Use-dependent plasticity in assistive interfaces:

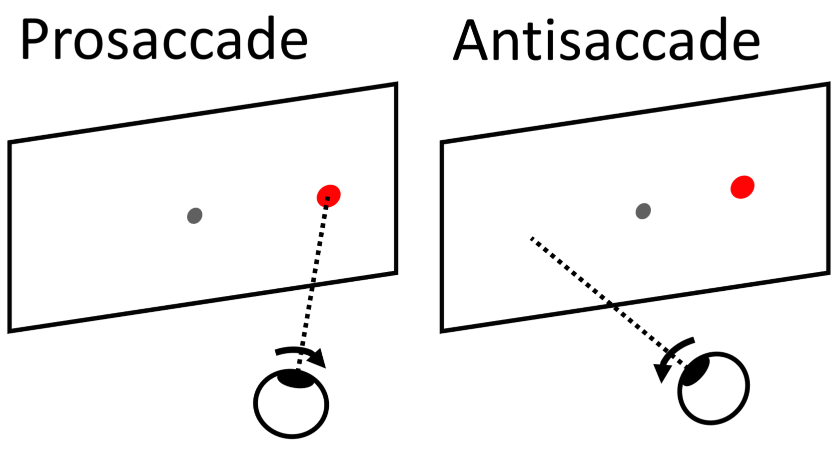
Gaze-typing improves inhibitory control

David Souto[1], Olivia Marsh[1] and Kevin Paterson[1]

Pdf + Demo
VisuoMotorLab.ac.uk

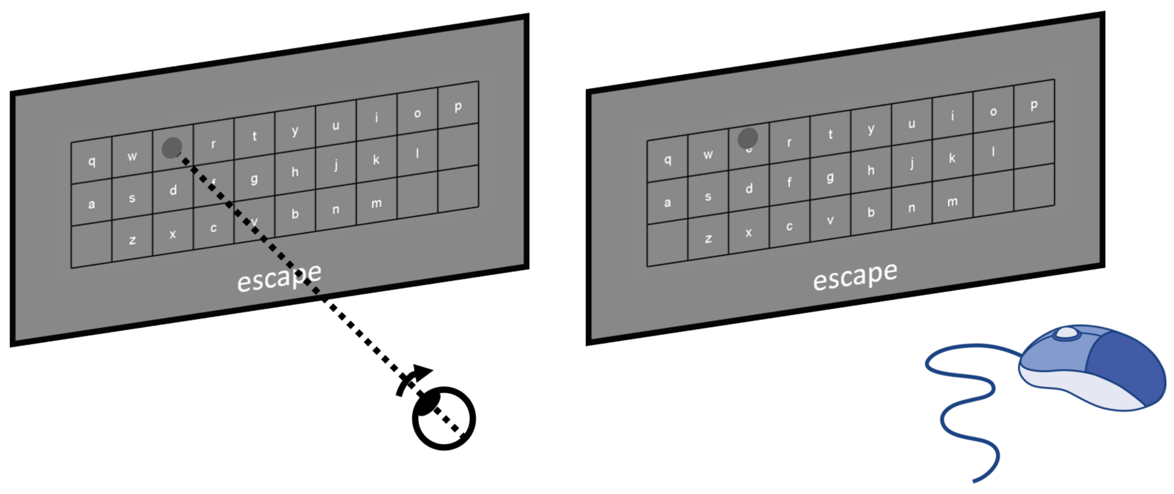
Gaze has proven to be an efficient way of controlling a computer interface (e.g. for people with MND). How do we learn to look for the sake of selection rather than for the sake of looking? How does gaze control differ from hand control? We tested novice gaze- and mouse-typists' saccadic inhibition (anti-saccade task) at the beginning and end of five typing sessions.

Pre– and post training: Antisaccade task



Used as a measure of saccadic inhibition. We also evaluated spatial memory and linguistic skill in the pre-test phase.

