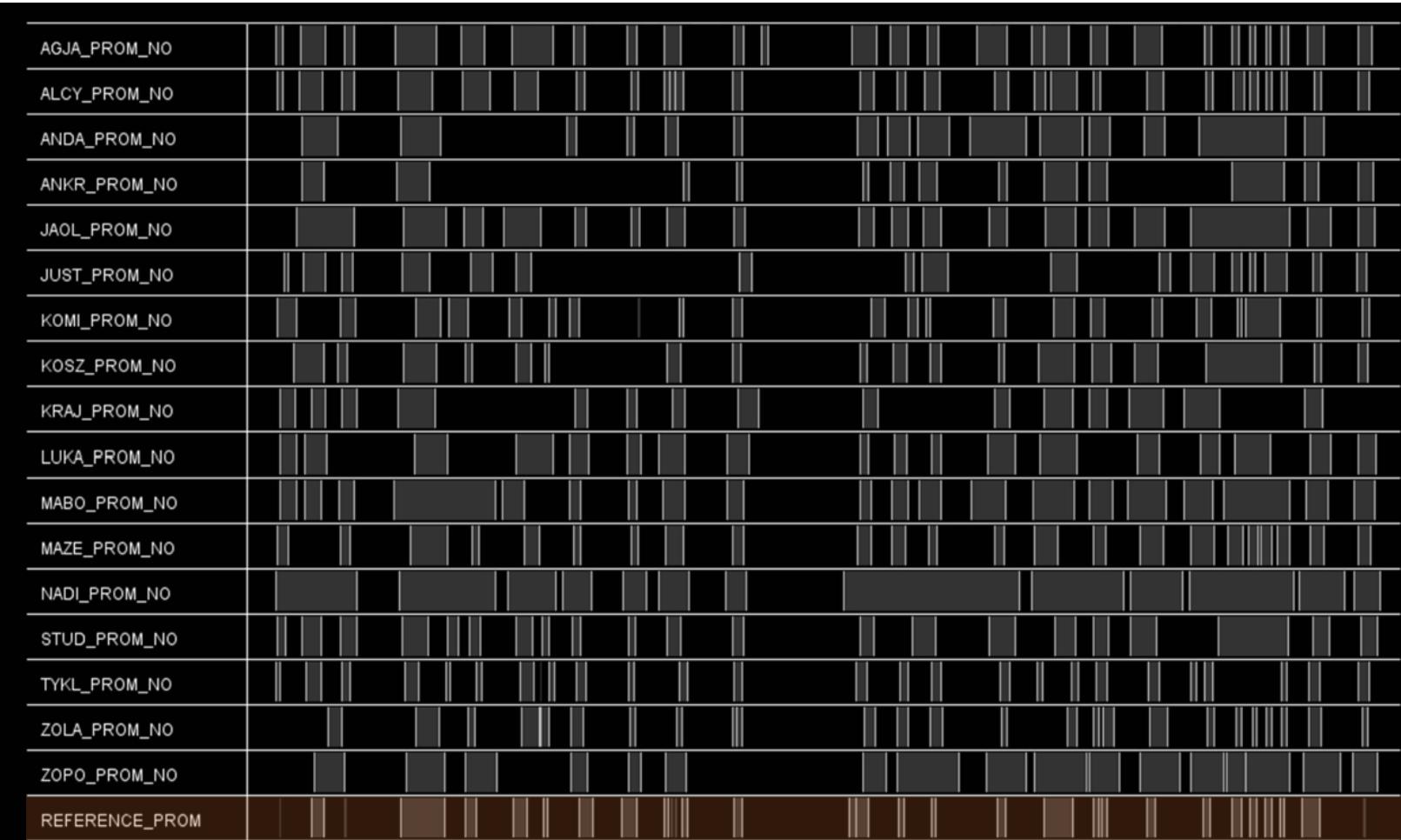


Fig. 5. Annotation density plot for gestural prominence in the “silence” condition.

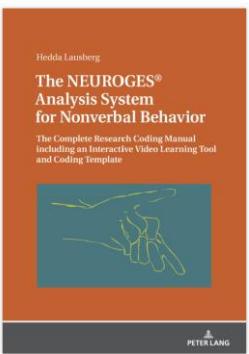
Working with manual annotation...



Flexible

Powerful, esp. for quali-analysis

Somewhat consensus around annotation schemes



Linguistic Annotation System for Gestures (LASG)

September 2013

DOI: [10.1515/9783110261318.1098](https://doi.org/10.1515/9783110261318.1098)

In book: Body – Language – Communication. An International Handbook on Multimodality in Human Interaction. (Handbooks of Linguistics and Communication Science 38.1.) .
Publisher: De Gruyter Mouton · Editors: Cornelia Müller, Alan Cienki, Ellen Fricke, Silva H. Ladewig, David McNeill, Sedinha Teßendorf

