# Relevant experiments using mouse-tracking

“Continuous attraction toward phonological competitors” by Spivey et al.

Much of cognitive science theories build on “discrete stage-based theoretical framework[s]”, however Spivey et al. wants to show that “partial activation of multiple lexical representations (“cohorts”) cascading to later stages of processing even just of the way through hearing a word”. Meaning that information about the word being heard are being passed along to the next stage even before “the single correct lexical item is identified”.

In this paper Spivey et al. wants to investigate whether the activation of word representations are updated continuously and cascading the output to later stages or if the process still have parts working in a discrete stage-based like manner.

The confusion has come from that it can be hard to distinguish between a continuous account and discrete account when averaging over the motor outputs.

Mouse-tracking provides a high quality visualisation of the continuous cognitive dynamics, e.g. in real-time spoken-language processing.

A model called TRACE that simulates speech processing show a nonlinear increasing probability function for “beaker”, when “beaker” is the spoken word. The probability function for “beetle” will be rising and then falling over time.

Spivey comes with a good motivation of mouse-tracking over eye-tracking. Eye-tracking is only a semicontinuous record of eye-movement, since the steady fixations are a bit like categorical data since it is a steady fixation of one object over time only making researchers able to approximate the continuous nature. Movement-tracking however will show continuous movements’ graded pull towards other object than the one chosen.

Their first test is a REALLY SIMPLE AND UNINTERESTING statistical test of error rates.

They give a good account of time normalisation of x-, y-coordinates. The method uses linear interpolation to calculate a mouse-coordinate between two discrete samples. This is done for x and y separately.

In their analysis section they seem to do a lot of different t-tests and some linear models. But so far it all seems a bit dumb. None of it is actually answering the question about dynamic or discrete stage-based processing.

They show a stronger effect for rightward movements compared to leftward. The explanation proposed involves kinematics of right arm and position of the mouse to the right of the keyboard.

They use a speech-recognition model called TRACE to simulate the same experiment. The model produces results that are comparable to the experimental results.

List of analysis elements:

* T-test between percentage of incorrect trials in cohort and control
* T-test between total response time (from visual onset to correct mouse click) in cohort and control
* Linear model??? (based on no main effect): time\_initiation\_movement ~ condition
* Linear model??? (based on significant main effect): duration\_of\_movement ~ condition
* T-test between x-coordinates in cohort and control (done for each time slice)
  + Only significant for leftward from 70th to 81st time slice
  + Only significant for rightward from 9th to 92nd time slice
* T-test between proximity to target object and proximity to distractor object for control condition (done for every 10th time slice)
* T-test between proximity to target object and proximity to distractor object for cohort condition (done for every 10th time slice)
* Calculated degree of curvature, converted to z-scores within participants (for both control and cohort), and then pooled across participants. Then they calculate mean, variance, kurtosis, skewness and bimodality coefficient (b) for both cohort and control (“with b > 0.555 being the standard cutoff for multimodality”)
  + Kolmogorov-Smirnov test done to estimate normality of data. Both are either not normal or close to not normal due to high kurtosis, meaning that they are further from bimodality
* Calculate area under the trajectory, converted to z-scores within participants (for cohort and control seperately), and then pooled across subjects
  + Use Kolmogorov-Smirnov test to evaluate differences (since mean and variance is the same (I do not know how???))
  + Since control should be unimodal, then if they are similar cohort is also unimodal

“Mouse tracking as a window into decision making” by Maldonado et al.

“The Cognitive Dynamics of Negated Sentence Verification” by Dale & Duran