

Gaze and Mouse Coordination in Everyday Work

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Mouse and gaze

Related work:

How do trajectories of mouse and gaze vary together in time?

Lab studies

Fitt's law

Time (T) varies with distance (D) and size (W)

$$T = a + b \log_2 \left(1 + \frac{D}{W} \right)$$

In the real world:

D and W are uncontrolled.

Targets don't exist in isolation.

Lab: coordination in time

Smith *et al.* ETRA 2000

Three patterns: gaze leads mouse, gaze follows, switching between mouse and target

Bieg et al. ETRA 2010

Unknown target location: gaze “leads” by 300 ms

Known target location: mouse often leads

Lab: coordination in space

Chen *et al.* CHI 2001: Web browsing

Average gaze-mouse distance when moving between AOs:

90 px, with 40% of cases < **35 px**

Huang et al. CHI 2012: Web search

Average gaze-mouse distance: **178 px** and $\Delta x > \Delta y$

Mouse and gaze

Investigation

How do trajectories of mouse and gaze vary together in time **in the real world?**

Tasks and time boundaries not so clearly delineated!

Observational study

11 office workers

Used their own displays

Used their own applications

30 – 45 minutes

Tobii REX Laptop Edition

30 Hz, $\leq 1^\circ$ acc., $\leq 1^\circ$ prec.

Simultaneously record mouse and gaze

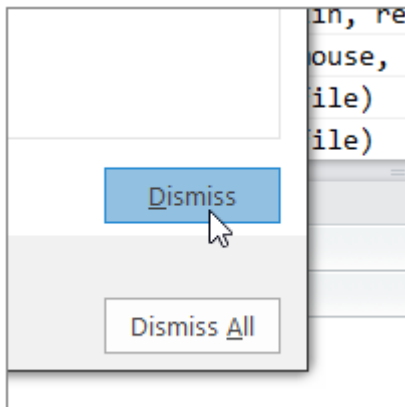


Clicks: a useful delimiter

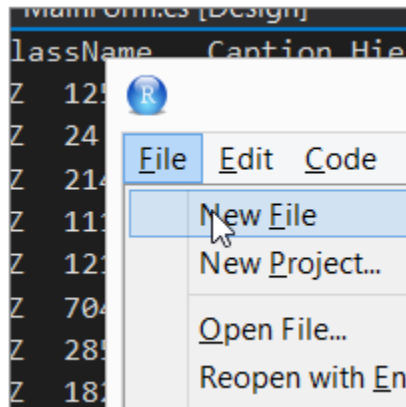
Clear signal of action intent!

Upon click:

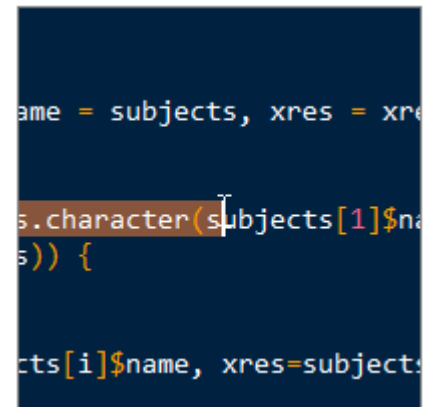
Take 200×200 px screenshot, record class of object



