# Movimentos Oculares e Percepção Visual

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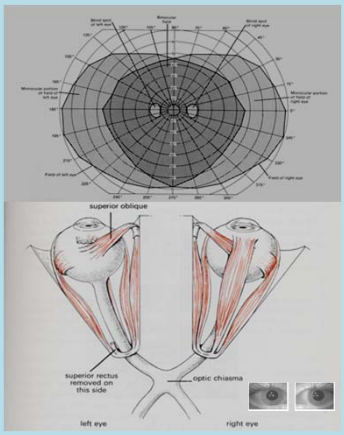
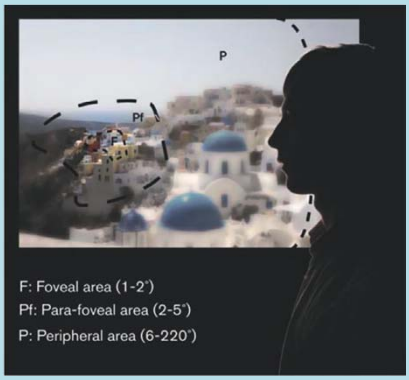
## Por que estudar movimentos oculares?

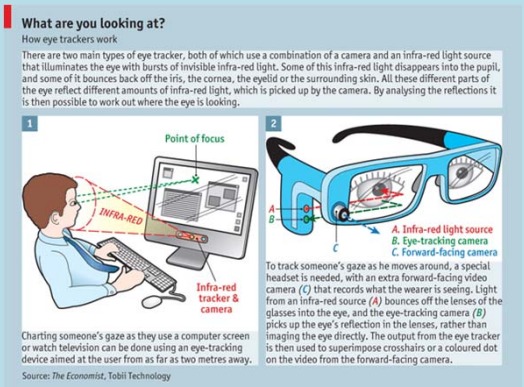
Método não-intrusivo
Popularização do método devido a melhoria tecnológica e redução de custos dos rastreadores de movimentos oculares (eye trackers)

Aplicações em pesquisas sobre:

- Processos perceptuais, cognitivos e motores
- Processos motivacionais
- Investigações clínicas
- Interfaces homem-máquina



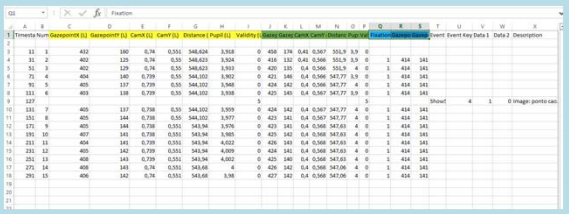




## Como funciona?

FIGURE 1.3
The relative position of the pupil and corneal reflection does not change when the head moves but the person is looking at the same spot.

**TABLE 3.2** SHELF STUDIES OF DIFFERENT LEVELS OF ECOLOGICAL VALIDITY AND SCIENTIFIC CONTROL

| Stimuli and Setting | Eye Tracker | Example | Ecological Validity | Scientific Control and Ease of Analysis |
|---|---|---|---|---|
| Shelves in a real store | Wearable |  | Highest | Lowest |
| Shelves in a mocked-up store | Wearable |  | | |
| Shelves in a lab | Wearable |  | | |
| Real-size image of shelves in a lab | Remote |  | | |
| Image of shelves displayed on a computer screen in a lab | Remote |  | Lowest | Highest |



**A partir do registros de dados do rastreador de movimento ocular se extraem dois grupamentos de movimentos:**

- Fixações
- Sacadas

## Fixações

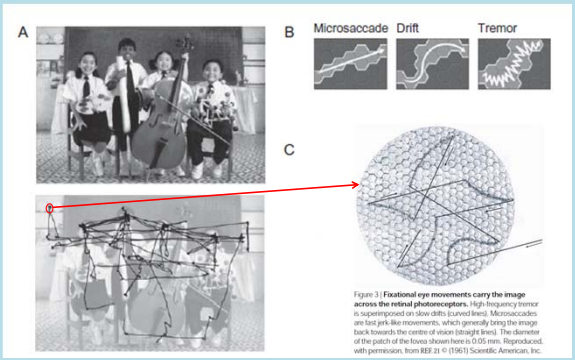



Figure 3 | **Fixational eye movements carry the image across the retinal photoreceptors.** High-frequency tremor is superimposed on slow drifts (curved lines). Microsaccades are fast jerk-like movements, which generally bring the image back towards the centre of vision (straight lines). The diameter of the patch of the fovea shown here is 0.05 mm. Reproduced, with permission, from REF.21 © (1961) Scientific American, Inc.