Training phase: Gaze (N=21) vs Mouse (N=21) typing



Typing task: type about 100 frequent 6-letter target-words over 5 sessions using a QWERTY virtual keyboard. Selection controlled by dwelling time adaptively. Dwelling time goes down/up depending on correct/incorrect selection.

Gaze-typing improves the ability to **inhibit** saccades within five 30 mn sessions.

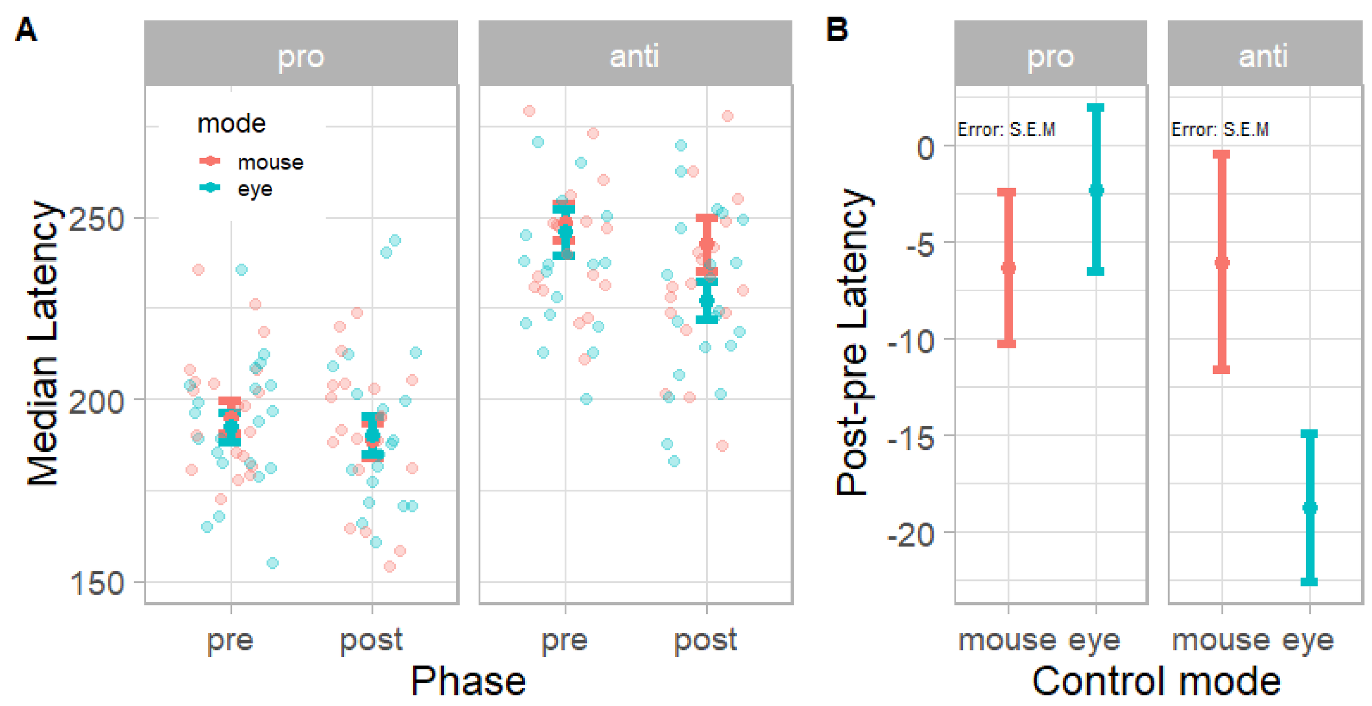
Gaze and mouse-typing differ the most **temporally**. To make a correct selection, dwelling times need to be about **150 ms longer** with gaze typing. The capacity to plan a movement sequence appears to be lower with gaze too.

The **spatial** distribution of errors is similar for gaze and mouse typing.

