



UNIVERSITEIT VAN PRETORIA  
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# HCI and Interface Design

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# OVERVIEW

- The psychology of interface design  
(understanding the user)
- Design principles and guidelines
- Eye tracking

# PART 1

## COGNITIVE PSYCHOLOGY

### (Understanding the user)

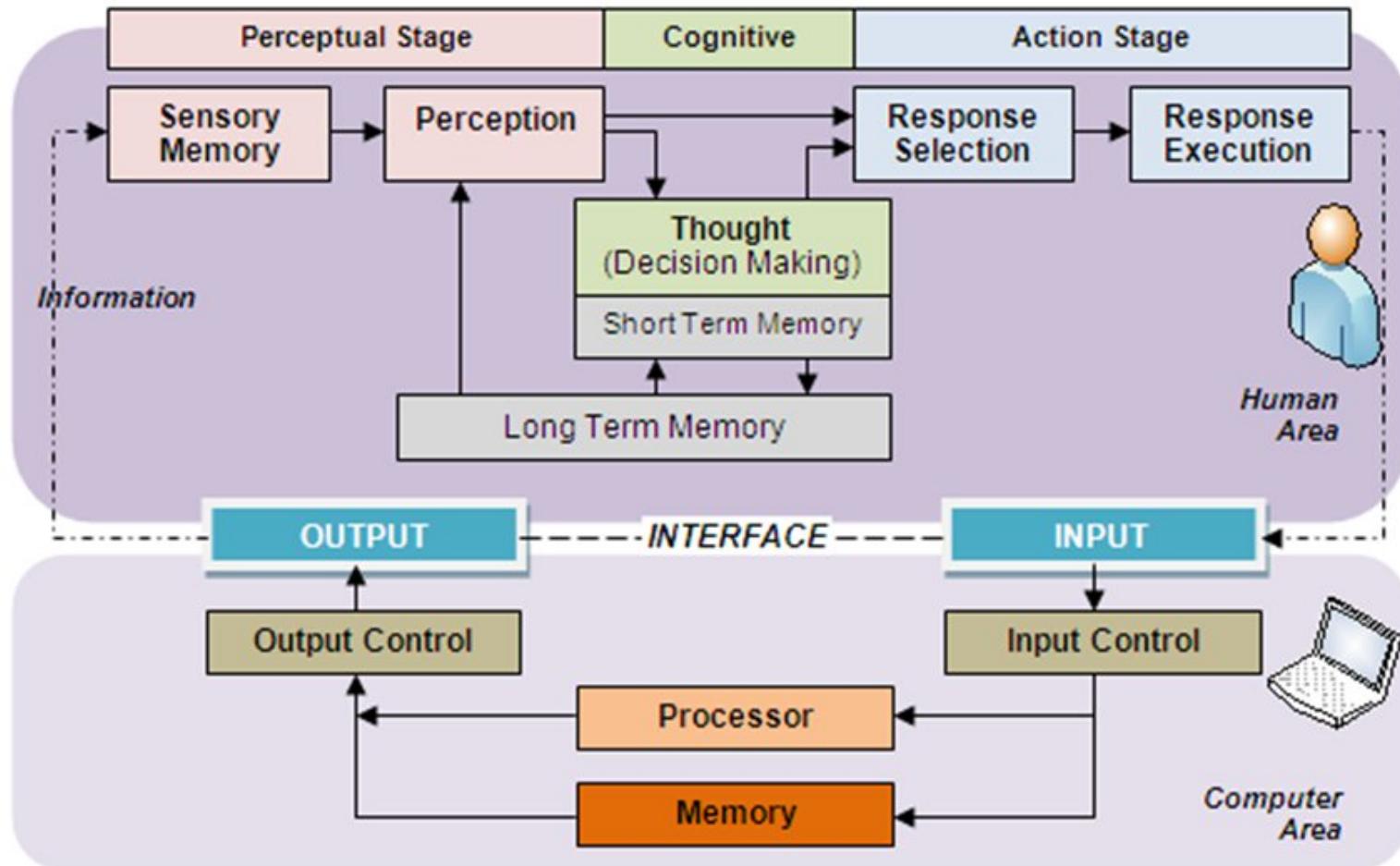
- Cognition
- Perception
- Attention
- Thinking
- Emotions

# Why do designers need to know about cognitive psychology?

- Design guidelines and principles are based on how people think, learn and behave.
- Applying guidelines properly requires understanding of their scientific basis.
- Designers need reasons for rules.



