

Data Request form YOUth (version 5.0, December 11, 2019)

Introduction

The information you provide here will be used by the YOUth Executive Board, the Data Manager, and the Data Management Committee to evaluate your data request. Details regarding this evaluation procedure can be found in the Data Access Protocol.

All data requests will be published on the YOUth researcher's website in order to provide a searchable overview of past, current, and pending data requests. By default, the publication of submitted and pending data requests includes the names and institutions of the contact person and participating researchers as well as a broad description of the research context.

After approval of a data request, the complete request (including hypotheses and proposed analyses) will be published. If an applicant has reasons to object to the publication of their complete data request, they should notify the Project Manager, who will evaluate the objection with the other members of the Executive Board and the Data Management Committee. If the objection is rejected, the researcher may decide to withdraw their data request.

Section 1: Researchers

In this section, please provide information about the researchers involved with this data request.

- Name, affiliation and contact information of the contact person
- Name and details of participating researchers (e.g. intended co-authors)
- Name and details of the contact person within YOUth (if any)

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Section 2: Research context

In this section, please briefly describe the context for your research plans. This section should logically introduce the next section (hypotheses). As mentioned, please note that this section will be made publicly available on our researcher's website after submission of your request.

Please provide:

- The title of your research plan
- A very brief background for the topic of your research plan
- The rationale for and relevance of your specific research plan

- The specific research question(s) or aim(s) of your research (Please also provide a brief specification)
- A short description of the data you request

References can be added at the end of this section (optional).

Title of the study
Automatic estimation of infant posture in videos of parent-child interaction

Background of the topic of your research plan, rationale, relevance (max. 500 words)
<p>Interaction between infants and caregivers is an often-studied topic within developmental sciences, where certain behaviors during these interactions are thought to be predictors of several constructs in later age. For example, already in 1976, Beckwith, Cohen, Kopp, Parmelee & Marcy found that reciprocal social transactions underlie development of several infant competencies, from coarse motor development to social and emotional development.</p> <p>The interaction between caregiver and infant is often studied with face-to-face paradigms, where the infant and their caregiver are seated across from each other in stationary positions. In these studies behaviors like face looking are often studied (face looking can precede joint attention, a construct considered to play a vital role in social interaction (Mundy & Sigman, 2006)). However, previous research has established that the posture of an infant moderates the amount of face looking. Franchak, Kretch, & Adolph (2018) found that increased motor costs decreased face looking. For example, when infants were prone, they were less likely to look at the caregivers' face, and caregivers were less likely to look at the infants' face. Likelihood of the infant to look at the caregivers' face was similar during sitting and standing.</p> <p>The annotation of behavior (in the latter case posture of the infant) is usually done by hand. However, manual coding is time and labor consuming. In recent years, there has been some attention to automating these manual coding processes. Ossmy, Gilmore and Adolph (2019) proposed a Computer-Vision Framework to Enhance and Accelerate Research in Human Development, named AutoViDev. In a test case of the (still developing) AutoViDev, the program was able to reliably annotate movement patterns from infants.</p> <p>In this study, we will explore the possibilities of automated coding of posture. Besides being time and labor saving, automated coding provides the possibility of studying behaviors and interaction at various time-scales.</p>

The specific research question(s) or aim(s) of your research
Is it possible to automatically estimate infant posture in videos of parent-child interaction?

Summary of the data requested for your project: Please indicate which data you request to answer your research question.
Videos of the parent-child interaction in the 10-months wave are requested.

References (optional)
<p>Beckwith, L., Cohen, S. E., Kopp, C. B., Parmelee, A. H., & Marcy, T. G. (1974). <i>Child development</i>, 47(3), 579-587.</p> <p>Cao, Z., Hidalgo, G., Simon, T., Wei, S-E., & Sheikh, Y. (2018). OpenPose: Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields. eprint=1812.08008.</p>

Franchak, J. M., Kretch, K. S., & Adolph, K. E. (2018). See and be seen: Infant-caregiver social looking during locomotor free play. *Developmental Science*.

Mundy, P., & Sigman, M. (2006). Joint attention, social competence, and developmental psychopathology. In D. Cicchetti & D. J. Cohen (Eds.), *Developmental psychopathology: Theory and method* (p. 293–332). John Wiley & Sons Inc.

Ossmy, O., Gilmore, R.O., & Adolph, K.E. (2019). AutoViDev: A Computer-Vision Framework to Enhance and Accelerate Research in Human Development. *Advances in Computer Vision*, 147-156.

Section 3: Hypotheses

In this section, please provide your research hypotheses. For each hypothesis:

- Be as specific as possible
- Provide the anticipated outcomes for accepting and/or rejecting the hypothesis

Hypotheses
We will study whether, with state-of-the-art software from the computer science, we can automatically estimate infant posture in videos. Potential outcomes are (1) it is generally feasible or (2) it is feasible within certain constraints (e.g. positioning of the infant within the video).

Section 4: Methods

In this section, you should make clear how the hypotheses are tested. Be as specific as possible.