• Jana Bressem · • Silva Ladewig · • Cornelia Müller

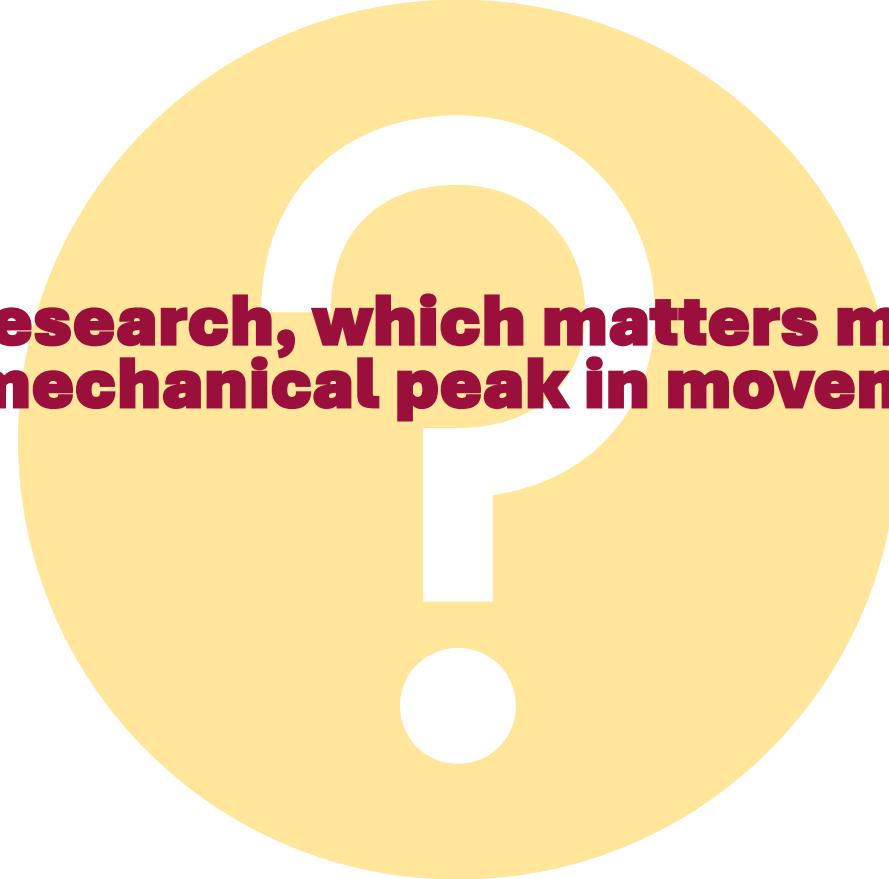
Laborious

Can be quite slow and buggy

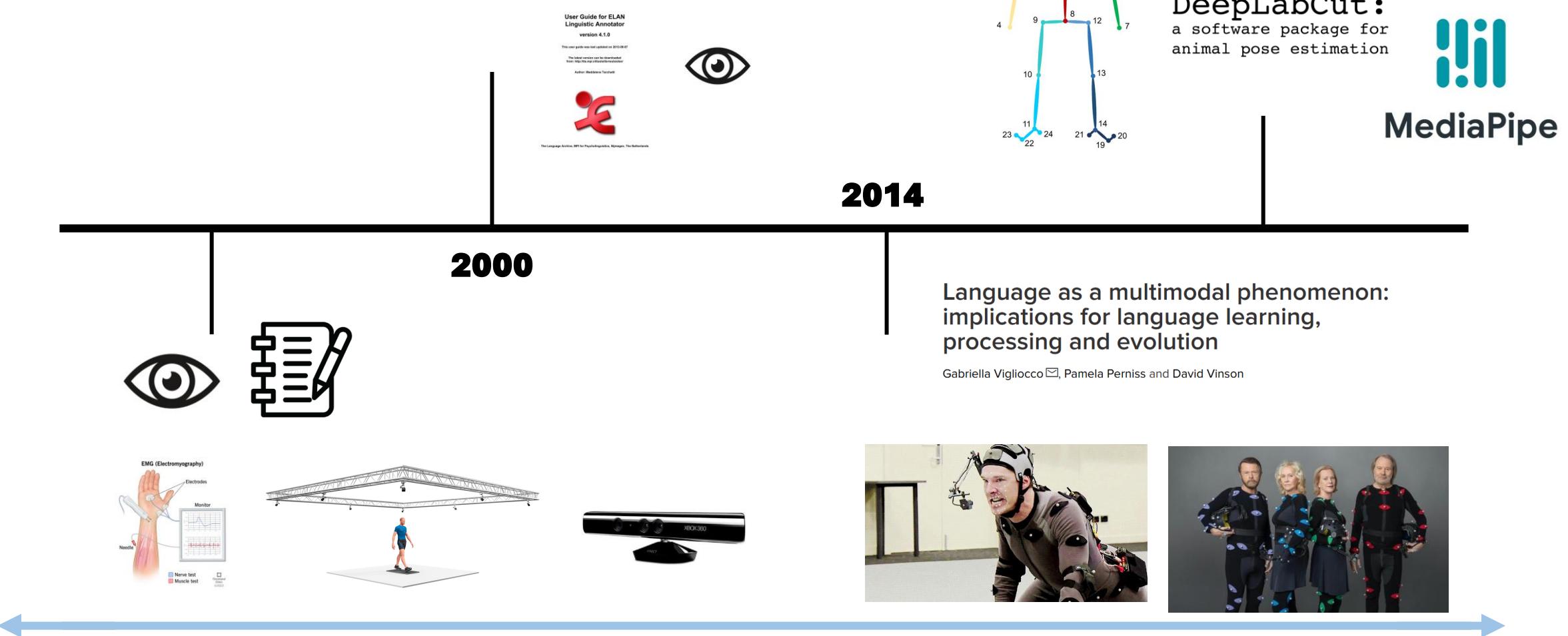
Different types of annotation schemes

Perception-dependent

For prominence research, which matters more – the perceptual stroke or the biomechanical peak in movement (aligned with speech)?