Button



Menu item



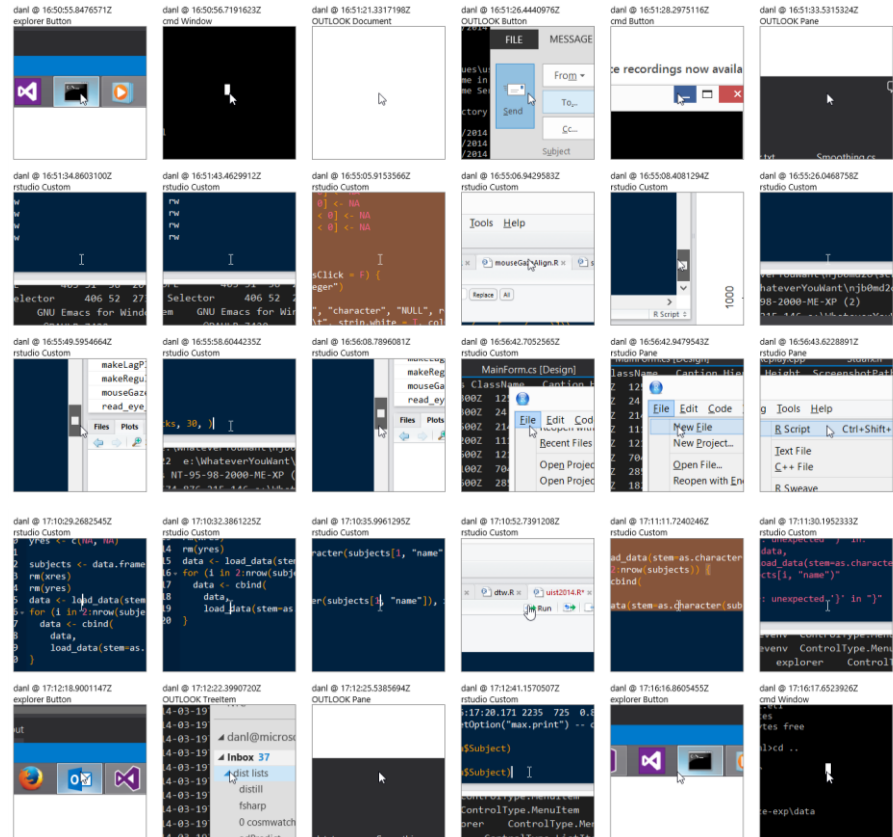
Document

Data extent

378 minutes

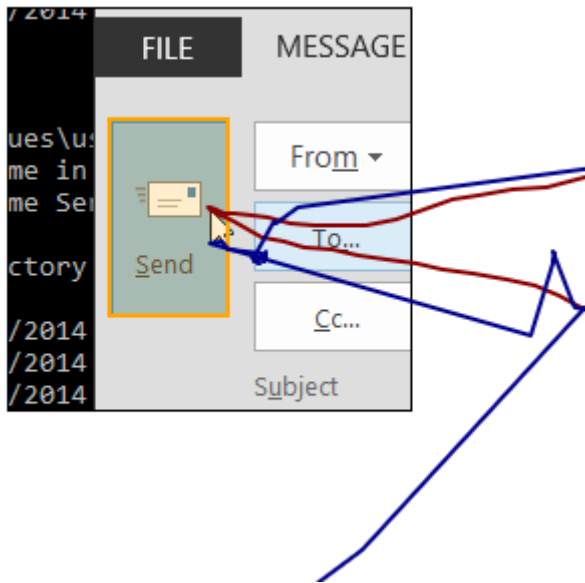
485K gaze points

3.6K clicks

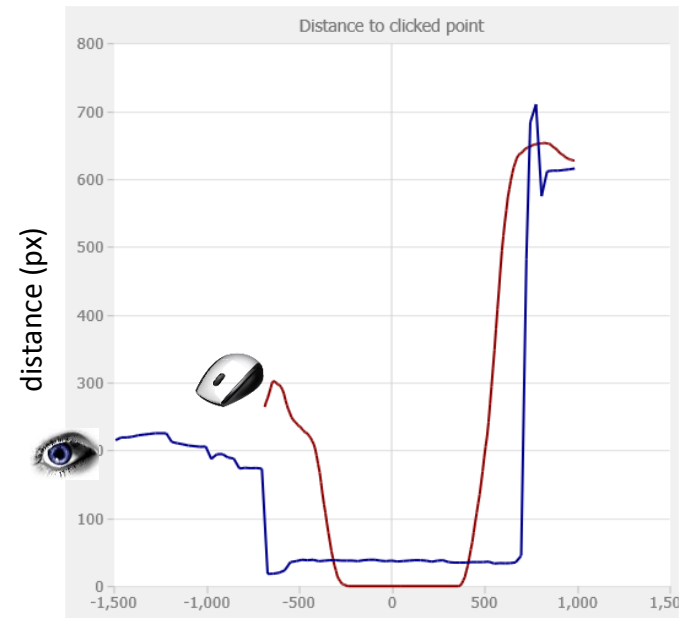


Window around the click

Spatial



Spatiotemporal

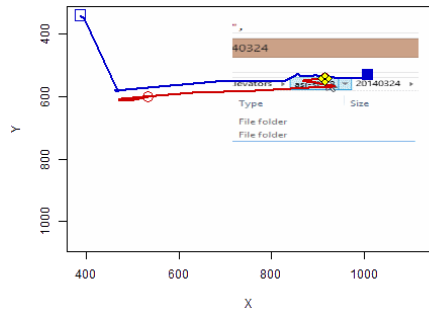