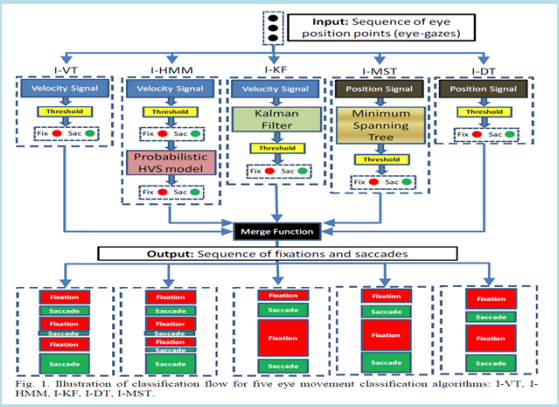
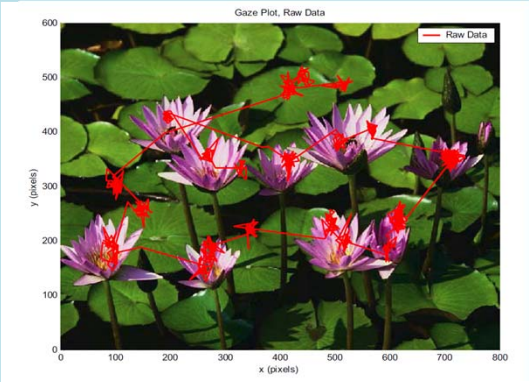


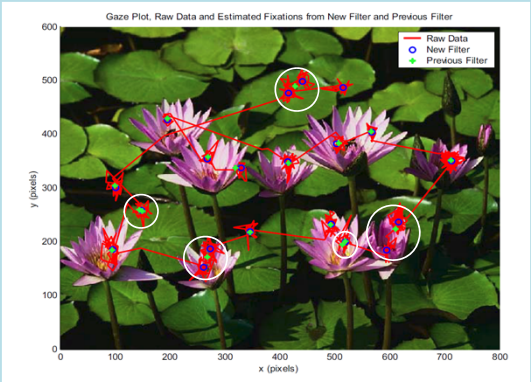

Fig. 1. Illustration of classification flow for five eye movement classification algorithms: I-VT, I-HMM, I-KF, I-DT, I-MST.

**O. V. Komogortsev, D. V. Gobert, S. Jayarathna, D. Koh, & S. Gowda, Standardization of Automated Analyses of Oculomotor Fixation and Saccadic Behaviors. IEEE Transactions on Biomedical Engineering, 57 (11), pp. 2635-2645, 2010.**

## I-VT x Olson filter




## I-VT x Olson filter



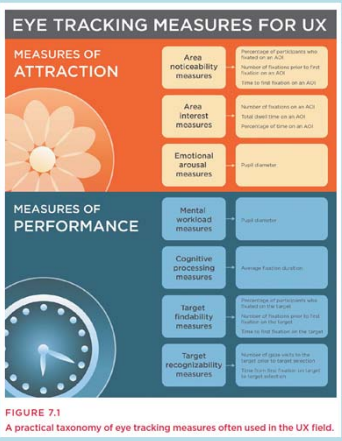
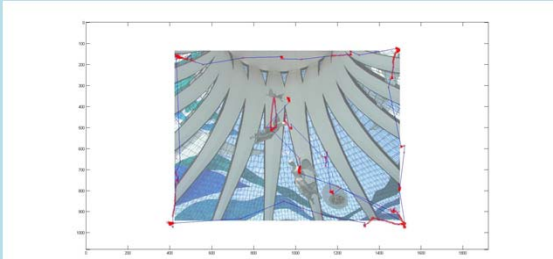
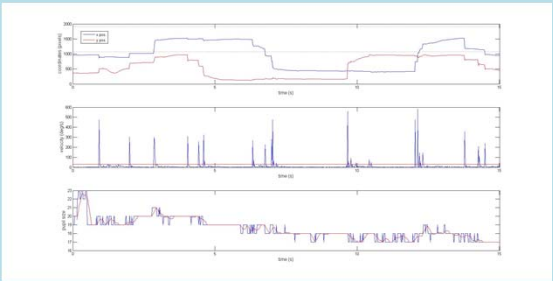


FIGURE 7.1
A practical taxonomy of eye tracking measures often used in the UX field.

