... cont'd from last time :
    finishing up reading studies
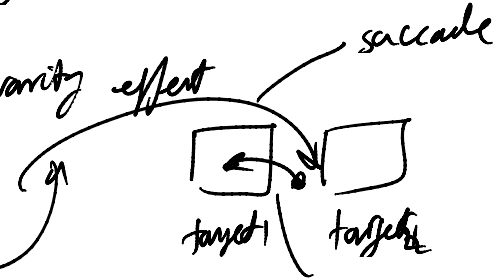 — two other findings :
    1. — center of gravity effect
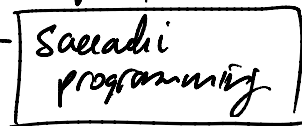
saccade

reading strategies
  eg. careful vs. risky
    — not known whether
  you can choose this trajectory:
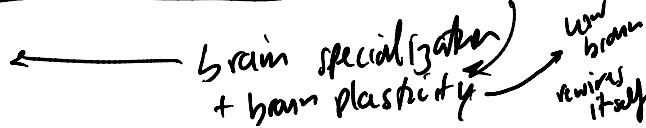   thought to be computed
  in brains —

target 1   target 2

microsaccade to
correct

Saccadic
programming

→ neuroscience

functional regions
  — Broca's area
    → language

brain specialization
+ brain plasticity

how
brain
rewires
itself

Scene Perception

— main difference vs. reading:
        no obvious strategy

— context is important
    (e.g. expectation — what do you expect to see
                        in a scene
— [scanpaths are task-dependent] — Yarbus

- 3 reasons to study eye movements:
    - eye movements are critical for efficient & timely acquisition info

    - how we acquire info is important in study of perception + cognition

Best of both: { Unobtrusive measure — doesn't interfere — interferes with task
Retrospective Think-aloud
    ↳ becoming particularly important for usability studies
        ↳ e.g. argument analogous to one against think-aloud
            ↑ obtrusive

— Two important issues:

1. where fixations go — Regions Of Interest
ROIs

2. how long do they dwell there

fixation duration $\overset{?}{=}$ cognitive load

— Methods

very common {
- fixation location
- fixation duration
- total time ROI fixated

scanpath (circled) — first fixation duration (within RoI)
(order) — first pass gaze duration (time in region)
— second " " " (2nd time in RoI)

(UYC)
scene perception
— also relevant
to visual
inspection
(IG)

Tasks:

Perception of Art :
- fixations tend to be regular
  (falling on same regions)
  why? maybe because artist wanted
      you to look there ...

- Dave Woodings : 5,000+ subjects (London gallery)

Visual Search : how are search for things
    in image
- active research area, particularly for modelling

Visual Search Models?

    Treisman's FIT

                Feature Integration Theory

    Wolfe's Guided search

    Osberger and Maeder's _____

    Itti et al : a very good computer
                model of visual search
                (still & now video)

contrast,
luminance, etc. _____ Saliency - based
    ⤷ known to attract visual attention — modeled on
                          neurons in the cortex

Natural Tasks

- Land + Hayhoe → Sandwich making
    making tea
    - eyes provide
        info (as needed) — you don't
            memorize everything
            about the scene
    - eyes usually
        precede motor
        functions (hand movements)

[─ other tasks]

- Auditory language processing — psycholinguistics
- math, number reading
- Face perception   — see Rayner's article
- Illusion)

Last time :

    eye movement research in Psyc

Today :

    IE (HF) + CPSC

I.E:
    looking at environments where humans work

<u>usability</u>

performance process
metrics methods
(speed, accuracy) (eye movements)
everyday tasks)

Megaw & Richardson (1979 ?)

of
survey of eye movement (metrics)

aviation
driving
visual inspection :
    — conveyor belt lines (looking at bottles, underwear,
    — x rays { radiologist   garments)
           { TSA —   at airport
            people

training
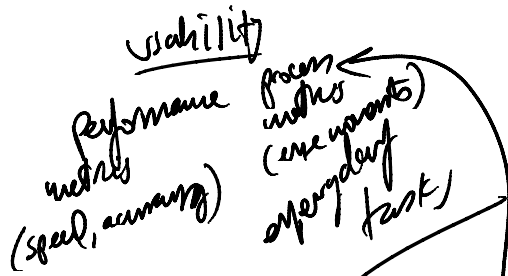
In HF:

— simulators are often used / developed

e.g. cockpit / flight simulators

driving simulators

cars trucks tractors

John Deere

Vision in vehicles conference

aviation conferences

Anders (2001)

chip Scialfa
@ U of Calgary

↳ cluttered scenes

"vigilance studies" — do operators fall asleep
(eye lid tracking)

driving: cell phones are ~ hot topic these days

Grueher & Andre (1999):

