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Eye tracking & e-learning: what and how do students see

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Eye tracking & e-learning: what and how do students see

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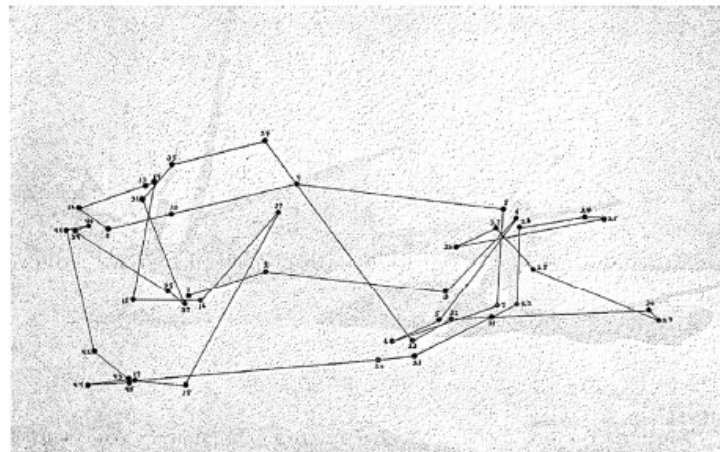
Eye Tracking

>> Field of research is 100+ years old



Courtesy Art Institute of Chicago

PICTURE 9, "STOPPING THE SAIL--BARBAMAS," WINSLOW HOOPER
In color, size 97.3 cm. X 17.8 cm.



RECORD OF MISS W. (SEASIDE 38), PICTURE 9

3-4	4-14	7-8	10-6	15-7	16-7	18-5	22-10	25-10	28-9	31-11	31-6	37-8	40-8	43-11
8-10	2-9	6-9	11-6	14-6	17-9	20-8	25-7	31-12	32-7	33-11	33-7	38-11	41-11	44-14
9-11	6-11	9-9	13-6	15-11	18-2	21-11	24-14	27-11	28-2	29-10	30-9	33-11	40-10	42-9

Durations of fixation passes for this and similar plates to follow are given above. The first number in each pair indicates the serial order of the fixation; the second number the duration of the fixation in the fields of a second. For example, the duration of the first fixation in this plate is 2 thirds of a second; of the second fixation 10 thirtieths, etc.

Figure 2.2: First Scanpaths, Source: Buswell, G.T. How people look at pictures. University of Chicago Press Chicago, 1935 [21].

“... beams of light used to illuminate the participants’ eye. The reflections were captured via mirrors on a celluloid film ...”

>> basically seeing is a sequence of saccades / fixations



Eye Tracking Evolution

Experiment of Yarbus

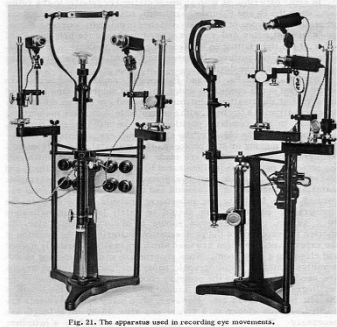
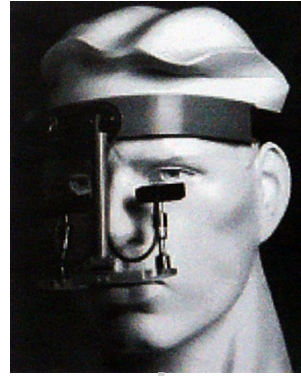


Fig. 21. The apparatus used in recording eye movements.