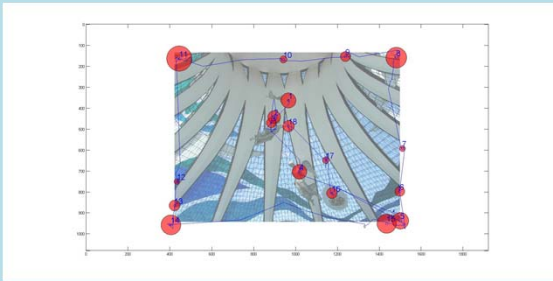
## Visualizações de Dados



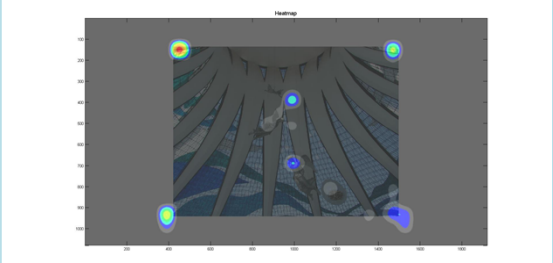
## Visualizações de Dados



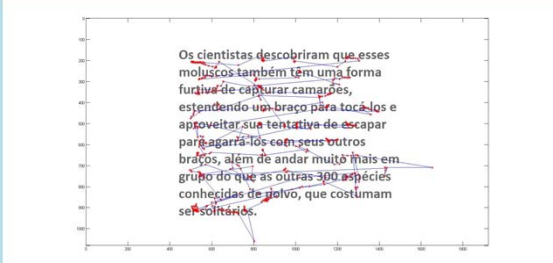
## Visualizações de Dados



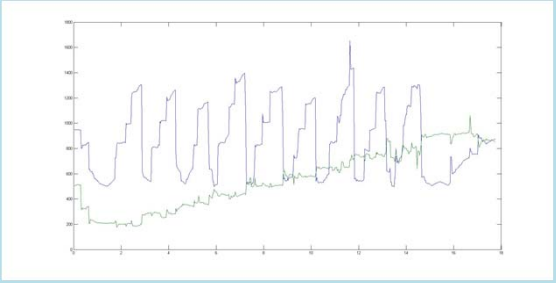
## Visualizações de Dados



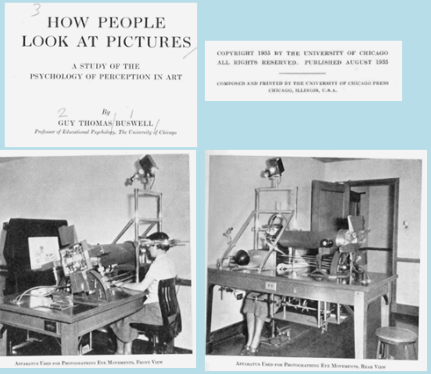

## Visualizações de Dados - Leitura

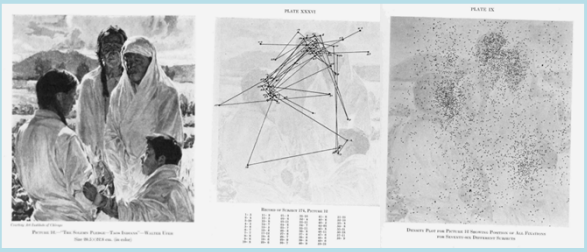


## Visualizações de Dados - Leitura



Outro exemplo



Buswell(1935)

Um exemplo mais atual

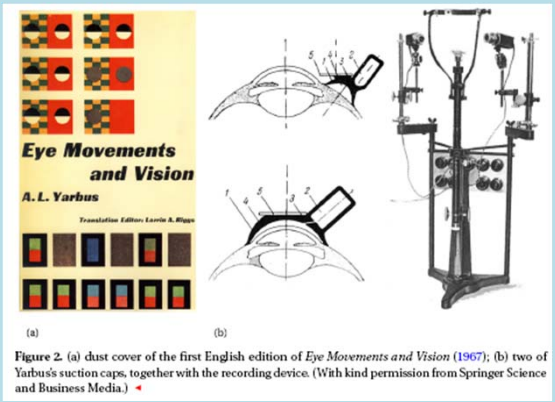



**Figure 2.** (a) dust cover of the first English edition of *Eye Movements and Vision* (1967); (b) two of Yarbus's suction caps, together with the recording device. (With kind permission from Springer Science and Business Media.)