Anti– and pro-saccade latencies

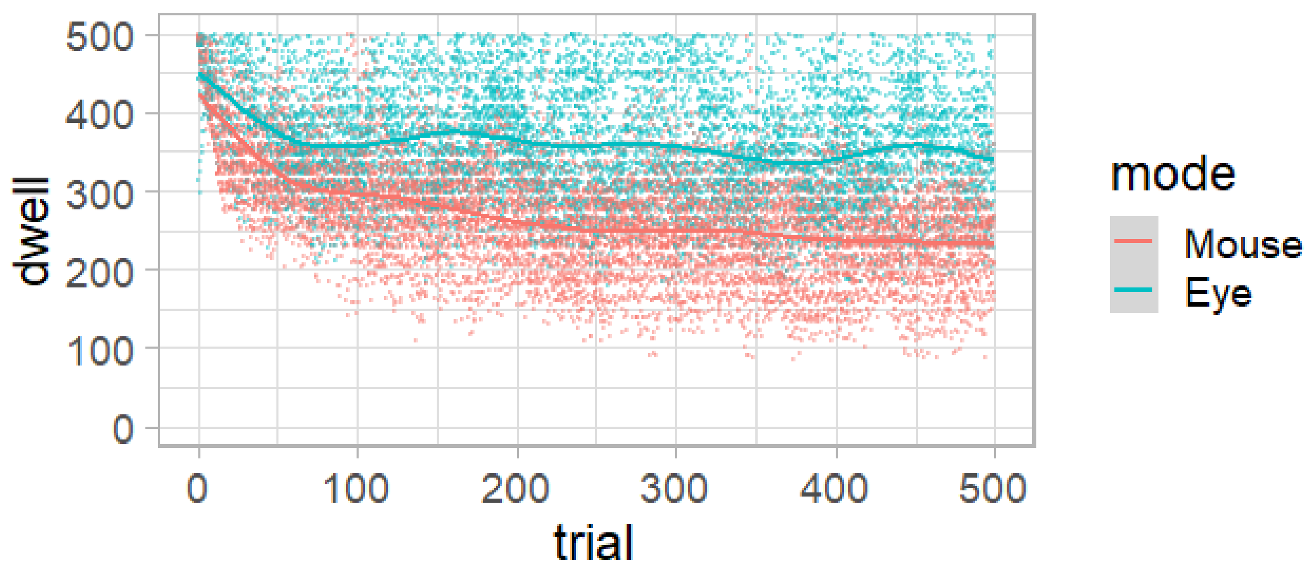
Significant interaction between control mode and testing phase ($X^2(1)=18.059$, $p<.001$) explained by shorter RTs after training in the gaze-control group (see A & B).

No effect found on anti- or pro-saccade errors.