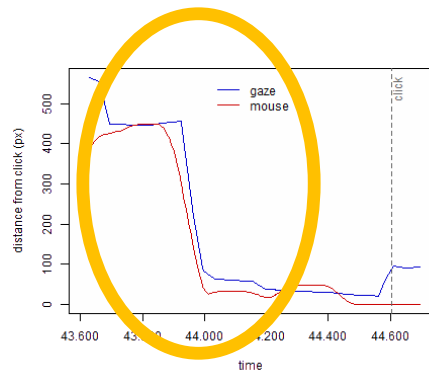


— Mouse — Gaze

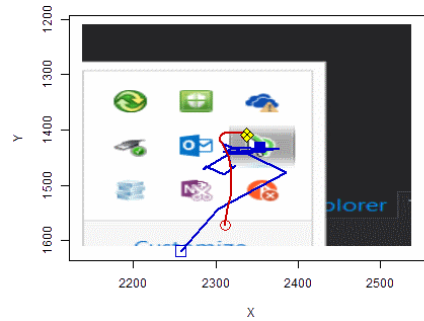
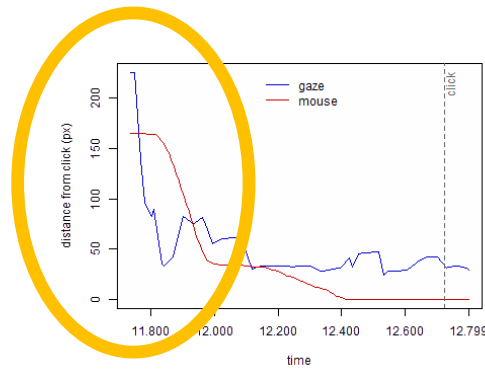
↑
click

Coordination patterns

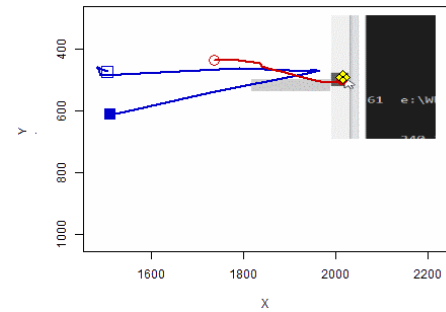
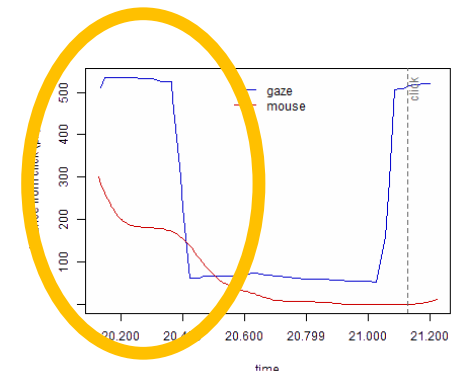
Synchronized



