**Eye-Hand Coordination Plan**

Experiment Completed

* 8 subjects tested (~240 reaches each – about 60 for each condition)
* 4 conditions
  + Eye-Alone No Feedback
  + Eye-Alone Feedback
  + Eye-Hand No Feedback
  + Eye-Hand Feedback
* Questions that we hoped we could answer:
  + What is the temporal sequence of events that occur during reaching?
    - Hypothesis – Target onset 🡪 Eye onset 🡪 Eye Fixation 🡪 Hand onset 🡪 Hand fixation.
  + How accurately can humans fixate on a target?
    - Hypothesis – 4cm
  + What information from gaze data can we use to approximate reach?
    - Hypothesis – Delays, onset velocities, saccades, smooth pursuits
  + What is the impact of entangled feedback on subjects during reaching?
    - Hypothesis – Feedback will increase accuracy but also increase noise.
  + What can we do to improve the accuracy and overall feel of the system?
    - Hypothesis – use (micro-saccade) feedback but manipulate effector dynamics to smooth movement. Also, more closely resemble natural reach.
* Paper will include:
  + Temporal sequence of events (not novel)
  + Accuracy of achieving targets (not novel)
  + Entangled feedback (novel)
  + Generating reaching trajectory from gaze data to match natural reach (novel)
* Potential next steps:
  + Changing effector dynamics to improve accuracy and feel (maybe novel in 3D)
  + Experiment to evaluate effectiveness of changing cursor dynamics and natural reaching trajectories?

**Paper Overview**

**Questions to answer:**

1. Temporal sequence of events
2. Accuracy of human reaching
3. Impact of entangled feedback
4. Natural reaching trajectories

**Hypothesis:**

1. Target onset 🡪 Eye onset 🡪 Eye Fixation 🡪 Hand onset 🡪 Hand fixation
2. 4cm
3. Improve accuracy, increase noise
4. It is possible

**Step to complete:**

1. **{Target onset}** is known.
2. Offline fixation filter described by Pontus Olsson (2007) – will detect where fixations occurred in 2D **{Eye Fixations}**. Can also use CUMSUM for each signal independently in 1D, but probably less valuable and delayed.
3. Velocity thresholds described by Gopal (???) – will detect onsets **{Eye onset, hand onset, hand fixation}**
4. **{Accuracy}** is determined by the difference between **Eye fixation** and **Target location** during a specific reach.
5. **{Noise}** can be computed using a high pass filter (Olsson).
6. Still unknown: how best to approximate reaching function?

**Notes (4/15):**

* Write down independent and dependent variables
  + Dependent (will find significance of accuracy for each dependent variable)
    - Feedback vs no feedback (categorical)
    - Targets
      * Start with each target number, so have 6 of them (categorical)
      * Reach length (numerical)
    - Subject
  + Independent: Accuracy (eye and hand)
* Need to add more in the intro and methods including above and more on data analysis and statistics
* Look up “what statistical method should I use UCLA?”
* Eric thinks the outcome of the second research question should be a mapping between the eyes and the hand. If it’s simply the gaze data plus a delay, I should see if that works for all subjects

**Statistical Tests**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Independent** | **Dependent** | **DV Type** | **Nature of IVs** | **Test** |
| Feedback vs no Feedback | Fixation accuracy | numerical | 1 IV with 2 levels | 2 independent sample t-test |
| Feedback vs no Feedback | Hand accuracy | numerical | 1 IV with 2 levels | 2 independent sample t-test |
| Target number | Fixation accuracy | numerical | 1 IV with 6 independent levels | One-way ANOVA |
| Target number | Hand accuracy | numerical | 1 IV with 6 independent levels | One-way ANOVA |
| Reach Length | Fixation accuracy | numerical | 1 IV with 4 independent levels | One-way ANOVA |
| Reach Length | Hand accuracy | numerical | 1 IV with 4 independent levels | One-way ANOVA |
| Target Number & Reach Length | Fixation accuracy | numerical | 1 IV with 6 dependent groups | ??? |
| Target Number & Reach Length | Hand accuracy | numerical | 1 IV with 6 dependent groups | ??? |