Ophthalmograph



Limbus tracker



Head-mounted Trackers

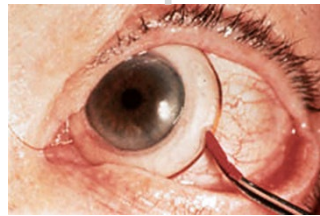


1950s

1970s

2000s

Search Coil in Contact Lens



Electro-oculography



Visual Analysis of Human Motion



Precise Tracking



Remote Trackers



Eye Tracking Evolution



Tobii Pro Glasses



Today



VR
Integration

Visual Analysis of Human Motion



Eye Tracking Evolution

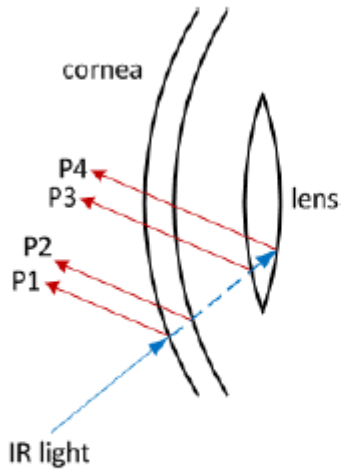


Figure 2.11: Four Purkinje Reflections

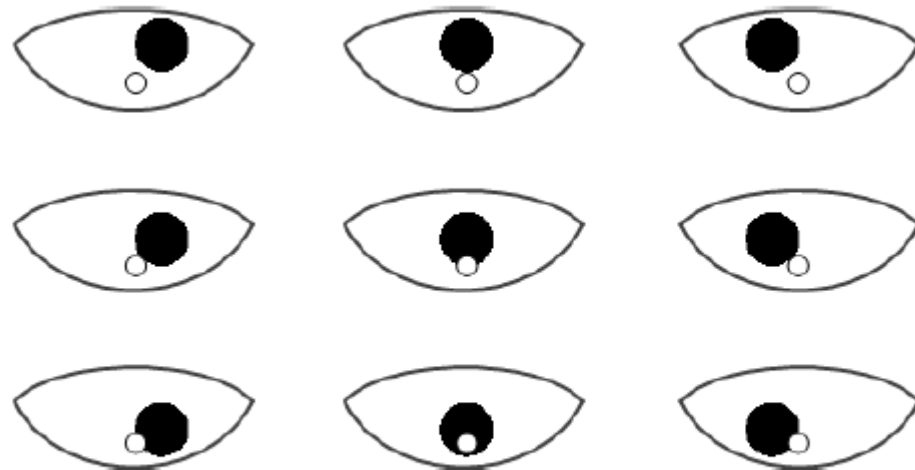


Figure 2.12: Positions of the Corneal Reflection (P1) relative to the pupil center

[Dissertation G. Rakoczi "Analysis of Eye Movements in the Context of e-Learning"]



>> Gaze data used for

- > insights into navigation processes of a VLE
- > detect areas where features expected
- > usability testing
- > Differences of human factors (resp. gaze data)

Human Sensory Perception

- Vision ~ 70%
- Hearing ~ 20%
- Smelling ~ 5%
- Tasting ~ 4%
- Touch/haptic perception ~ 1%

*“Windows to mind”
(Salvucci, 1999)*



How we (students) look

- Illusion of complete vision
- Brain is limited in capacity, works on **need-to-know basis** ... eye tracker challenge videos 😊
- Constant, fast and abrupt repositioning of the eyes
- Only foveal area ($\sim 2^\circ$) is “sharp” → *fovealization*
- Various vision techniques (pop-out, peripheral, parafoveal etc.)



EYE TRACKER CHALLENGE WITH MY GIRLFRIEND
8.9 Mio. Aufrufe · vor 1 Jahr
Miniminter
Music from MediaMusicNow.co.uk Video uploaded by Simon/Miniminter/mrm7games.



Visual Analysis of Human Motion

1. Arrangement of stimuli

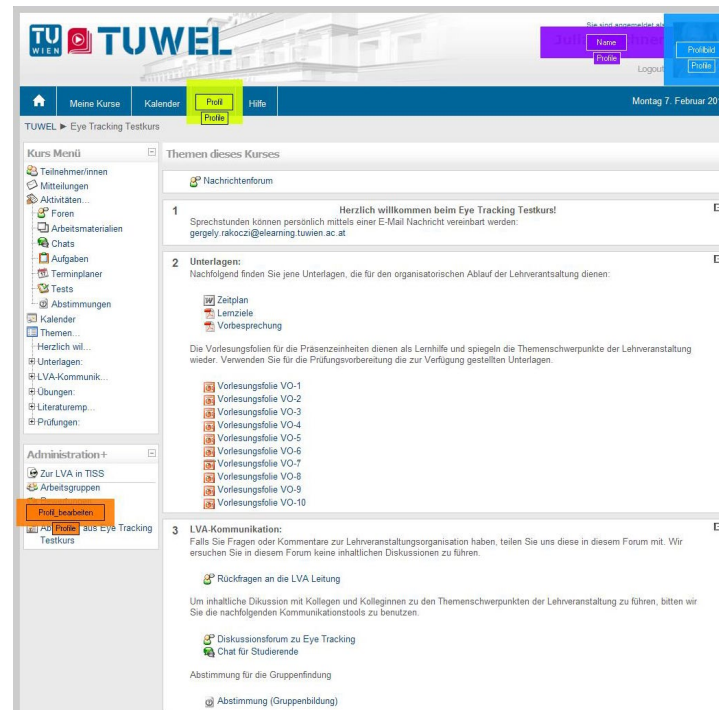


2. Definition AOIs (Areas of Interest)

3. Pull parameters from AOIs

time to first fixation
mean fixation duration
returns

...