The dawn of motion tracking



What is so great about it?

- 1) it allows to **ask** new research questions
- 2) it **democratizes** science
- 3) it **frees** the hands
- 4) it **crosses** the departments & fields



New possibilities for gesture!



Automatic detection
Quantification
Precise temporal alignment
Capturing variation

Dimensions of movement

I. Kinematics

describes motion of points and bodies

Where?	Position
How far?	Displacement
How fast?	Velocity/speed
How suddenly?	Acceleration
How smoothly?	Jerk
How big?	Volume
How configured?	E.g., hand shape
How regular?	Rhythmicity
How coordinated?	Temporal/spatial relationships

Dimensions of movement

II. Kinetics/dynamics

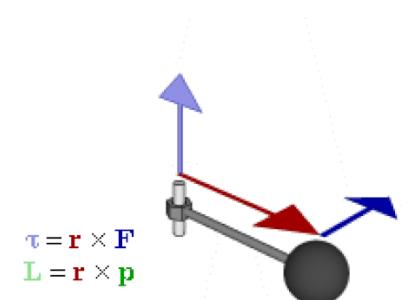
describes the cause of motion

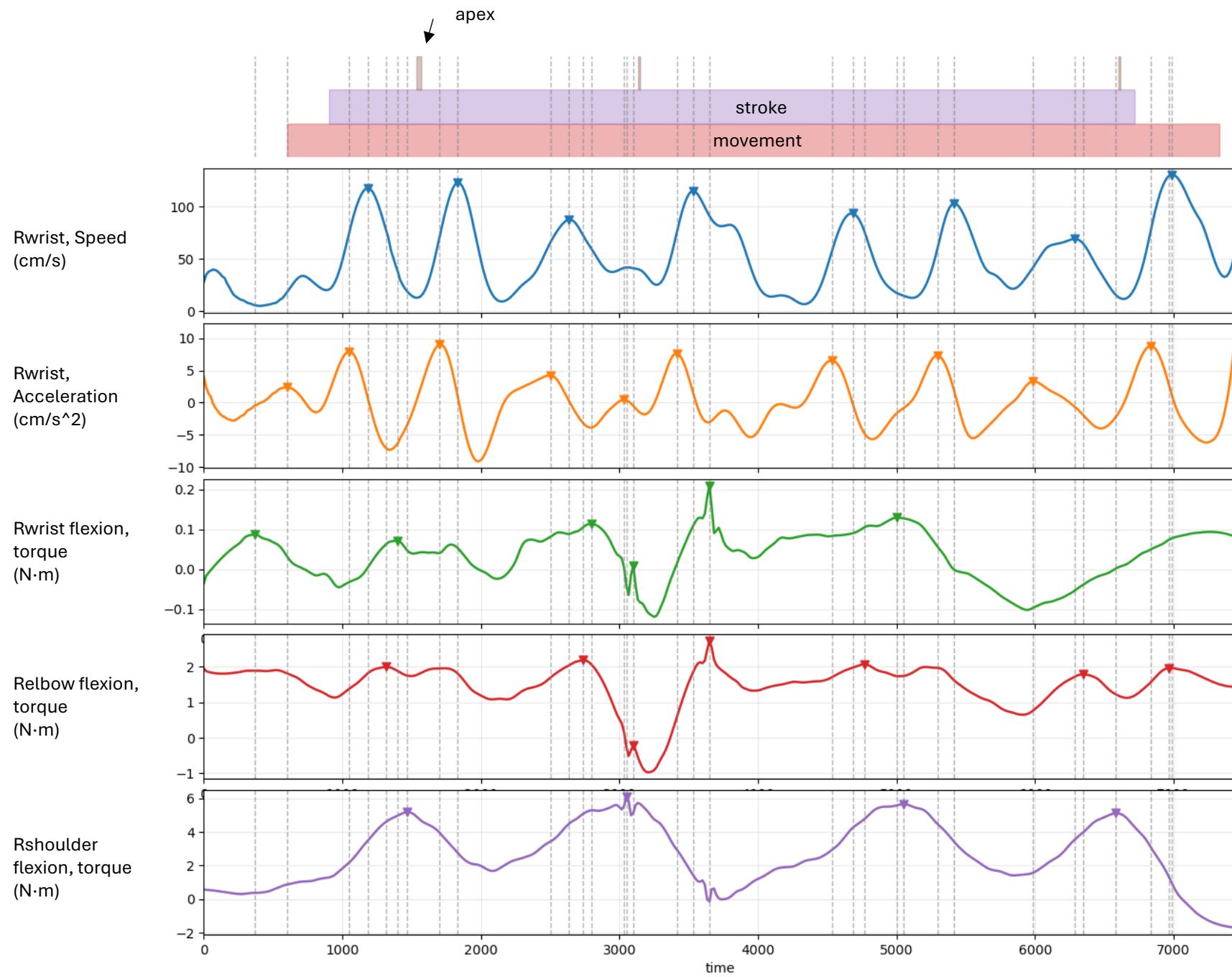
How effortful?