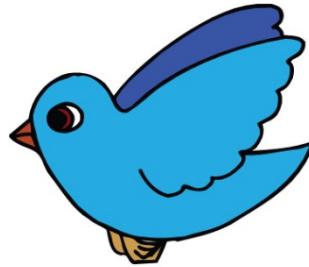
# Human information processing



FROM: Kantowitz, Barry H. "The role of human information processing models in system development." *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*. Vol. 33. No. 16. SAGE Publications, 1989.

# COGNITION

- Knowing
- Remembering
- Understanding
- Communicating
- Learning



- We understand by creating **concepts** – i.e. we group things together so that we can talk about and make sense of them. It helps simplify our thinking (otherwise we would need a unique name for everything)
- We organise our mental concepts into prototypes or **MENTAL MODELS** – these are mental images of the best representative examples people have of themselves, others, the environment and the things they encounter and with which they interact.
- People form mental models through experience, training and instruction. Concepts and mental models speed up thinking, but they also restrict our thinking.

# COGNITION

- Mental models (or people's own theories of how things work) are often constructed from incomplete information and naïve psychology that make people see causes, mechanisms and relationships where none really exists.
- Such misunderstandings can have serious implications and has led to many disasters.
- Mental models, once formed, are very difficult to let go of.

The down side: Mental models can lead to prejudice and incorrect assumptions.