Eye tracking experiment



Figure 4.15: Tobii X50 at the Austrian lab

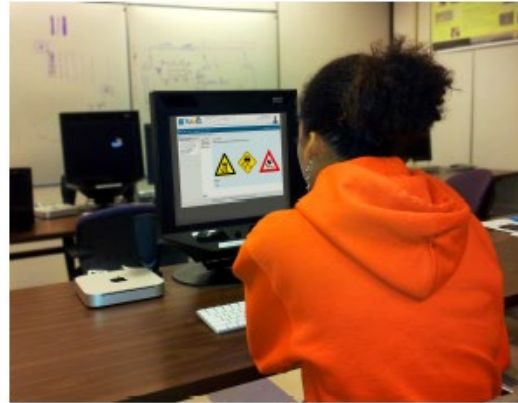
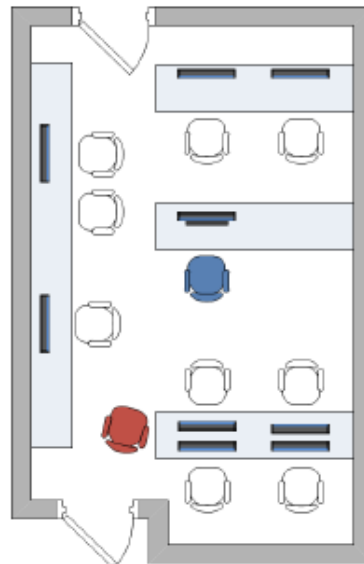
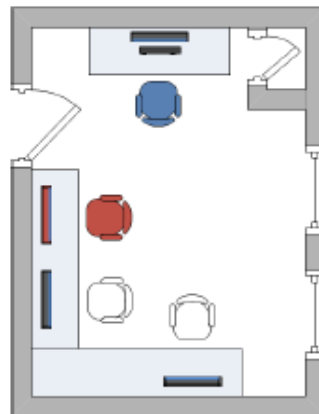
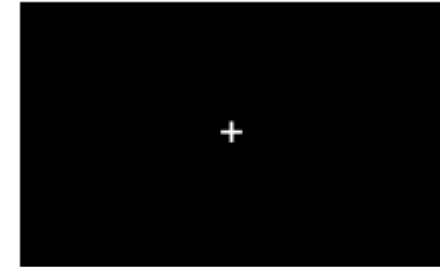


Figure 4.16: Tobii ET-1750 at the US lab



Legend	
	Participant
	Fadlitator
	Unused chair
	Eye tracker
	Regular Screen
	Screen for Live Monitoring



Eye tracking experiment

- Calibration is not easy
→ e.g. black pupils, glasses, mascara impair tracking)

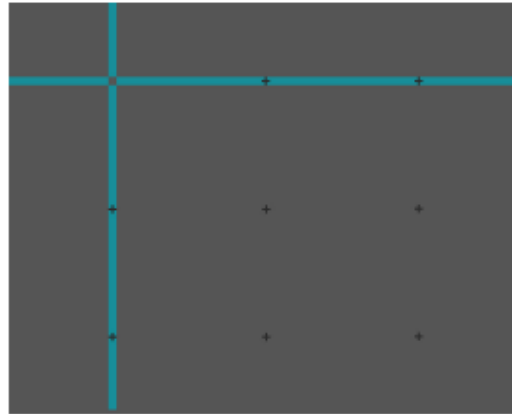


Figure 4.19: Calibration grid, Source: Screenshot of Tobii Studio, Tobii Inc.

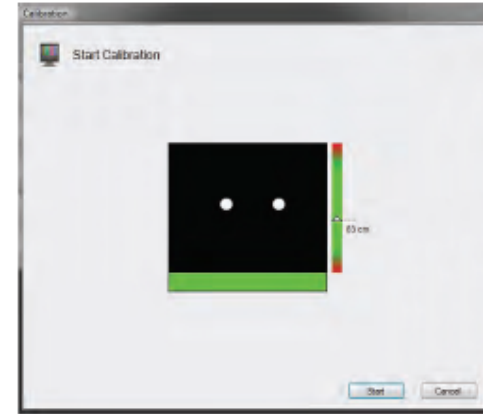


Figure 4.20: Tobii's Track Status, Source: Screenshot of Tobii Studio, Tobii Inc.

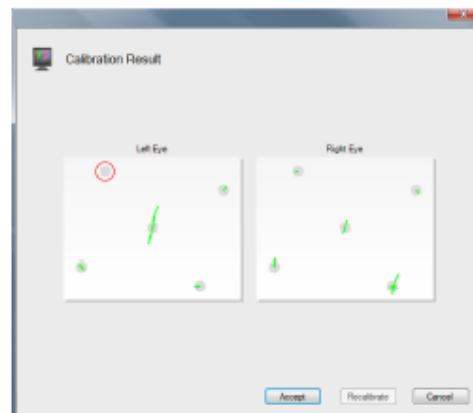


Figure 4.21: Calibration results, Source: Screenshot of Tobii Studio, Tobii Inc.