Please describe:

- The study design and study population (Which data do you require from which subjects?)
- The general processing steps (to prepare the data for analysis)
- The analysis steps (How are the data analysed to address the hypotheses? If possible, link each description to a specific hypothesis)
- Any additional aspects that need to be described to clarify the methodological approach (optional)

Study design, study population and sample size (e.g. cross-sectional or longitudinal; entire population or a subset; substantiate your choices)

General processing steps to prepare the data for analysis
We will use OpenPose, a 'multi-person system to jointly detect human body, hand, facial, and foot keypoints (in total 135 keypoints) on single images', to detect body key points in the parent-child interaction videos. We will use this pose estimation data and determine rules (features) to detect whether the infant in the video is prone, supine, sitting, crawling or standing.

Specific processing and analysis steps to address the hypotheses

First, we will use OpenPose for body detection in the videos. Output from running OpenPose on the videos consists of a.o. body key-points (shoulders, hips, neck etc.) locations in the screen, and detection confidence of these key-points (see image 1) per frame.

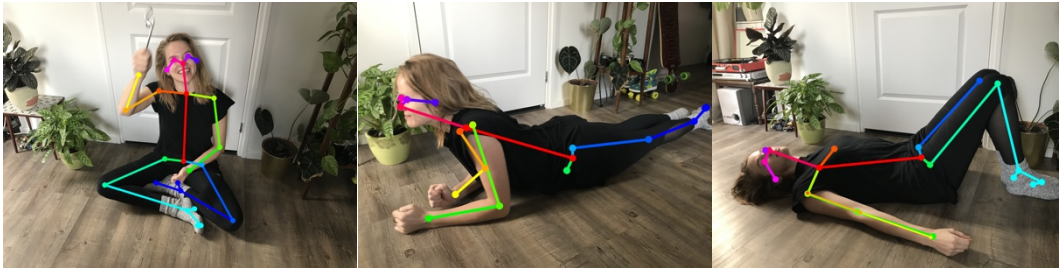


Image 1. Examples of body keypoint detection by OpenPose. The colored dots represent the output OpenPose provides you with: locations of eyes, ears, shoulders, elbows, etc. in the screen.

We will then use a smoothing method (specifically the savgol filter), to smooth the output data from OpenPose. OpenPose regards every frame in a video as a picture where it detects the body key-points. This results in noisy data, which can be smoothed with the Savitzky-Golay filter.

After filtering, we will determine some rules to detect the infant in the videos (e.g. length between key-points might be an indicator).

Finally, we will determine some feature rules which will be able to discriminate different postures (prone, sitting, crawling or standing) from the video. For example, we will first determine whether the angle between the torso and the horizontal axis is larger or smaller than 60° . If the angle is smaller than 60° , we will ask whether there is movement. If yes, we conclude that the infant must be crawling (see image 2).

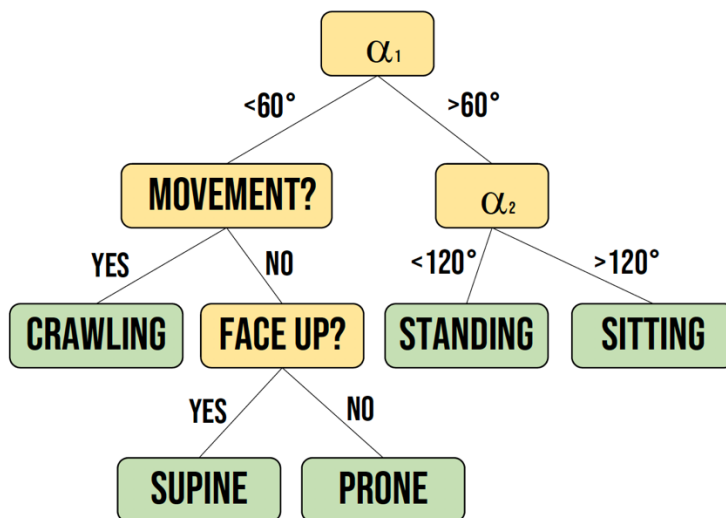


Image 2. Example of a schematic decision tree. The decisions are in yellow and the estimated poses are in green. In the first layer the decision is whether the angle (α_1) between the torso and horizontal axis is larger or smaller than 60° . In the second layer, the decisions are whether or not there is movement, or whether the angle (α_2) between the upper and lower leg is smaller or larger than 120° . In the third layer the decision is whether the face of the infant is facing up or downwards.

Additional methodological aspects (optional)

The determination of the feature rules will first be decided by hand, and then tested whether these rules are enough for reliable posture detection. If reliable posture detection is not possible through these rules, we will use machine learning techniques where similar rules are determined by the computer.

The first option would result in annotating less videos by hand (to verify whether the rules are discriminatory enough to detect the different postures, sitting, crawling, standing, prone or supine) in comparison to the second option (we would need to annotate a training and a testing set of videos), which is why we will work in this order.

Section 5: Data request

In this section, please specify as detailed as possible which data (and from which subjects) you request.

Data requested

It is yet unclear what problems we will encounter, we expect 50 10m PCI videos to be enough for option 1 (as described in specific processing and analysis steps). If we need to proceed to option 2, we would need additional videos to apply machine learning methods.

Data request for the purpose of:

- Analyses in order to publish
- Analyses for data assessment only results will not be published)

Publication type (in case of analyses in order to publish):

- Article or report
- PhDthesis

Would you like to be notified when a new data lock is available?

- Yes
- No

Upon approval of a data request, the complete request will be made publicly available on our researcher’s website by default.

Do you agree with publishing the complete request on our researcher’s website after it is approved?

- Yes
- No. Please provide a rationale