          Electronic Moving Maps (EMMs):

for aviation: did they help pilots taxi better
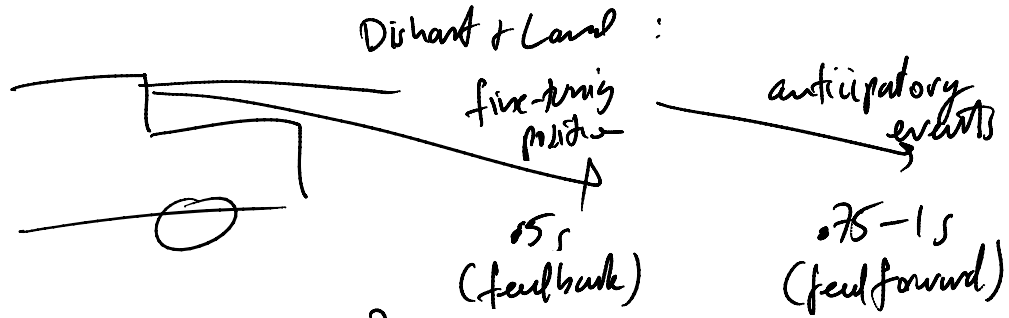
          (esp in bad weather)

new display design

                              where do drivers look?

chapman & underwood: driving experiments ✓ ⟶

        expert to novice comparison

          hot topic in eye tracking right now

popular technique is to use genetic algorithms for
      bioinformatics: comparing scan-paths: like DNA
                     sequence)

Dishart & Land :

five-going position

anticipatory events

.5 s
(feedback)

.75 - 1 s
(feedforward)

where do Drivers look?

straight roads : roughly at point near to
focus of expansion (where
objects appear stationary)

curve : at tangents

More visual inspection:

    Schoonard et. al:

        Inspection of: poultry meat, fish

             (drugs, x-rays, industrial line

drug labels

           photo interpretation)

(
visibility of
dry label)

                aerial photo inspection

(Bojko 2006) ___ User center in chicago with Abby Stephage)
              & Jen Pappas   ) CU

                        Psyc
                        student
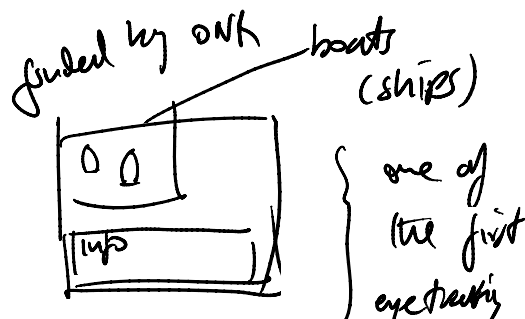
Megaw & Richardson:

metrics:

fixation duration

fixations

spatial distribution (coverage)

interfixation distances

direction of eye movements

sequential indices (scanpaths)

HCI : CPSC

1990 {
— Rob Jacob @ Tufts
    — WYSIWYG
    — Midas Touch problem

— Starker & Bolt

eyetracking + other stuff

voice
knyli
brain
———
multimodal
VR
}

everything
you look at
gets activated

no easy way to click on something with eye

funded by ONR   boats
                       (ships)

1990

{ one of
the first
eyetracking

"visible gpir"
interactive app
~ feasibility study

dwell
⟹ time
(500 ms)

Starker & Bolt: interactive 3D world ("Little Prince")
— storytelling — narrative would change
based on gaze

↳ maybe
relevant to
game play
— dwell time: used to
zoom in
(navigate in 3D)

⇓

how to use gaze
for interaction
↳ David Smith's ACE 2006 paper

— Majavanta et al   (from Finland — Univ. of
Tampere)

↓
ETRA 2000 or 2002
(survey) of (eye typing)

→ pretty difficult to pull off for conference

└→ broad + better app for eye tracking manufacturers
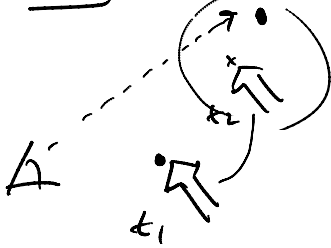(disability app) —— "Universal Accessibility"

↓
was an NSF funding program

Shumin Zhai — IBM
— MAGIC pointing
└ is Manual Accelerated Gaze Input Cascaded (?)
└→ a way to warp the mouse pointer