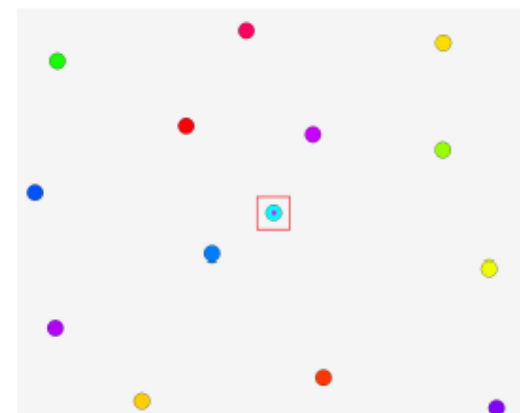
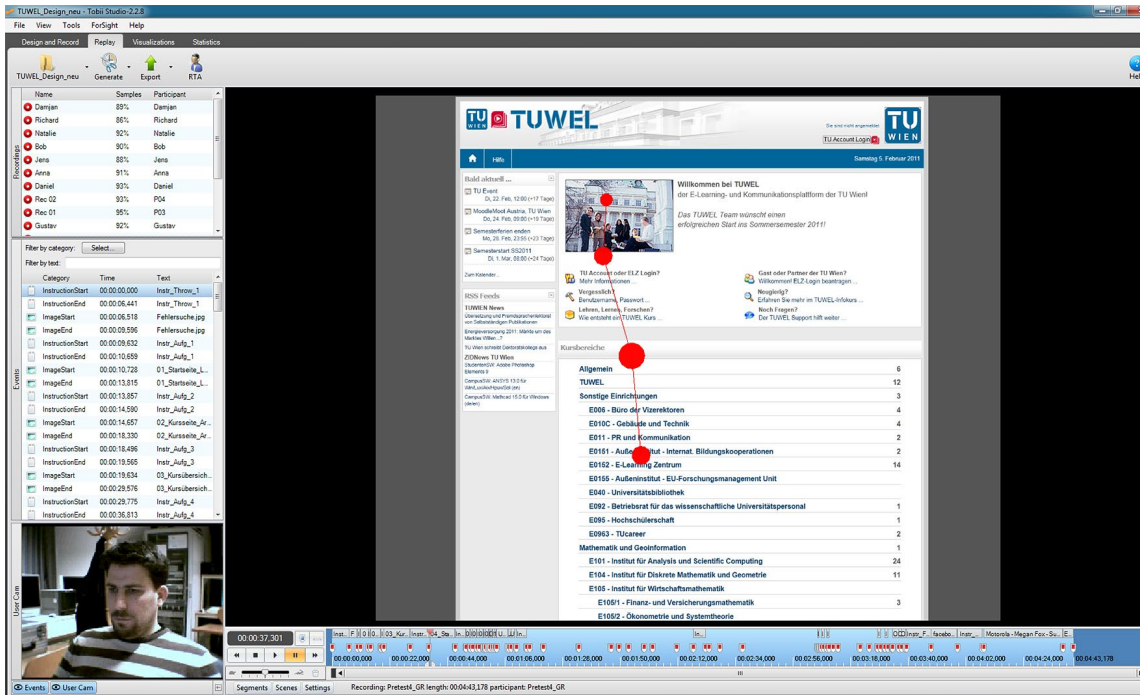
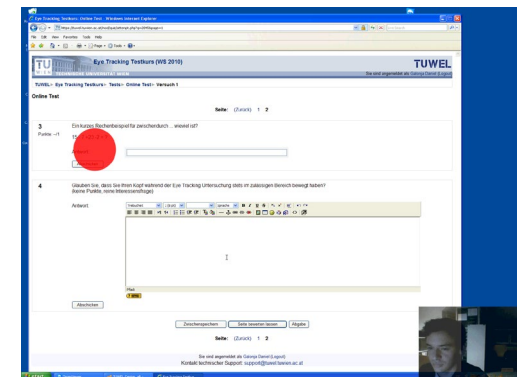


Figure 4.22: Verification Grid, Source: Screenshot of Tobii Studio, Tobii Inc.

Gaze-Replay



The screenshot shows the TUWEL Design Studio interface. On the left, there is a 'Recordings' list with columns for Name, Samples, and Participant. Below it is a 'Filter by category' section. The main window displays the TUWEL website with red circles indicating gaze points on various elements like the logo, navigation menu, and a list of departments. A 'User Cam' window in the bottom left shows a video of the participant, Damjan, looking at the screen. The bottom of the interface features a timeline and playback controls.



This screenshot shows a test video from the TUWEL system. It displays a test page with red circles indicating gaze points. The page contains a question about the TUWEL system and a list of departments. The video shows the participant's gaze points on the page, with red circles highlighting the areas of interest. The interface includes a 'User Cam' window in the bottom right corner showing the participant's video feed.

Video: Testvideo Damjan - Kopfrechnen.avi



Eye tracking experiment

- BeeSwarm Analysis (Video: `Fehlersuche_BeeSwarm_edited.mp4`)

Click on the two differences ...

Press [F10] if you have finished ...

00:00:00,677

00:00:00,396 00:00:02,969 00:00:04,982 00:00:06,975 00:00:08,968 00:00:10,961 00:00:12,954 00:00:14,947 00:00:16,940 00:00:18,933



