# Intro, mouse tracking and motivation

“How Mouse-tracking Can Advance Social Cognitive Theory”

<https://www-sciencedirect-com.ez.statsbiblioteket.dk:12048/science/article/pii/S1364661318300731#bib0015>

Mouse-tracking investigates a decision conflict and how this is resolved. Dual-system theories (i.e. Kahnemann) suggests that an automatic process (system I) controls the first part, while a rational controlled process (system II) inhibit the response of system I if needed. This could possibly also be part of the explanation in Spivey experiment. The dual system approach do not always expect a conflict, it is more seen as the system II either affirms or corrects the response of system I. “In the context of mousetracking,

such systems might predict either (i) trajectories that are direct towards one option,

and then perform a sizable mid-flight correction (system II corrects), or (ii) relatively direct

trajectories towards the chosen option (system II affirms)”. The article actually mentions the Dale and Duran experiment as a dual-system one.

Another type of explanation could be models collectively referred to as dynamical frameworks, referring to many conscious and unconscious processes competing when making a judgment or decision. This would be seen as more of a curved mouse-trajectory, and not so much a straight one. Mouse-tracking has proved more support of dynamical than dual-system, supporting that the dynamical frameworks is a better description of how decisions actually unfold.

Before mouse-tracking researchers tried to infer decision conflicts from self-report or behaviour rather than measuring it. Measures like eye-tracking, EEG and reaction times often complicates directly measuring the unfolding of decisions.

Mouse-tracking can be used to measure decision processes in real time, because research indicate that motor movements are being corrected and changed while cognitive processes progress and change, creating a continuous update of the movement according to the internal processes.

The often-used experimental setting in a mouse-tracking experiment involves a repeated binary choice selection task, where the participant has to move their mouse from the bottom of the screen at a designated start location to one of the two options. Often this involves either the task of categorising a stimulus (you could possibly say that this is done in Spivey?) or choosing what option a participant prefer.

Nature of trajectory evolution: this section talks about how a trajectory “should” look like, if the dual system theories are “right”. The mouse should be moving towards the wrong category and then have an abrupt change of direction (“large mid-flight correction”). This could also be seen by whether trajectories have relatively small or large AUC values compared to an optimal straight line.

Integration times: note necessarily interesting for us, but it could be included in explanation of why certain stimuli do not show the expected cohort effect, while others do.

An interesting study investigated gender-typical appearance and politicians. They found that politicians who were less stereotypical male/female was associated with fewer votes.

The article also has a section on why mouse-tracking is even necessary, when eye-tracking, EEG, fMRI and reaction times exist. The argument basically come down to being: mouse-tracking is much cheaper and also much simpler to interpret, and does not rely on complex modelling or previous research. They move on to closely relate mouse-tracking to reaction times (but maybe it would have been more interesting to compare it to eye-tracking?).

The article ends with evaluating mouse-tracking and stating the limitations of the method, such as only being valid for multi-trial experiments, having to include a rather simple decision (i.e. complex decisions for example involving reading would interfere too much with the measure), the choices have to be made explicitly and the method works the best with only two options (binary choice selection tasks).

“Doing Psychological Science by Hand” by Freeman

Since Donders in 1868 first made use of reaction time and Donders’ subtraction method to infer a difference between two distinct processes, reaction time has been the golden standard in estimating cognitive processes happening in just a few milliseconds.

Methods such as eye-tracking with a high temporal resolution has provided solid knowledge about the temporal evolution of behavioural responses and their underlying cognitive processes, however eye-tracking is lacking a “more direct measures of the real-time evolution of the response itself—and of potential activation of alternative responses”.

Results from research with single-cell recordings of monkeys suggest that “ongoing

updates of a decision process are made immediately available to the premotor cortex, which continuously guides response-directed hand movement as a decision unfolds” making the moving of the mouse a direct visualisation of the cognitive processes in relation to the decision.

The article also mentions the fact that much of mouse-tracking research have been done in relation to dynamic models vs. dual-system models.

Dynamic systems approach would predict the mouse-trajectories to be unimodal, since the trajectories will be a result of a lot of different processes competing. The dual-systems approach would predict the mouse-trajectories to be bimodal, since system I would either be corrected or affirmed by system II, causing “extreme mid-flight correction” trials or no-attraction-trials.

However, patterns of dynamic processes can still look like a stage-like process pattern but reflecting a rapid “phase transition” within a single dynamic system, as opposed to be a rapid change caused by system II overriding system I. Therefore “the important question may not be which pattern is observed for a given cognitive process, but rather under what conditions these different patterns manifest”.

A comparison of eye-tracking and mouse-tracking ending up suggesting that they might be complementary of each other, since eye-tracking can catch “pre-attentive processes before initiation of hand movements” and since mouse-tracking tracks hand movements which can “inhabit in-between states among multiple responses” (as opposed to eye movements that can only fixate on one response at a time).

“Action Dynamics Reveal Parallel Competition in Decision Making” by McKinstry, Dale and Spivey

Two option decision tasks are common in both daily life but also in regards to bigger life decisions, e.g. choosing career in academia or industry. You often feel pulled towards both decisions in such tasks while making the decision. Results of experiments where people had to indicate a response with a hand movement indicate that a decision process is not necessarily completed, when movement starts, making the movement update throughout the trajectory towards an end goal. This suggests a dynamic approach to mental processing.

The experiment is a simple two-choice mouse-tracking task, where people had to answer whether a question is “true” or “false”.

“MouseTracker: Software for studying real-time mental processing using a computer mouse-tracking method” by Freeman and Ambady

This article starts out by also describing the possibilities and limitations of other method, thereby motivating mouse-tracking.