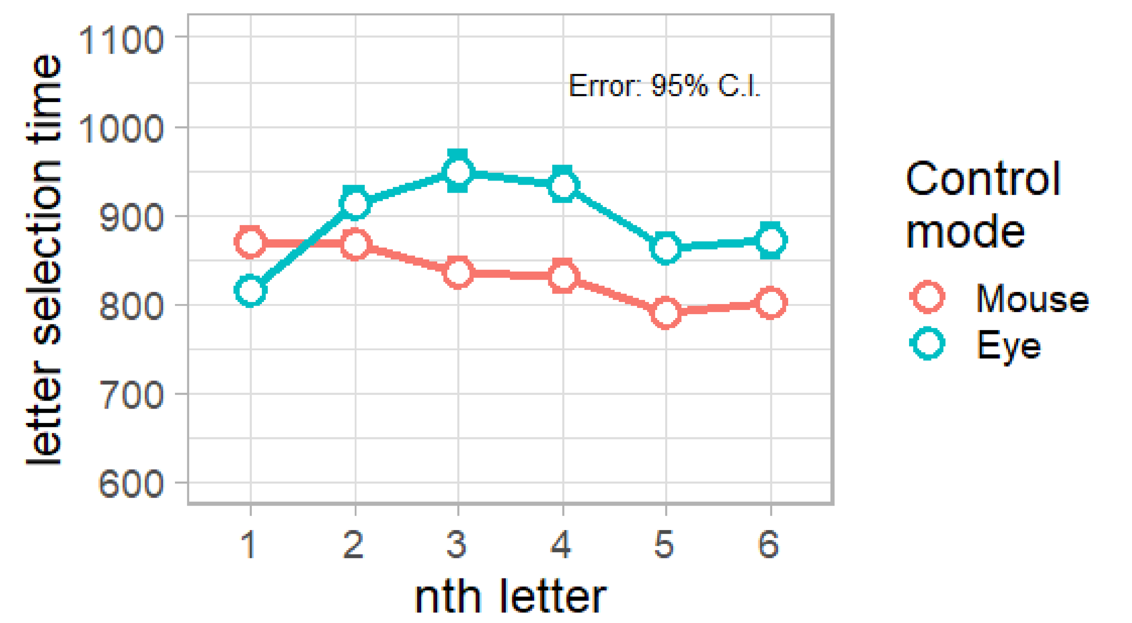
Dwelling time

Since selection dwelling time was adjusted adaptively, it gives us a measure of performance



Letter selection time

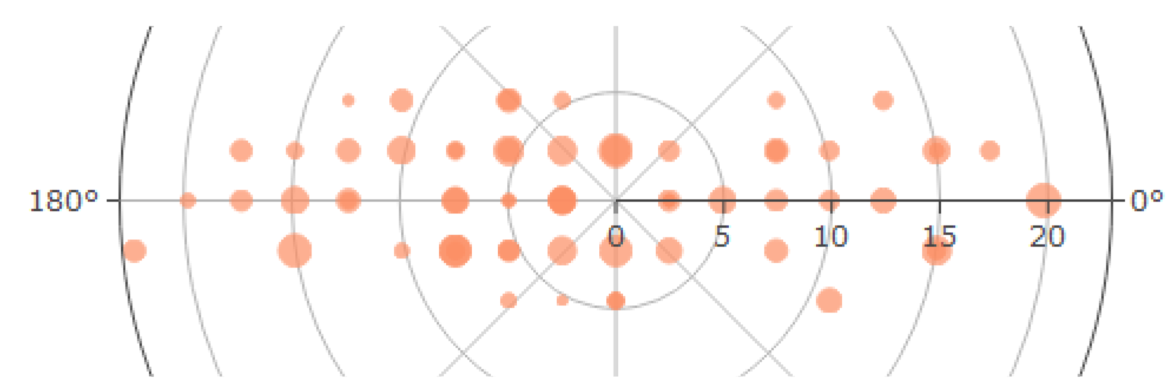
The time it took to select each of the letters of a target word differed between control modes, which could suggest a more limited capacity in pre-planning sequences of eye vs. hand movements.



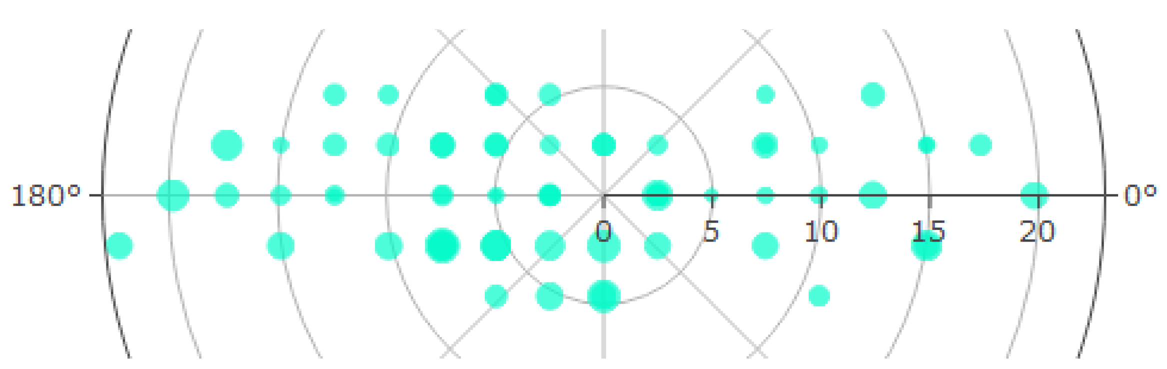
Spatial statistics

At the character level the correlation of error rates between control modes is high (r=.78). Below, frequent letter-transitions are represented by direction (degrees) and distance in degrees of visual angle, with error-rates (0 to .5) represented by dot size.