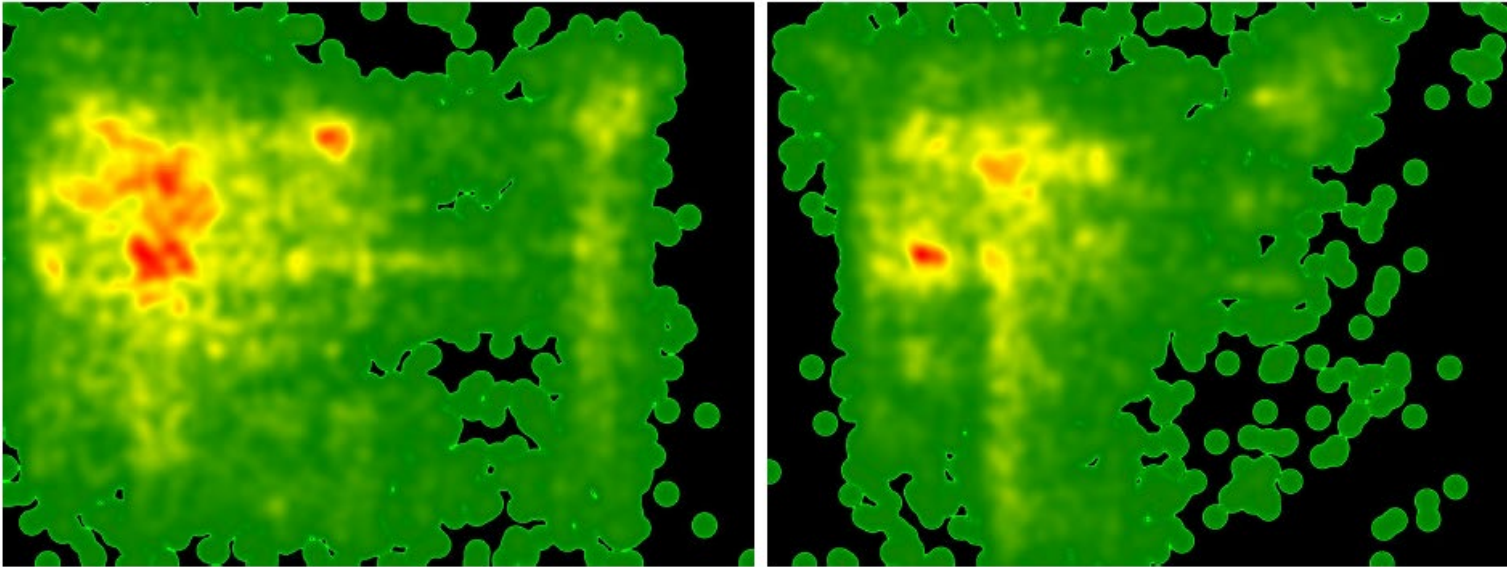
http://static2.thrivesmart.com/uploaded_images/business_images/0003/4105/Eyes_slide_show.jpg



Studies



VLE Usability - distribution



(a) 3-column Design

(b) 2-column Design

Figure 5.29: Heatmap Layers Indicate Learners' Overall Visual Distribution

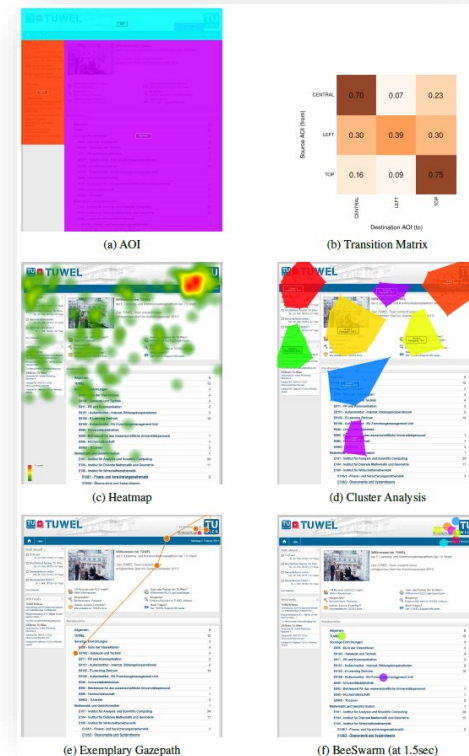
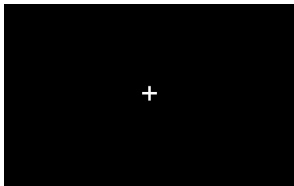
“F-shape pattern”

High Priority	Medium Priority
Medium Priority	Lower Priority
Lowest Priority	Lowest Priority