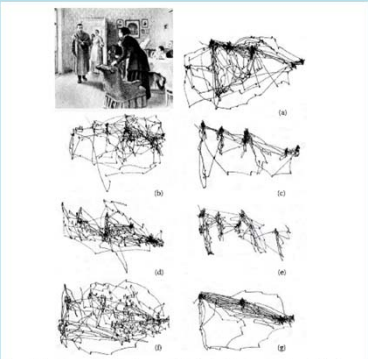
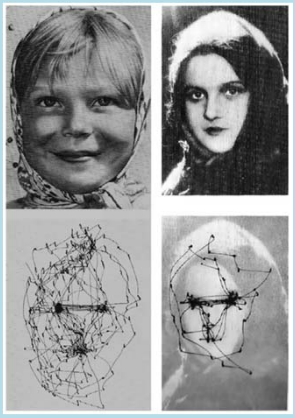


**Figure 3.** Examining a picture (*The Unexpected Visitor*) with different questions in mind. Each record lasted 3 min. (a) Free examination. (b) Estimate the material circumstances of the family in the picture. (c) Give the ages of the people. (d) Surmise what the family had been doing before the arrival of the 'unexpected visitor'. (e) Remember the clothes worn by the people. (f) Remember the position of the people and objects in the room. (g) Estimate how long the unexpected visitor had been away from the family. (Illustration adapted from Yarbus 1967, figure 109, for Land and Tatler 2009).



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# Yarbus, eye movements, and vision

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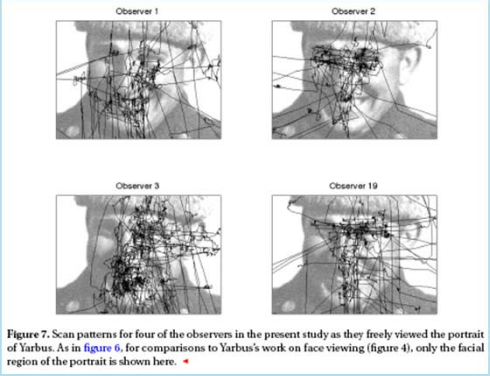



**Figure 7.** Scan patterns for four of the observers in the present study as they freely viewed the portrait of Yarbus. As in figure 6, for comparisons to Yarbus's work on face viewing (figure 4), only the facial region of the portrait is shown here.

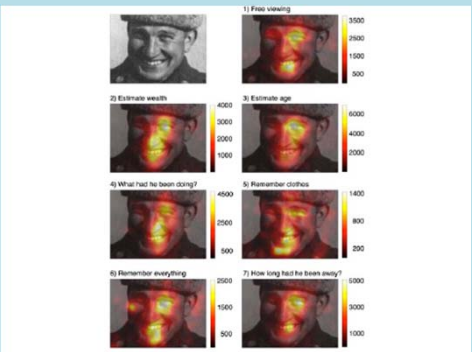



**Figure 9.** Fixation distributions on the face of the portrait for each of the seven instruction conditions. Note that the scaling for the colours varies between plots, with the bars to the right-hand side of each plot showing the viewing times denoted by the intensities of the colours. Viewing times shown in the bars to the right of each plot are in milliseconds and are cumulative across all participants.

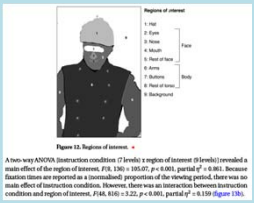



**Figure 12.** Regions of interest.

A two-way ANOVA (instruction condition (7 levels) x region of interest (9 levels)) revealed a main effect of the region of interest, $F(8, 136) = 105.07$, $p < 0.001$, partial $\eta^2 = 0.861$. Because fixation times are reported as a (normalised) proportion of the viewing period, there was no main effect of instruction condition. However, there was an interaction between instruction condition and region of interest, $F(48, 816) = 3.22$, $p < 0.001$, partial $\eta^2 = 0.159$ (figure 13b).