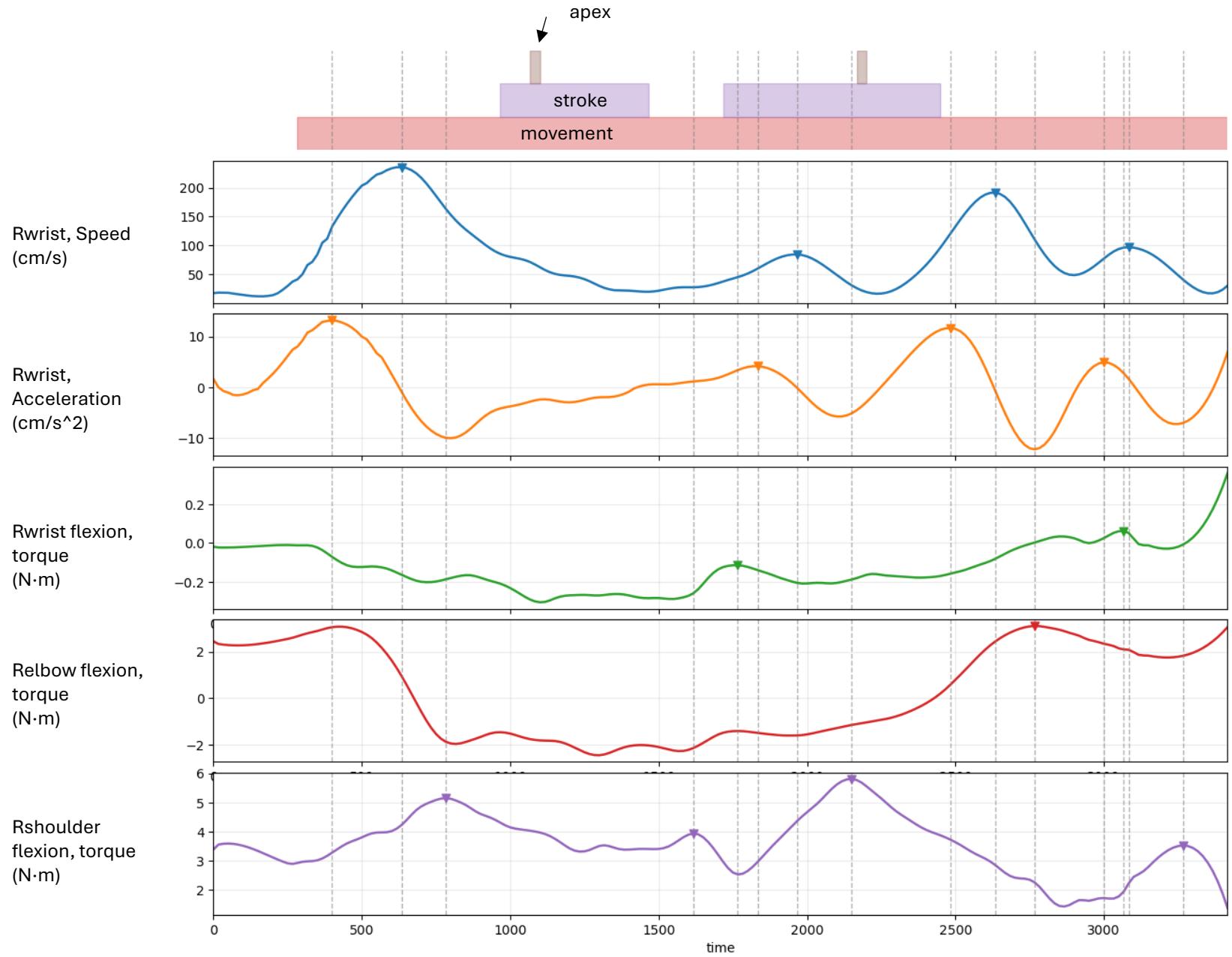
How coordinated?