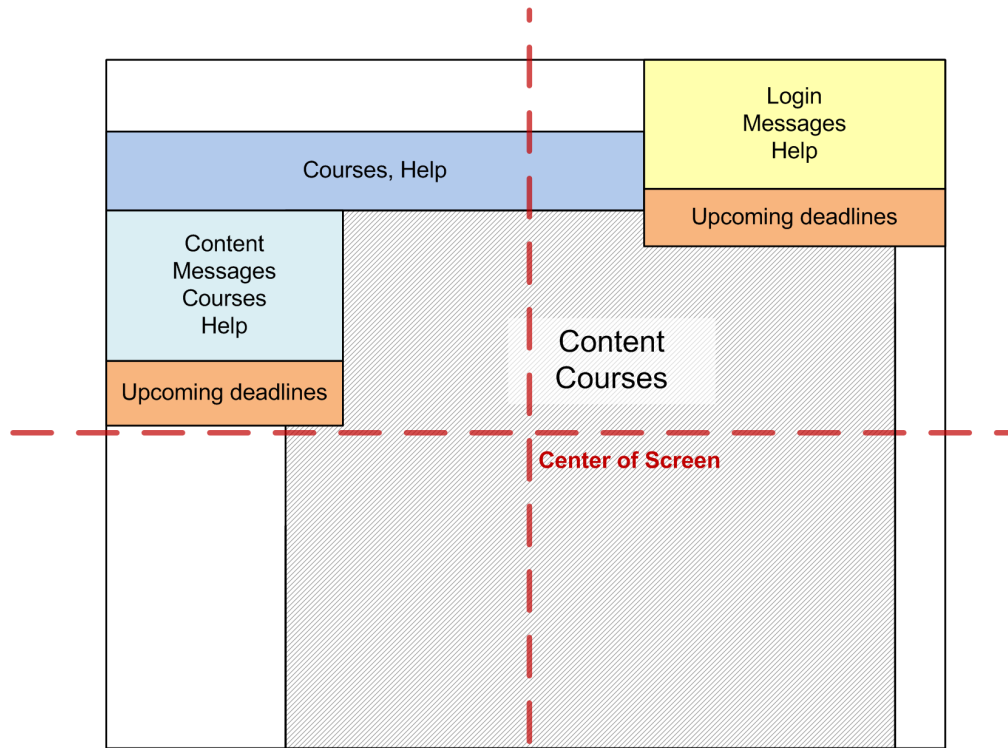
User interface design

- **Rapid fire task** design (10 seconds, white cross)
- 2-6 saccades are the most interesting
- 2 vs. 3 column-layout



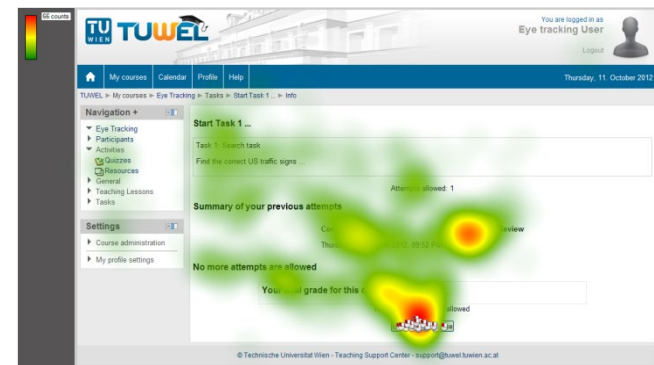
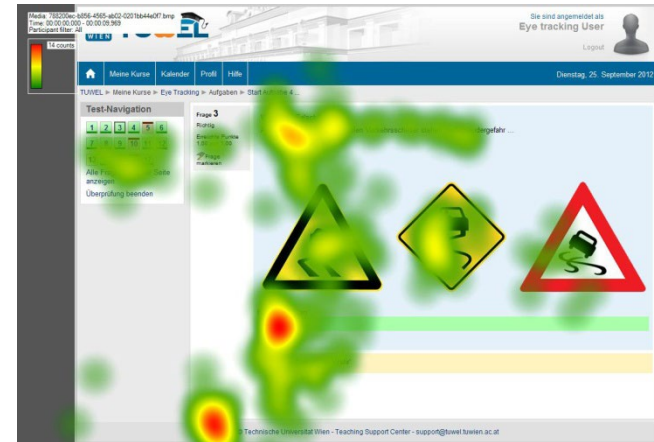
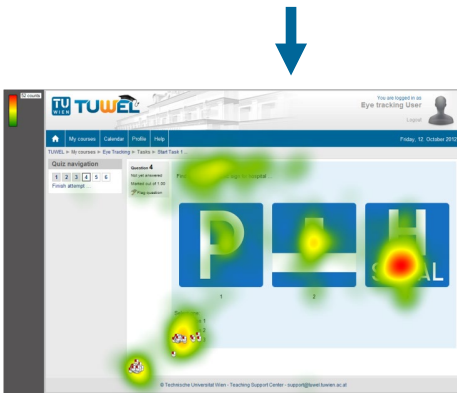
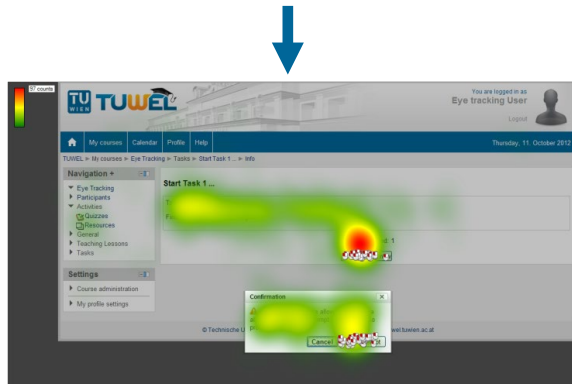


User interface design



Visual Analysis of Human Motion

Moodle quiz workflow





Visual attention development over time

>> images pull attention

>> but text provides context

>> interaction items → the easier to understand the less fixations / saccades needed

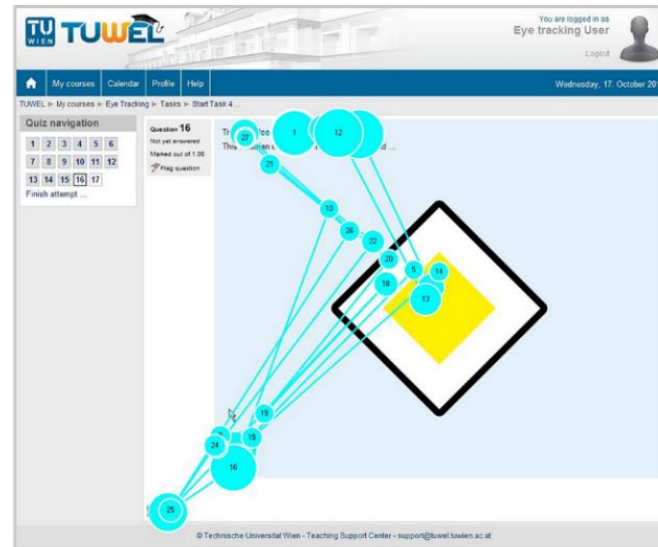
Time (in sec)	Multiple Choice Task	Matching Task	True/False Task
0,5			
1			
2			
5			