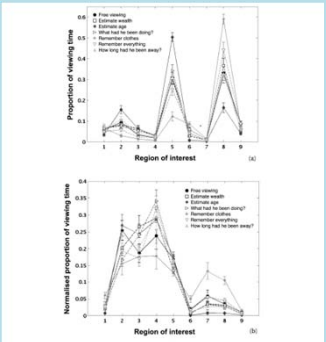



**Figure 13.** (a) Proportion of viewing time in each ROI for each of the seven instruction conditions. (b) Normalised viewing time in each ROI for each of the seven instruction conditions. Regions of interest: 1 = hat, 2 = eyes, 3 = nose, 4 = mouth, 5 = rest of face, 6 = arms, 7 = buttons, 8 = rest of torso, 9 = background.

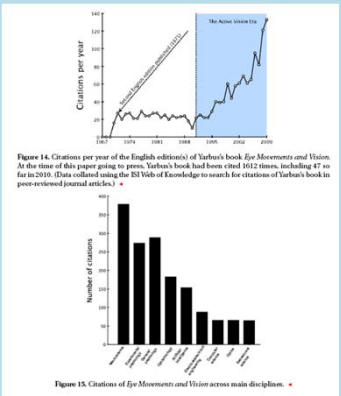



**Figure 14.** Citations per year of the English edition(s) of Yarbus's book *Eye Movements and Vision*. At the time of this paper going to press, Yarbus's book had been cited 1612 times, including 47 so far in 2010. (Data collated using the ISI Web of Knowledge to search for citations of Yarbus's book in peer-reviewed journal articles.)

**Figure 15.** Citations of *Eye Movements and Vision* across main disciplines.

## Desenvolvimento do olhar

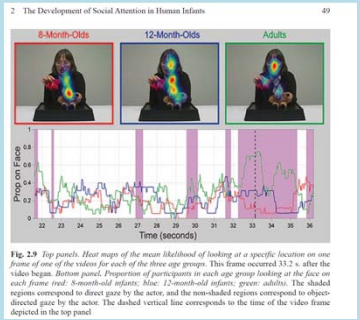



**Fig. 2.9** *Top panels. Heat maps of the mean likelihood of looking at a specific location on one frame of one of the videos for each of the three age groups.* This frame occurred 33.2 s. after the video began. *Bottom panel, Proportion of participants in each age group looking at the face on each frame (red: 8-month-old infants; blue: 12-month-old infants; green: adults).* The shaded regions correspond to direct gaze by the actor, and the non-shaded regions correspond to object-directed gaze by the actor. The dashed vertical line corresponds to the time of the video frame depicted in the top panel

Bertenthal ,BI & Boyer, TW (2015) The Development of Social Attention in Human Infants. from The Many Faces of Social Attention.

## Olhar de Autistas

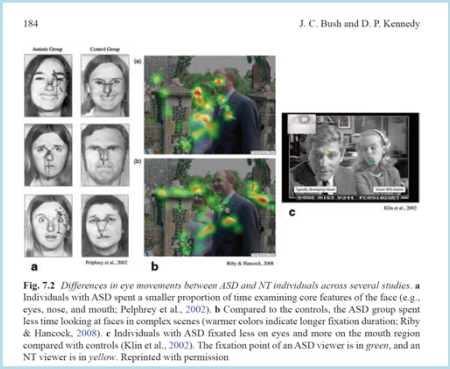
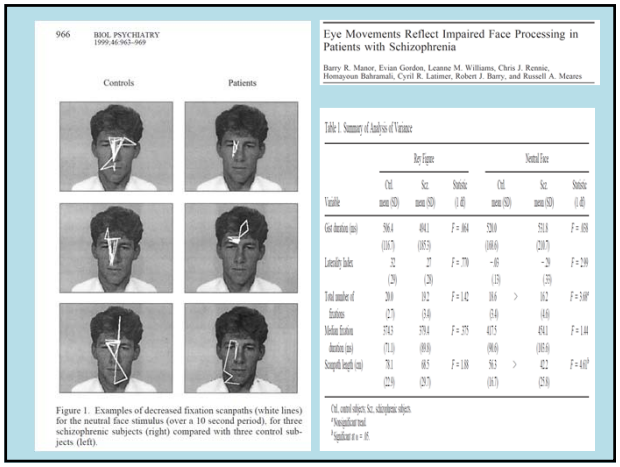