Gaze control

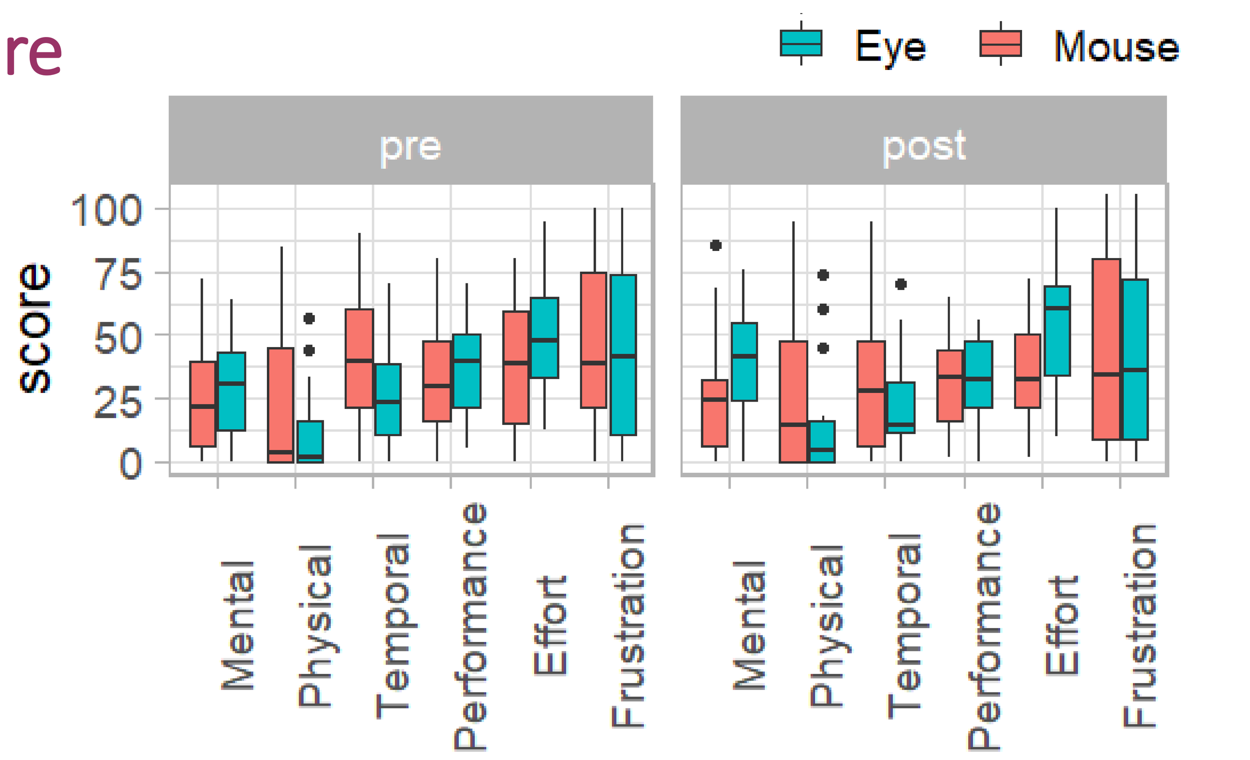


Mouse control



Usability: NASA-TLX questionnaire

Similar subjective workload between control modes along the dimensions of the NASA-TLX, before and after training. Only effort was found to be higher in the gaze-control group post training (p=.01).



1, Neuroscience, Psychology and Behaviour, University of Leicester

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