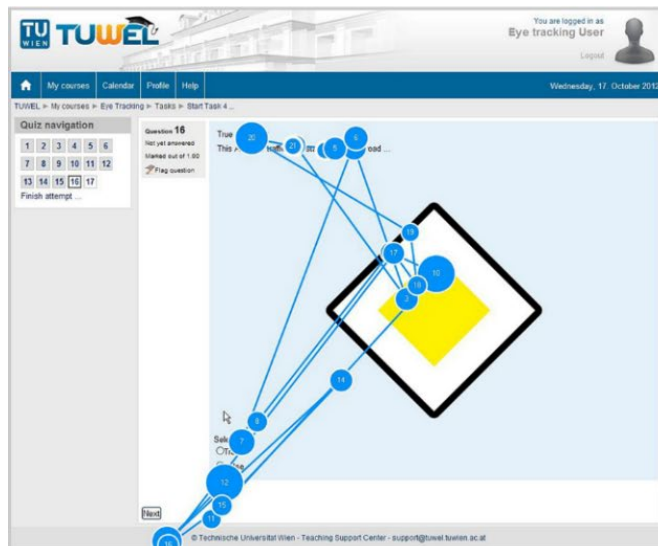
Performance groups



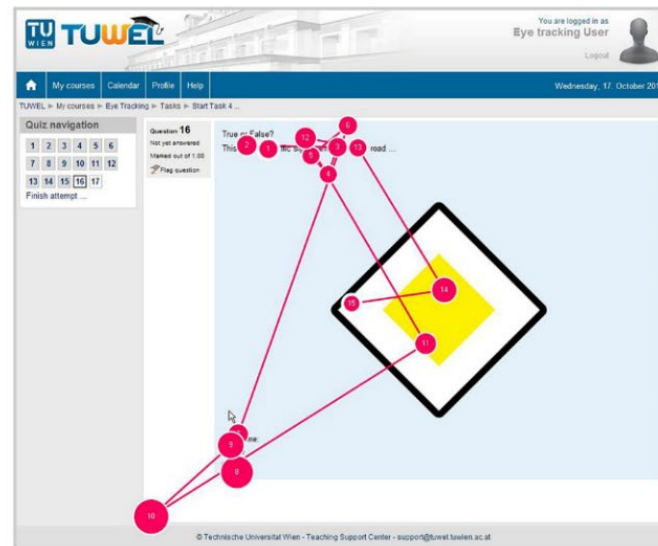
(a) Test Question without Gaze Overlay



(b) Scanpath of a low-level Learner



(c) Scanpath of a mid-level Learner



(d) Scanpath of a high-level Learner



Influence of ethnicity

Chinese students

- >> faster overall overview
- >> more focus on visuals (images) → so visual „reduction“ helps



China

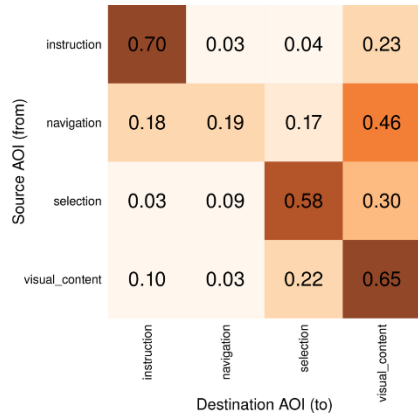


Österreich

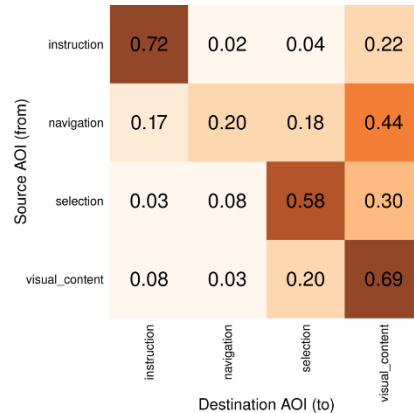


USA

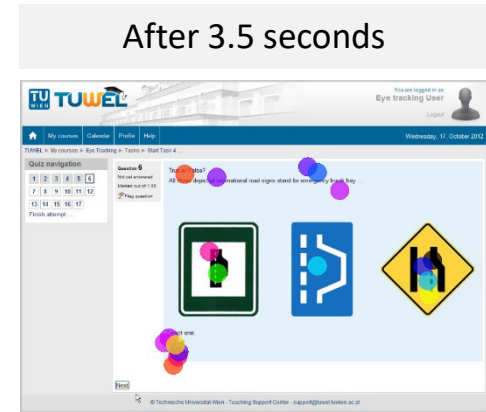
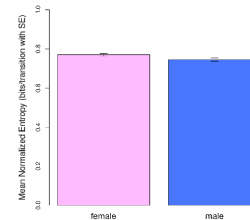
- Hardly any significant differences
 - Earlier fixations atop all AOIs for females
 - Female reading: Lower *mean fixation duration*
 - Female: Higher *fixation durations* atop navigational items (higher cognitive load during decision making)
 - Go along with *Comprehensive information processing* defined by [Meyer-Levy, 1986]
- Transition matrices not significantly different