184 J. C. Bush and D. P. Kennedy

**Fig. 7.2** *Differences in eye movements between ASD and NT individuals across several studies*. **a** Individuals with ASD spent a smaller proportion of time examining core features of the face (e.g., eyes, nose, and mouth; Pelphrey et al., 2002). **b** Compared to the controls, the ASD group spent less time looking at faces in complex scenes (warmer colors indicate longer fixation duration; Riby & Hancock, 2008). **c** Individuals with ASD fixated less on eyes and more on the mouth region compared with controls (Klin et al., 2002). The fixation point of an ASD viewer is in *green*, and an NT viewer is in *yellow*. Reprinted with permission


966 BIOL PSYCHIATRY 1999;46:963–969

Eye Movements Reflect Impaired Face Processing in Patients with Schizophrenia

Barry R. Manor, Evian Gordon, Leanne M. Williams, Chris J. Rennie, Homayoun Bahramali, Cyril R. Latimer, Robert J. Barry, and Russell A. Meares

Controls Patients

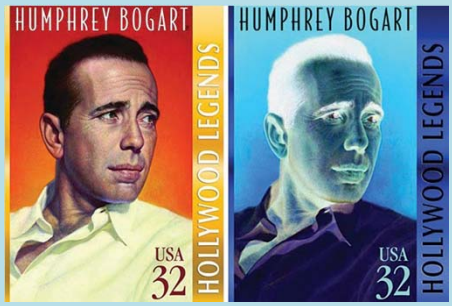
Figure 1. Examples of decreased fixation scanpaths (white lines) for the neutral face stimulus (over a 10 second period). for three schizophrenic subjects (right) compared with three control subjects (left).

Table 1. Summary of Analysis of Variance

| | Key Figure | | | Neutral Face | | |
|---|---|---|---|---|---|---|
| Variable | Ctl. mean (SD) | Sz. mean (SD) | Statistic (1, 48) | Ctl. mean (SD) | Sz. mean (SD) | Statistic (1, 48) |
| Gaz duration (ms) | 506.4 (116.7) | 494.1 (185.5) | $F = .064$ | 520.0 (160.6) | 551.8 (210.7) | $F = .658$ |
| Laterality Index | .21 (.29) | .27 (.20) | $F = .770$ | −.05 (.13) | −.20 (.19) | $F = 2.99$ |
| Total number of Fixations | 20.0 (2.7) | 19.2 (3.4) | $F = 1.42$ | 19.6 (3.4) | 18.2 (4.6) | $F = 3.08^a$ |
| Median Fixation Duration (ms) | 274.5 (71.1) | 279.4 (89.8) | $F = .275$ | 417.5 (98.6) | 454.1 (185.6) | $F = 1.44$ |
| Scanpath length (cm) | 70.1 (22.9) | 68.5 (20.7) | $F = 1.88$ | 56.3 (16.7) | 42.2 (25.8) | $F = 6.01^b$ |

Ctl. control subjects; Sz. schizophrenic subjects.
[a] Nonsignificant trend.
[b] Significant at $\alpha = .05$.

## A importância do olhar: captura da atenção visual




**Sinha, P. (2000). Here's looking at you, kid. (The perception of gaze direction) *Perception*, 29, 1005-1008.**

## Por quê?

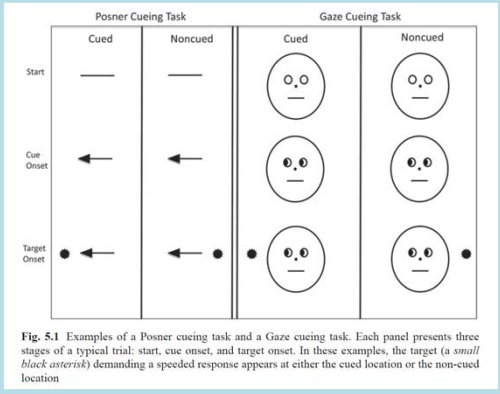
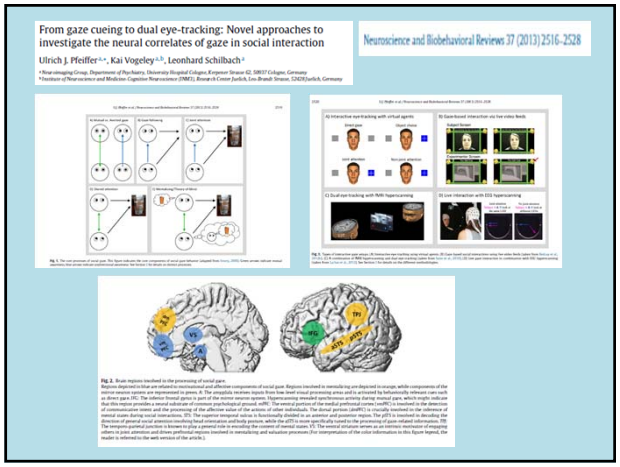