— good point
made in papers
eye is a perceptual organ
not meant at things
↓
motivation for ⟶ accelerating mouse pointer —
not slaved to the eye

Fitts Law : MT = a + b log₂ (A/w)   A: amplitude (dist)
(mean selection time)   w: width

$$MT = a + b \log_2 \left(\frac{A}{w} \right)$$

Zhai et al's paper: technical development + empirical
↓   analysis
motivated by Fitts' Law   experiment
which is a model of hand movements

Q: Do eye movements: do they follow Fitts' Law?
          (YES) — see Ashmore's 6D 05 for refs —
                 └──────────────── Špakov & others

Other Models (modelling paper)
_____

	ACT-R	EPIC
saccade dist:	variable	constant
target oriented:	never	regularly
marks scanpath over	follows saccades	starts after saccade ends
menus	only top-down	top-down + random

} models of cognitive processes
"low-level keystroke models"
           ↓
      see also KLM

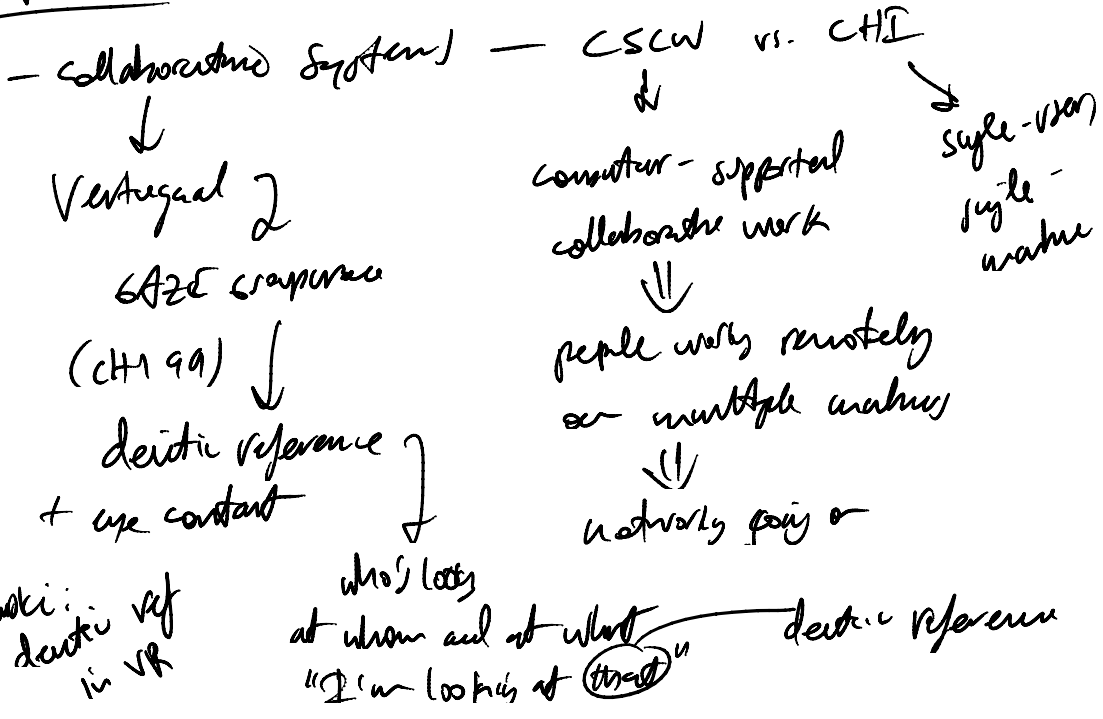} this was in context of
  pull-down menus

Result: "ground truth"; neither model
    correct (for this task)
— Hornof (U of Oregon)

Usability:
- Lots of stuff going on here
- Guan et al 2006 — Stimulated Retrospective
  validation paper → Think - Aloud
  ⌐ syndromes
        replay
        screenshots, get subjects to comment

- Bojko has a bunch of papers
- Neilsen Norman Group doing large scale studies
- business eff, seems like

Interaction :

— collaborative systems — CSCW vs. CHI

Virtual ⟩

GAZE groupware

(CHI 99)

deictic reference
+ eye contact ⟩

computer - supported
collaborative work

⇓

people work remotely
or multiple machines

⇓

networks going or

style-vision
style-
machine

Pschowski: deictic ref
deictic
in VR

who's looking
at whom and at what   deictic reference
"I'm looking at that"

GCDs:

McConkie & Rayner
Loschky & McConkie
Geisler
Luebke
Watson
Duchowski

} LOD: level of
Detail
at fovea

fovea vs periphery