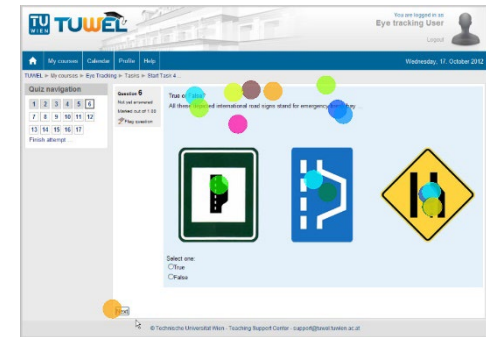
(a) Female Learners



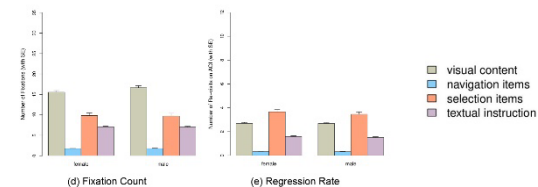
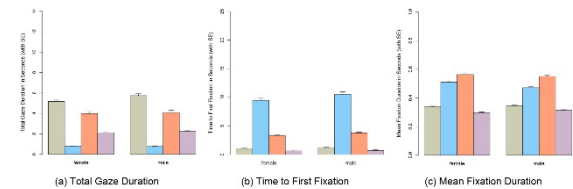
(b) Male Learners



After 3.5 seconds
Female learners



Male learners





<https://www.yumpu.com/en/document/read/29648360/22-useful-hints-teaching-support-center-der-tu-wien>

**Eye Tracking und E-Learning:
22 Praxistipps**

1. Statistische Auswertungen der Augendaten zeigen, dass beim Seiteneinstieg Überschriften und informative Abbildungen das visuelle Fixationsverhalten (unbewusst) lenken. Erst danach werden die Texte (Inhalte) verarbeitet!
2. Beachten Sie, dass Bilder mit (offensichtlich) niedriger Informationsdichte in der Regel ignoriert bzw. nur „tangiert“ werden.
3. Texte sind „Träger der Wissensinhalte“ und werden in der Regel visuell mit zumindest doppelten Fixationsintensitäten verarbeitet.
4. Komplexe text-basierte Lernmaterialien sind in E-Learning Umgebungen zwingend in kleine „Portionen“ zu splitten. Da schwer zu lesende Texte relativ bald nur mehr durch monotonen, unpräzises Lesen verarbeitet werden.
5. Ein kleiner Mehraufwand mit großer Wirkung! Berücksichtigen Sie einfache Webdesign Gestaltungsaspekte um die Augen der Studierenden zu führen: Bsp. Umrandung, Nummerierung, Aufzählung, Einrückung, Farbtonunterschied, auffällige Positionierung sowie entsprechende Leerräume (!)
6. Verwenden Sie (bitte) keine zu kleine Schriftgröße, Brillenträgerinnen werden es Ihnen danken. Durch optimale Schriftgrößen kann die Fixationsdauer beim Klicken verkürzt werden.
7. Wo werden Elemente gesucht? Aus den Fixationspräferenzen empirischer Untersuchungen lassen sich folgende inhaltliche Erwartungen zu den Bildschirmbereichen ableiten ...
8. Vermeiden Sie auf einer Seite konkurrierende Buttons mit sehr ähnlicher Funktion. Eine klare Trennung der zu Grunde liegenden Funktionen spart deutlich an „verschwendenden“ Fixationen, die sonst zum Vergleichen der Schaltflächen benötigt werden.
9. Eine Eye Tracking Faustregel: Es herrscht eine Dominanz der zentralen Kurspalte! Studierende beginnen ihre Suche überwiegend in der Kursmitte, diese sollte daher optisch ansprechend aufbereitet werden.
10. Eine große „Hilfe“ Schaltfläche schafft oft Abhilfe und reduziert Supportanfragen von Studierenden. Anderen Bezeichnungen wie „Tutorials“ oder „FAQs“ werden im Rahmen der visuellen Exploration weniger fixiert und oft nicht als Hilfe verstanden.

The document includes several eye-tracking heatmaps showing where users' eyes focus on a page. It also features a diagram of a user interface layout with various elements labeled: 'Menü, Navigation', 'Persönliches (Avatar, Profilbild, Name, Einrückung)', 'Login / Logout', 'Aktuelle Variante ID', 'Lerninhalt', 'Aktuelle Variante ID', and 'Hilfeschaltfläche'. A red dashed line indicates a 'Hilfeschaltfläche' (help button) area.





Thank you

... for your attention! 😊
Any questions?



<http://clj.roo.me/z3/B/k/8/d/a.baa-Very-funny-look-of-baby.jpg>