**Fig. 5.1** Examples of a Posner cueing task and a Gaze cueing task. Each panel presents three stages of a typical trial: start, cue onset, and target onset. In these examples, the target (a *small black asterisk*) demanding a speeded response appears at either the cued location or the non-cued location


From gaze cueing to dual eye-tracking: Novel approaches to investigate the neural correlates of gaze in social interaction

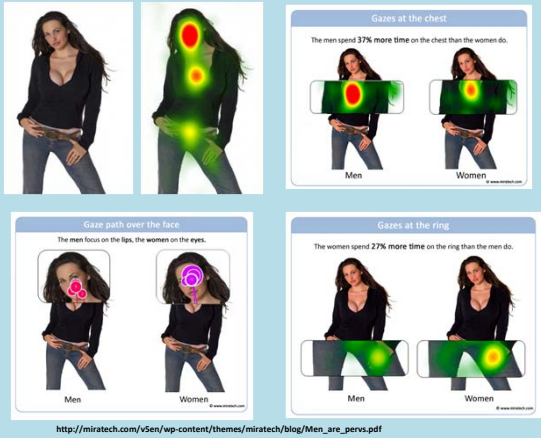
Ulrich J. Pfeiffer[a,*], Kai Vogeley[a,b], Leonhard Schilbach[c]

Neuroscience and Biobehavioral Reviews 37 (2013) 2516–2528



http://www.mrmediatraining.com/2012/10/24/three-ways-to-control-the-audience-with-your-eyes/


FIGURE 2.9 Heat maps shows that faces (left side) diverted attention from the textual information while logos did not have a similar effect (right side). (From Djamasbi et al., 2012b.)




http://miratech.com/v5en/wp-content/themes/miratech/blog/Men_are_pervs.pdf

**WHAT ARE YOU LOOKING AT?**

These pictures were shown to 30 men and 30 women whilst individually eyetracked. Results below - can you tell which was from the 30 men and which from the 30 women?

Men

What people do is often very different from what they say they do.

Women

http://www.bunnyfoot.com/blog/2010/10/make-sure-you-do-good-audience-research-observe-dont-ask/

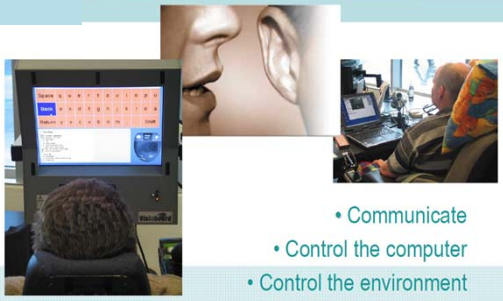
## Outras aplicações de eye trackers ...

## Out of 450 million people in the European Union…

| CONDITION | NUMBERS |
|---|---|
| ALS / MND (Amyotrophic Lateral Sclerosis / Motor Neurone Disease) | 27,000 |
| Multiple Sclerosis | 135,000 |
| Cerebral Palsy | 900,000 |
| Spinal Cord Injury | 36,000 |
| Spinal Muscular Atrophy | 54,000 |
| Retts Syndrome | 29,970 |
| Muscular Dystrophy | 126,000 |
| Brainstem Stroke | 688,500 |
| Traumatic Brain Injury | 675,000 |
| **TOTAL** | **2,671,470** |

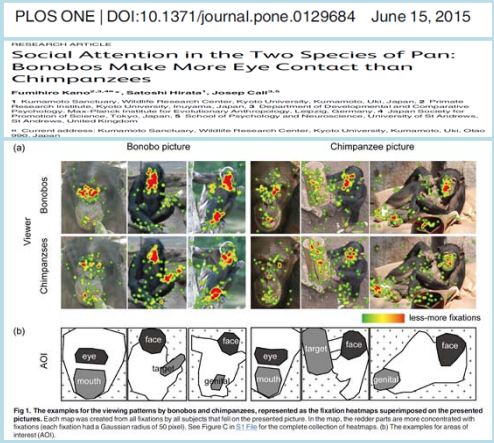
www.cogain.org

## How can people benefit?



- Communicate
- Control the computer
- Control the environment

www.cogain.org



PLOS ONE | DOI:10.1371/journal.pone.0129684 June 15, 2015

RESEARCH ARTICLE

Social Attention in the Two Species of Pan: Bonobos Make More Eye Contact than Chimpanzees



Fig 1. The examples for the viewing patterns by bonobos and chimpanzees, represented as the fixation heatmaps superimposed on the presented pictures. Each map was created from all fixations by all subjects that fell on the presented picture. In the map, the redder parts are more concentrated with fixations (each fixation had a Gaussian radius of 50 pixel). See Figure C in S1 File for the complete collection of heatmaps. (b) The examples for areas of interest (AOI).