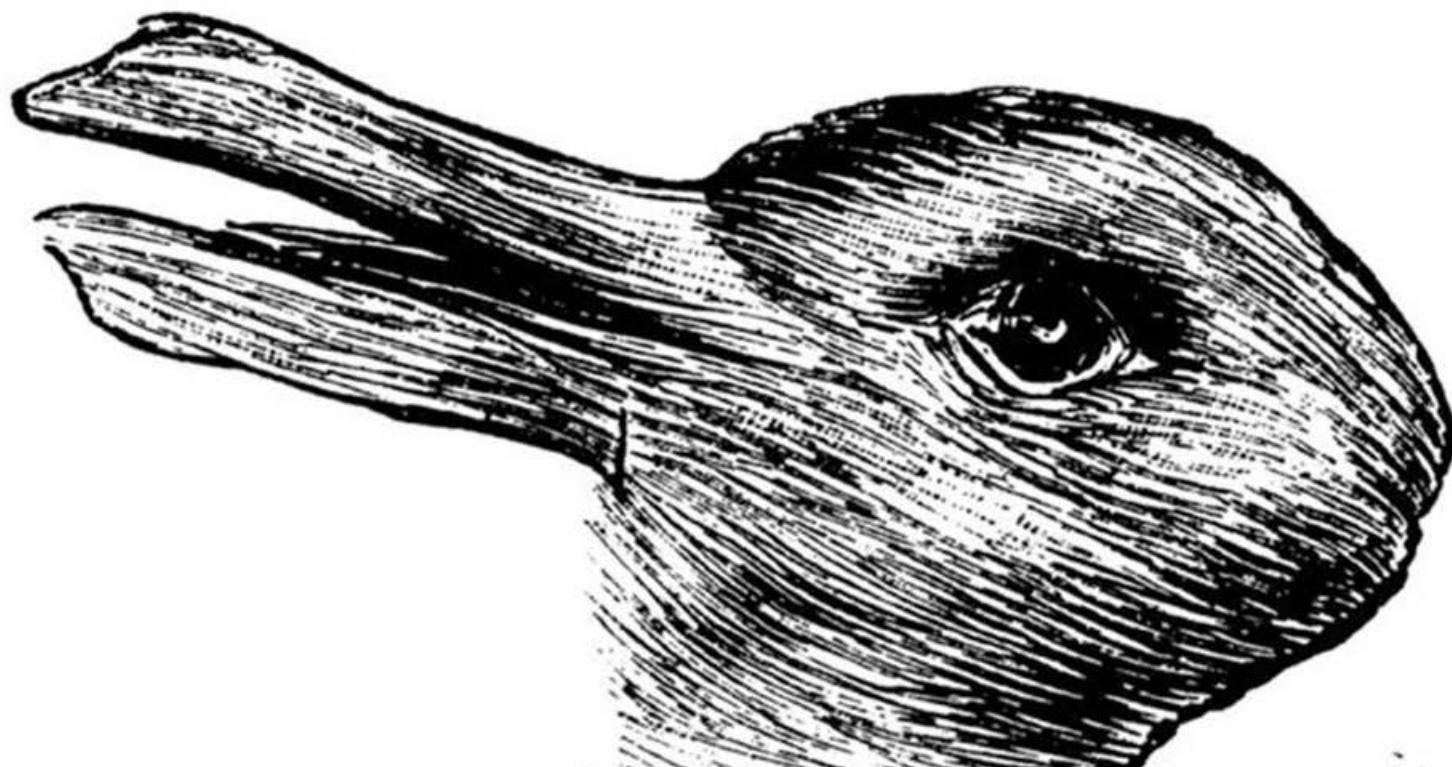
# PERCEPTION

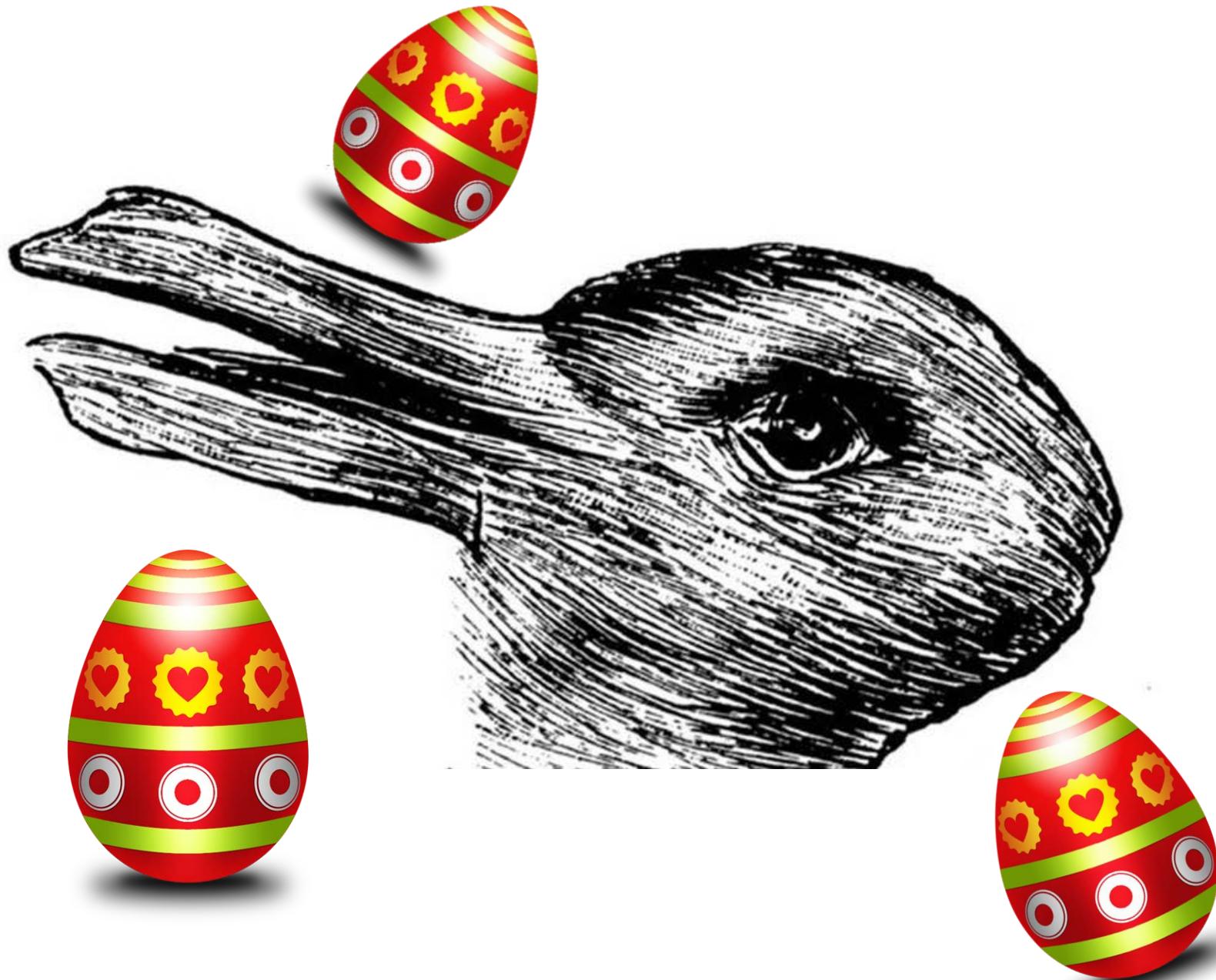
Perception refers to the top-down way our brains interpret and organise information and put it into context. It's the process that allows us to make meaning of our senses.