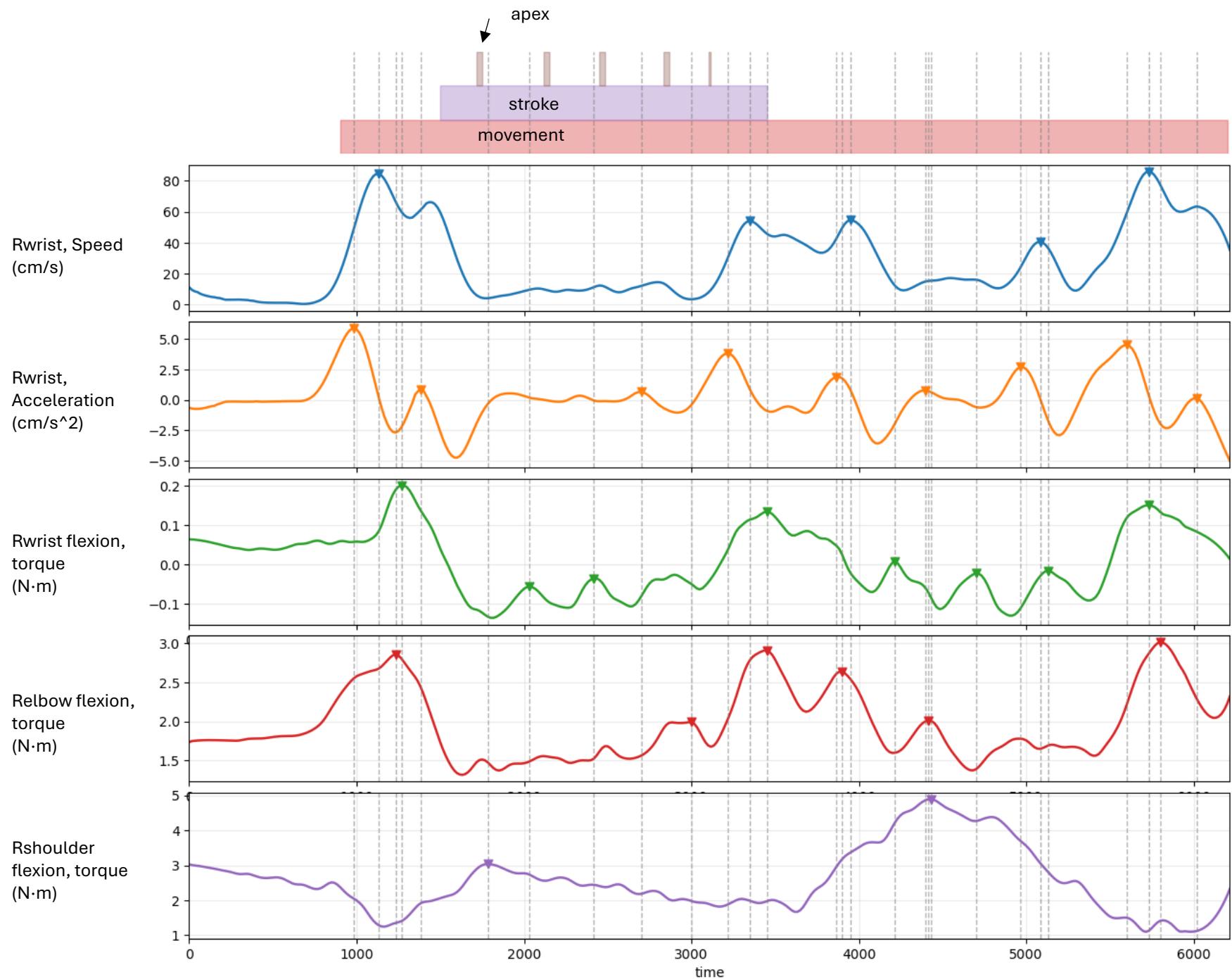
Forces, joint torques

Synergies

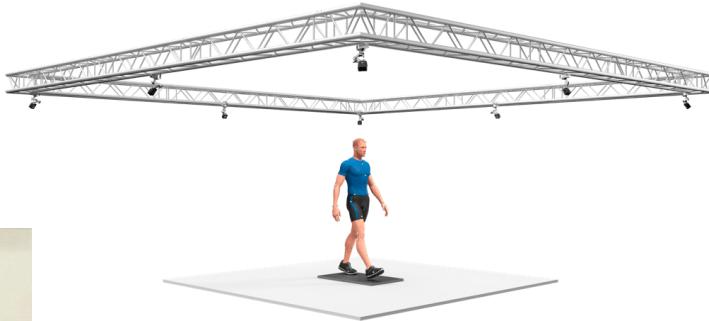




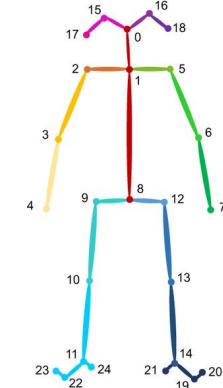




(Rather quick) intro to motion tracking



Very high precision (ca. 0.5 mm)
Lab-based
Proprietary (→ expensive)