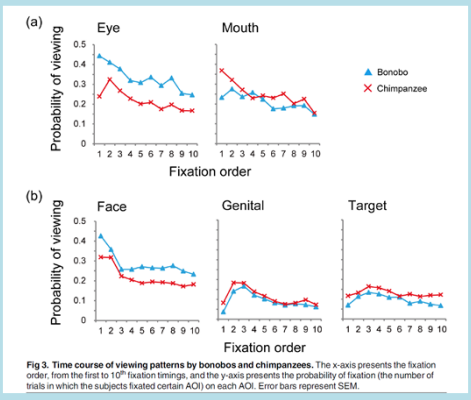




Fig 3. Time course of viewing patterns by bonobos and chimpanzees. The x-axis presents the fixation order, from the first to 10th fixation timings, and the y-axis presents the probability of fixation (the number of trials in which the subjects fixated certain AOI) on each AOI. Error bars represent SEM.

Anim Cogn (2012) 15:163–174
DOI 10.1007/s10071-011-0442-1

ORIGINAL PAPER

## Dogs do look at images: eye tracking in canine cognition research

Sanni Somppi · Heini Törnqvist · Laura Hänninen · Christina Krause · Outi Vainio

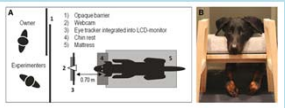



**Fig. 1** **a** A schematic picture of the experimental setup for eye movement tracking of dogs ($n = 6$) using a monitor integrated eye-tracking system without restraining, **b** the chin rest, on which the dogs were trained to keep their head still. The dog stayed in the pre-trained position while the experimenters and dog's owner sat quietly behind the opaque barrier

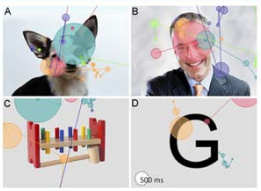



**Fig. 2** Examples of the four stimulus image categories presented in the study with their typical binocular scan paths: **a** dog face (DOG), **b** human face (HUMAN), **c** children's toy (ITEM), and **d** alphabetic character (LETTER). The scan paths of the gaze during a 2 s viewing of five dogs are drawn in a different *color* for each dog. The *lines* trace the path that the eye passed across the image. *Circles* represent fixed points of gaze (fixations). The larger the point, the longer the subject fixated onto the corresponding point. The original images **a** and **b** by Microsoft® Office and **c** by IKEA

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RESEARCH ARTICLE

## Through their eyes: selective attention in peahens during courtship

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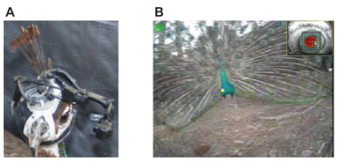


Fig. 1. (A)A peahen wearing the eye-tracking headpiece with a patch covering the unrecorded eye. (B)A sample frame from a display clip showing a female looking at a displaying peacock; the yellow dot indicates that the female is looking at the male's body. The eye-tracker records her eye position (upper right of image) and the field of view of her eye.

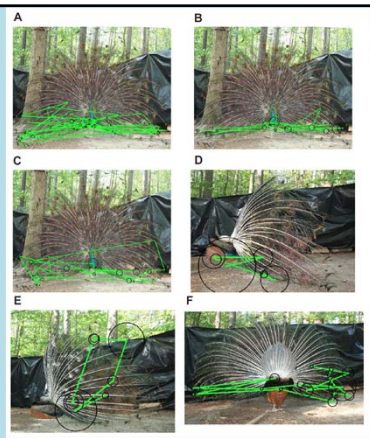


Fig. 4. Scanpaths of three different females showing visual assessment of the male's fron (A–C) and backside (D–F) display; the size o the black circles indicates the amount of time females spent looking at each location.