# Gesture–Discourse Alignment Project

### Research Prospectus (Public Repository)

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**Purpose:** To articulate the research motivation, conceptual framing, and analytic logic underlying a publicly available computational pipeline.

## 1. Why this project is public

This repository accompanies an independent research project developed in preparation for PhD applications.

The purpose of making this work public is **not** to present a finalized empirical paper, but to document the **research question, methodological logic, and analytic pipeline** underlying an ongoing line of inquiry.

Specifically, this repository is intended to allow readers to understand:

- What scientific question motivates the project
- How gesture is operationalized and analyzed
- How the analytic pipeline is structured end-to-end
- What kinds of claims the current implementation can and cannot support

No raw video or identifiable data are included.

## 2. Research motivation

A large body of prior work has demonstrated that gestures can reveal aspects of cognitive organization that are not fully explicit in speech.

However, much of this literature relies on **categorical gesture coding** or qualitative annotation, which limits scalability and makes it difficult to examine gesture–discourse relationships at a fine temporal resolution.

This project asks a complementary question:

> **Can gesture be treated as a continuous behavioral signal whose temporal dynamics systematically align with instructional discourse structure?**

Rather than asking *what kind* of gesture is produced, the focus here is on *when* gesture activity intensifies relative to independently defined structural moments in instruction.

## 3. Conceptual approach

The core conceptual commitments of this project are:

- Gesture is modeled as a **continuous kinematic process**, not a symbolic category.
- Gesture events are defined operationally via **velocity peaks**, not semantic labels.
- Discourse structure is annotated **independently of gesture data.**
- Alignment is evaluated through **rate-normalized comparisons**, not raw counts.

Under this framing, the central test is whether gesture activity is **enriched near discourse-structural points** relative to baseline instructional time.

## 4. Pipeline overview (how to read the repository)

The repository implements an end-to-end pipeline with the following stages:

1. **Video preprocessing and localization**
   Classroom videos are processed to identify teacher presence and extract wrist trajectories using computer vision tools.
2. **Kinematic signal construction**
   Frame-level wrist positions are transformed into continuous velocity signals.
3. **Gesture event detection**
   Salient gesture events are identified via high-quantile thresholding and temporal clustering of velocity peaks.
4. **Discourse–gesture alignment**
   Detected gesture events are aligned to pre-annotated discourse-structural points using symmetric temporal windows.
5. **Statistical evaluation**
   Alignment is quantified using rate-normalized enrichment statistics and evaluated against permutation-based null models.

Intermediate outputs (CSV files and Excel alignment workbooks) are preserved to support transparency and auditability.

## 5. Current status of the project

The code in this repository reflects an **active research implementation** that has been piloted on a small number of classroom lecture segments.
Preliminary analyses suggest that gesture events are **not randomly distributed in time**, but show systematic enrichment around discourse-structural moments. Robustness checks across detection thresholds and alignment windows indicate that this pattern is stable under reasonable analytic variation.
These results should be interpreted as **proof-of-concept**, not as final empirical conclusions.

## 6. Scope and limitations

This repository is intended to demonstrate:

- a methodological framework
- a reproducible analytic pipeline
- a theoretically motivated operationalization of gesture–structure alignment

It is **not** intended to:

- serve as a finalized paper
- claim generalizable effect sizes
- replace detailed qualitative analysis of gesture meaning

The project is designed to be extended, refined, and potentially integrated with complementary analytic approaches.

## 7. Intended audience

This prospectus and repository are intended for:

- faculty reviewing PhD applications
- potential advisors evaluating methodological fit
- researchers interested in quantitative approaches to gesture and instruction

Readers are encouraged to treat this repository as a **research artifact**, not a polished product.

### How to cite or reference

If you wish to reference this work, please cite the GitHub repository and note that the project represents ongoing, unpublished research.