Lower precision (1-2.5 cm)
No markers needed
Open-source

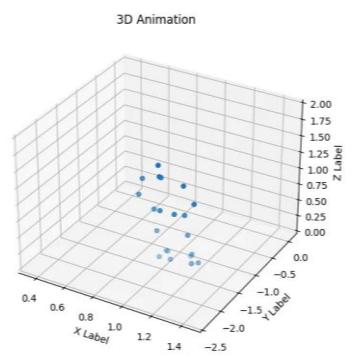
Most common marker-less tracking



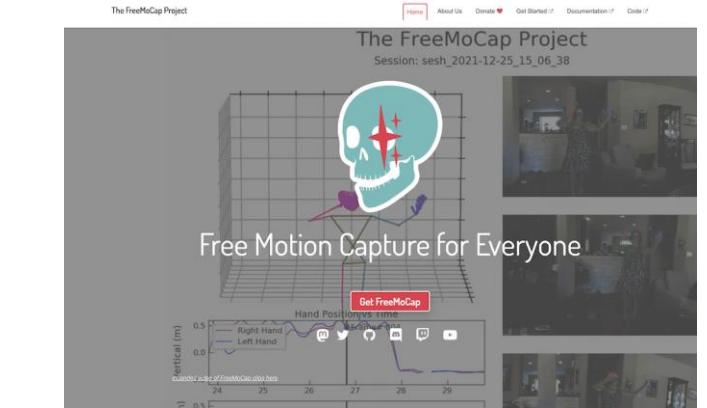
MediaPipe



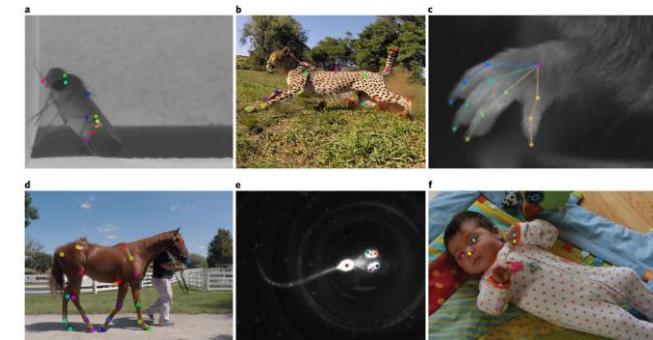
OpenPose



Pose2sim

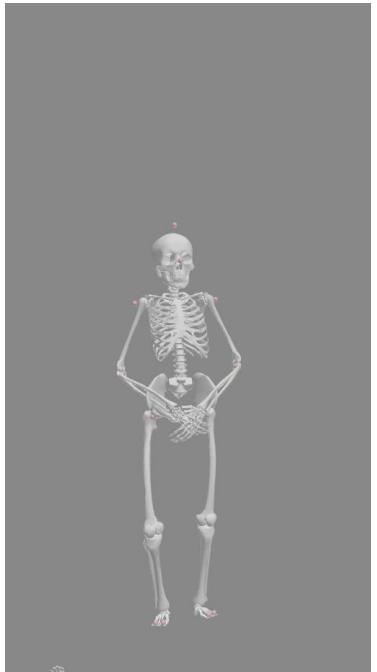


FreeMoCap

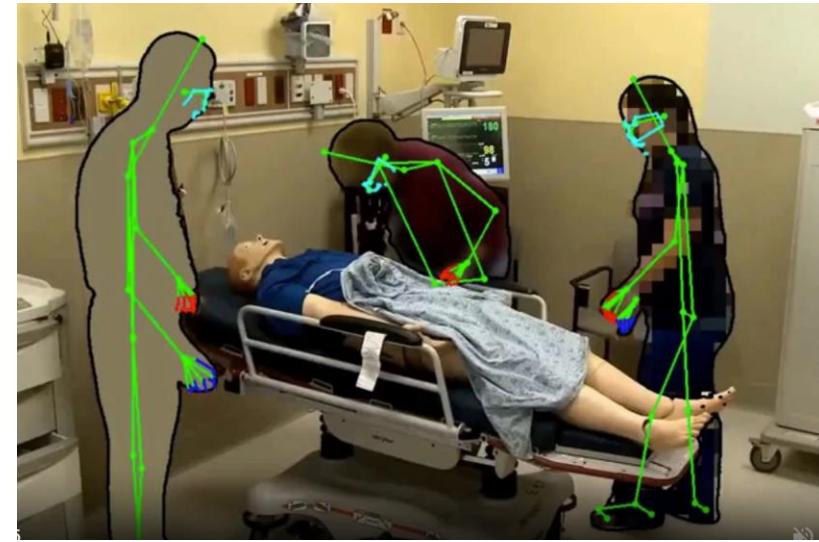
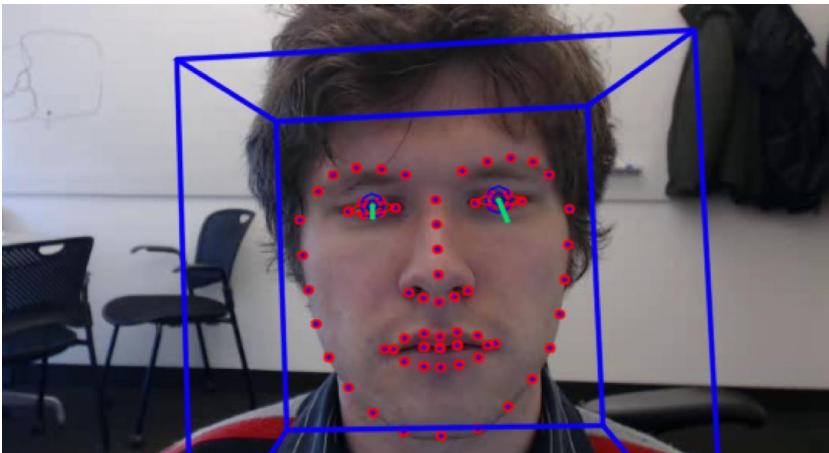


DeepLabCut

Add-ons



OpenFace



MaskAnyone

Considerations

Do I already have data, or am I just about to collect them?

What is my goal and how much is movement crucial for my RQ?

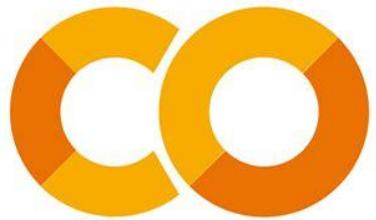
How much precision do I need?

How easy should I make my life?

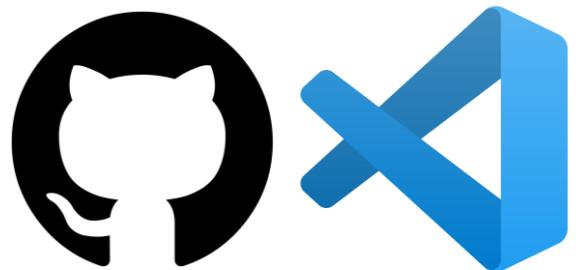


Let's get to work





[**https://tinyurl.com/prodige-script-1**](https://tinyurl.com/prodige-script-1)
[**https://tinyurl.com/prodige-script2**](https://tinyurl.com/prodige-script2)