Gaze Leads



Gaze Follows



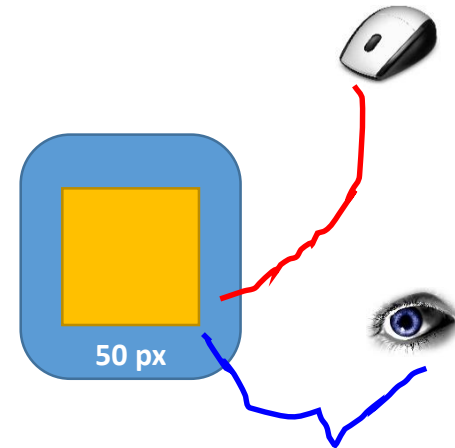
— Mouse — Gaze

How often does gaze lead?

Method 1:

Which gets to **within 50 px** of target first?

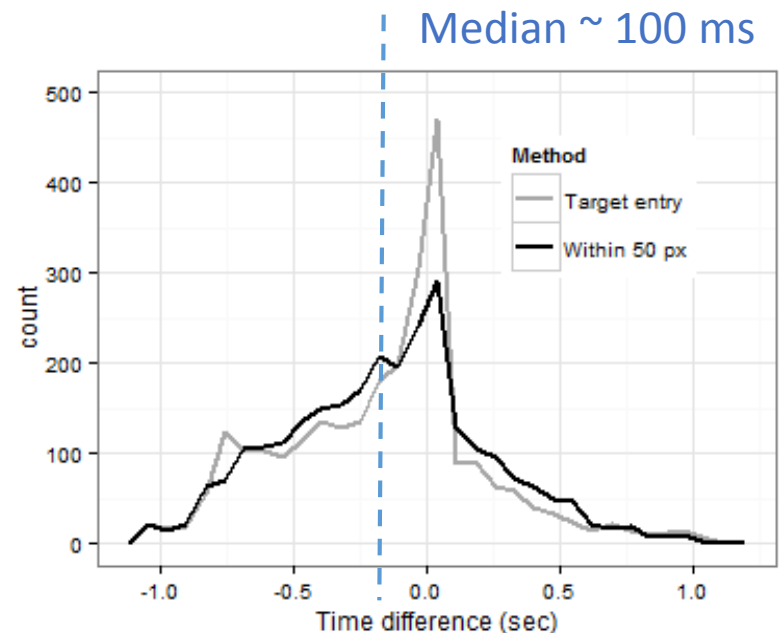
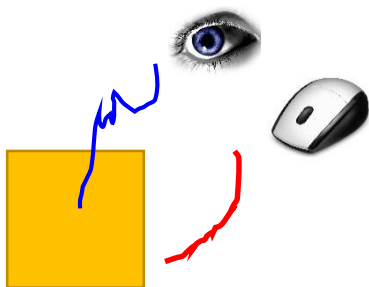
→ Gaze precedes *only* 63.5% of clicks



Method 2:

Which **enters the target first**?

→ Gaze precedes 64.2%



Quantifying gaze lead temporally

Method 3:

In 1000 ms window before click,

when does the first saccade occur?