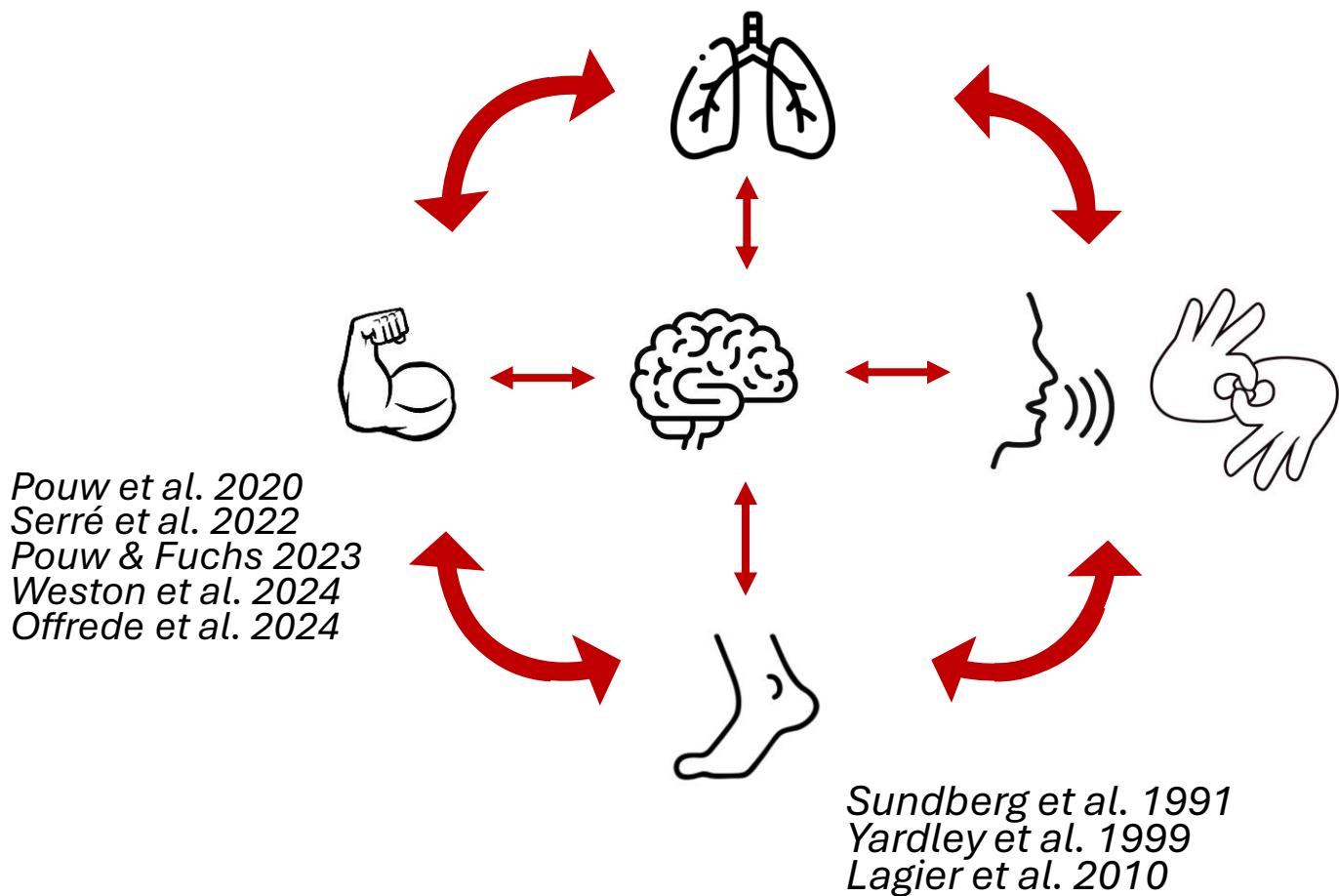


[**https://github.com/sarkadava/MotionTracingPipeline_ProDiGe2025**](https://github.com/sarkadava/MotionTracingPipeline_ProDiGe2025)

Final remarks

gesture does not operate on an abstract level, it's **profoundly physical and entangled with whole-body physiology**

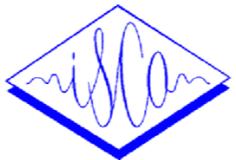
Fuchs & Rochet-Capellan 2014



Final remarks

other parts of body are also involved in meaning-making



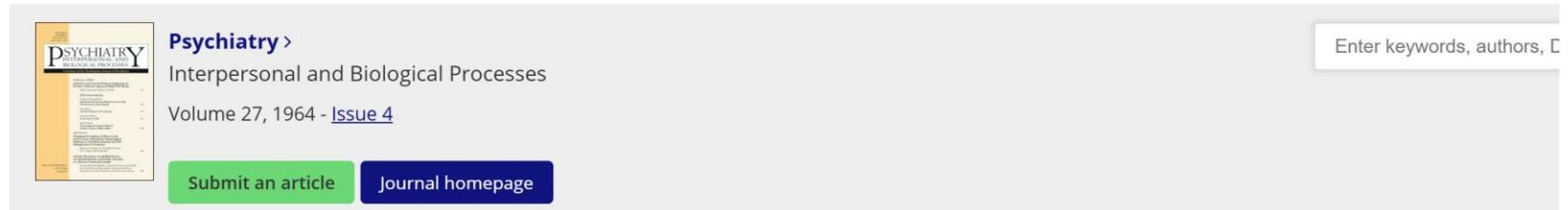


Are torso movements during speech timed with intonational phrases?

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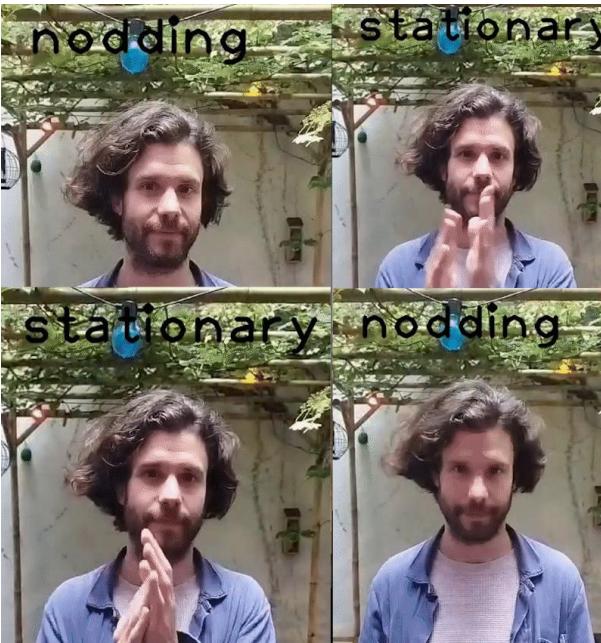
The screenshot shows a journal article page. At the top left is the journal cover for "PSYCHIATRY INTERPERSONAL AND BIOLOGICAL PROCESSES". To its right, the title "Psychiatry > Interpersonal and Biological Processes" is displayed, along with the volume information "Volume 27, 1964 - Issue 4". Below the journal cover are two buttons: "Submit an article" (green) and "Journal homepage" (dark blue). A search bar at the top right contains the placeholder text "Enter keywords, authors, C".

547
Views
368
CrossRef
citations to date
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Altmetric

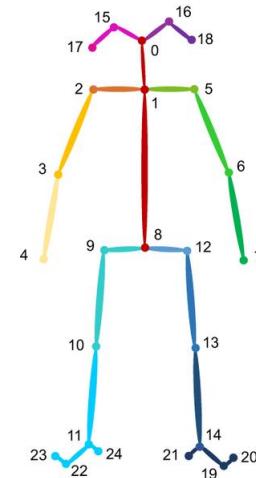
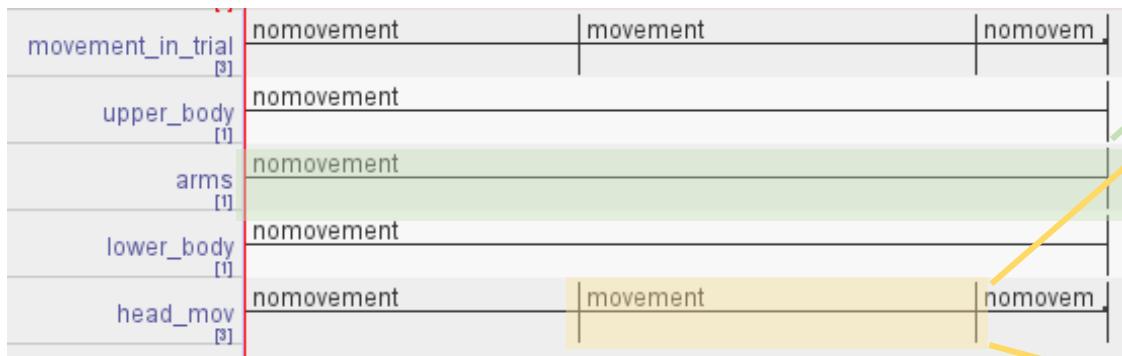
Original Articles
The Significance of Posture in Communication Systems†
Albert E. Scheflen
Pages 316-331 | Published online: 07 Nov 2016
Cite this article | <https://doi.org/10.1080/00332747.1964.11023403>

Final remarks

motion capture does not have to be the **endpoint**



What if all the time spent in [fill in a name of an annotation software that you really hate] in the past can contribute to less time spent in it in the future?



Co-Speech Gesture Detection Through Multi-Phase Sequence Labeling

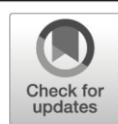
Esam Ghaleb, Ilya Burenko, Marlou Rasenberg, Wim Pouw, Peter Uhrig, Judith Holler, Ivan Toni, Aslı Özyürek, Raquel Fernández; Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (WACV), 2024, pp. 4007-4015

Behavior Research Methods (2020) 52:1783–1794
<https://doi.org/10.3758/s13428-020-01350-2>

Speeding up the detection of non-iconic and iconic gestures (SPUDNIG): A toolkit for the automatic detection of hand movements and gestures in video data

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Published online: 23 January 2020
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COMPARING MANUAL VS. SEMI-AUTOMATED METHODS FOR THE CODING OF CO-SPEECH GESTURES

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Learning Co-Speech Gesture Representations in Dialogue through Contrastive Learning: An Intrinsic Evaluation

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Final remarks

motion capture is a great accelerator of our field, but it does not do miracles

- ... there is some accuracy trade-off
- ... it requires some thinking about the 'infrastructure'
- ... it requires lots of processing steps (and thus, too, time)
- ... it requires constant sanity checks (!!)
- ... sometimes coding is as annoying as ELAN
- ... data are just data without theory

What's next?



Modules covering MediaPipe, OpenPose,
Pose2sim any many more



... And maybe see you in
Tilburg, June 2026?



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Thank you!

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On the FLEXibility and Stability of gesture-speech coordination (FLESH)



Aleksandra Ćwiek



Susanne Fuchs



Šárka Kadavá



Wim Pouw



Melissa
Ebert



Justin
Snelders



Jet
Lambers



Hamza
Nalbantoglu



Gillian
Rosenberg



Markus Steinbach



Judith Holler