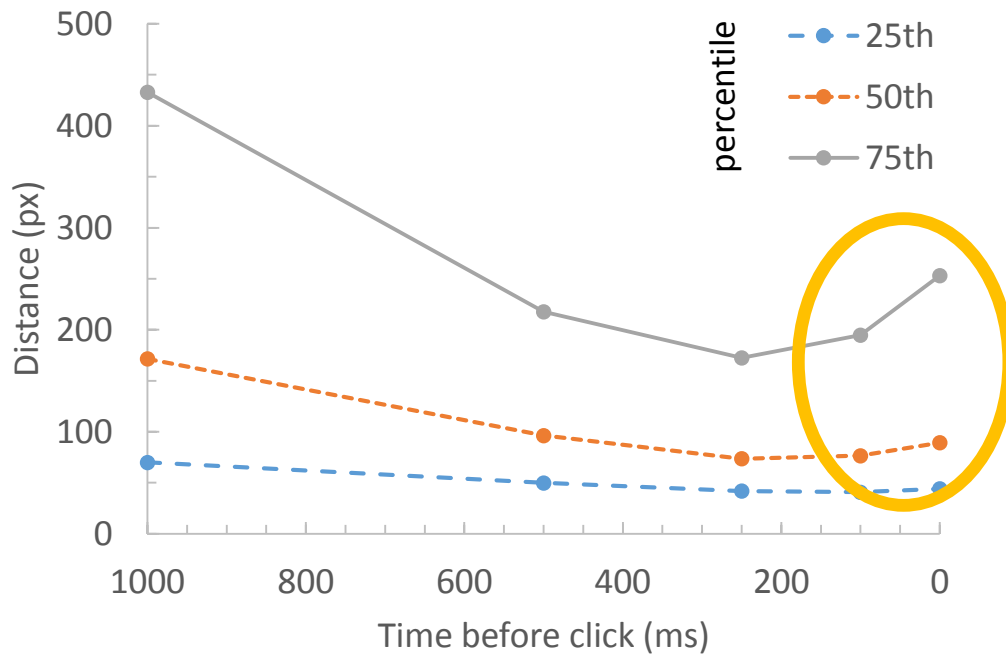
Median time of first saccade: 816 ms prior to click

(saccade threshold: $dx/dt > 200$ px/s)

Quantifying gaze lead spatially

Time to click

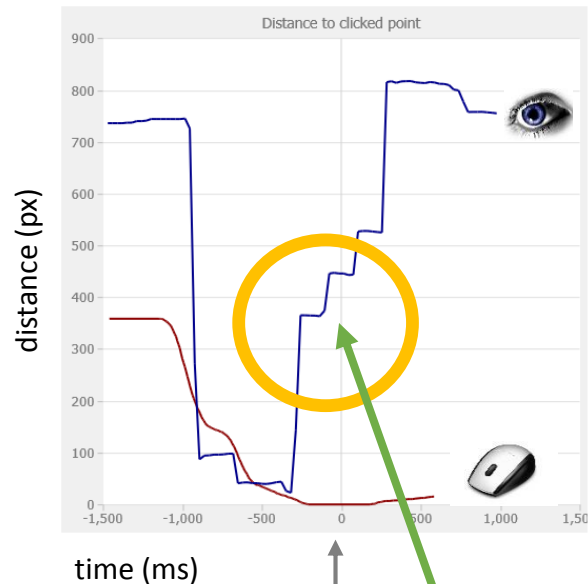
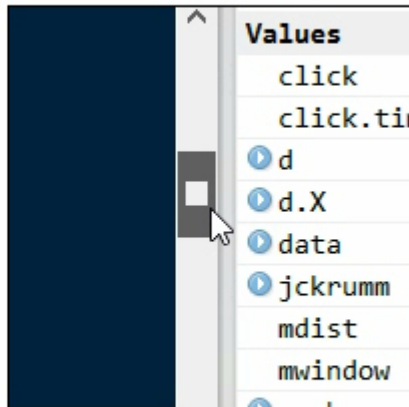
$\| \text{mouse} - \text{gaze} \|$ at t ms prior to click



Early departure

Where is the gaze at click time?

In 7.7% of clicks, gaze has already left the target.



— Mouse — Gaze

click

**Gaze is long gone
when the click occurs!**

Early departure

Seems to occur in highly stereotyped actions.
(e.g. Start Button, title bars, etc)

MAGIC (Zhai et al.) warps mouse cursor to gaze point after mouse actuation.

BUT

Due to early departure, can't always depend on gaze position during mouse actuation.

Conclusions

Open-ended task recordings give nuanced views

Use clicks as convenient action intent delimiters

Eye usually leads the mouse, as expected

But only 64% of cases

Early departure – 7.7% of cases

Implications for interaction techniques!

Thank you!

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