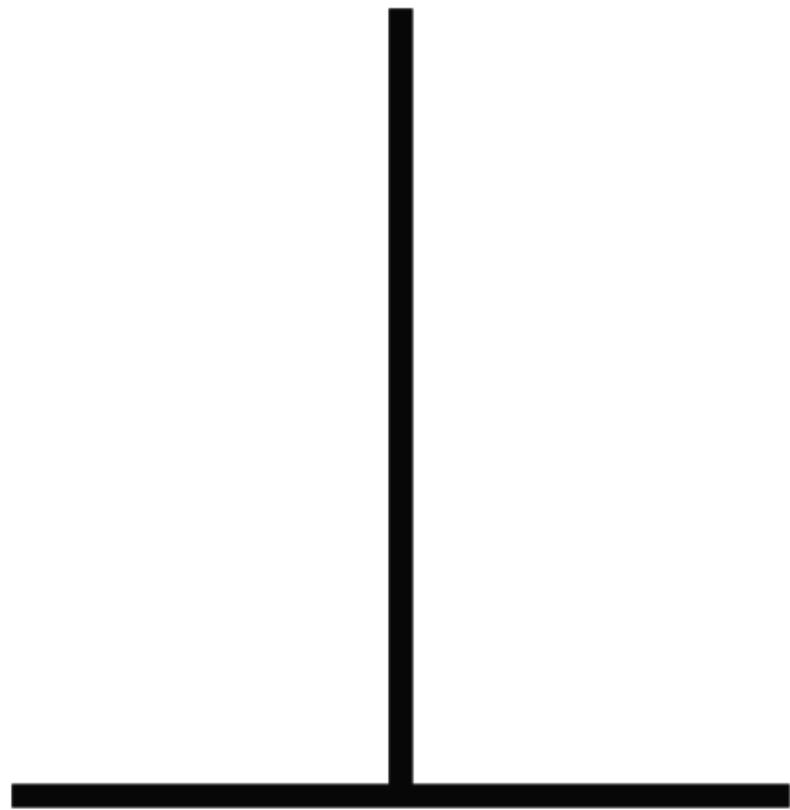
Our “perceptual set” – determines how we perceive our environment,. This includes:

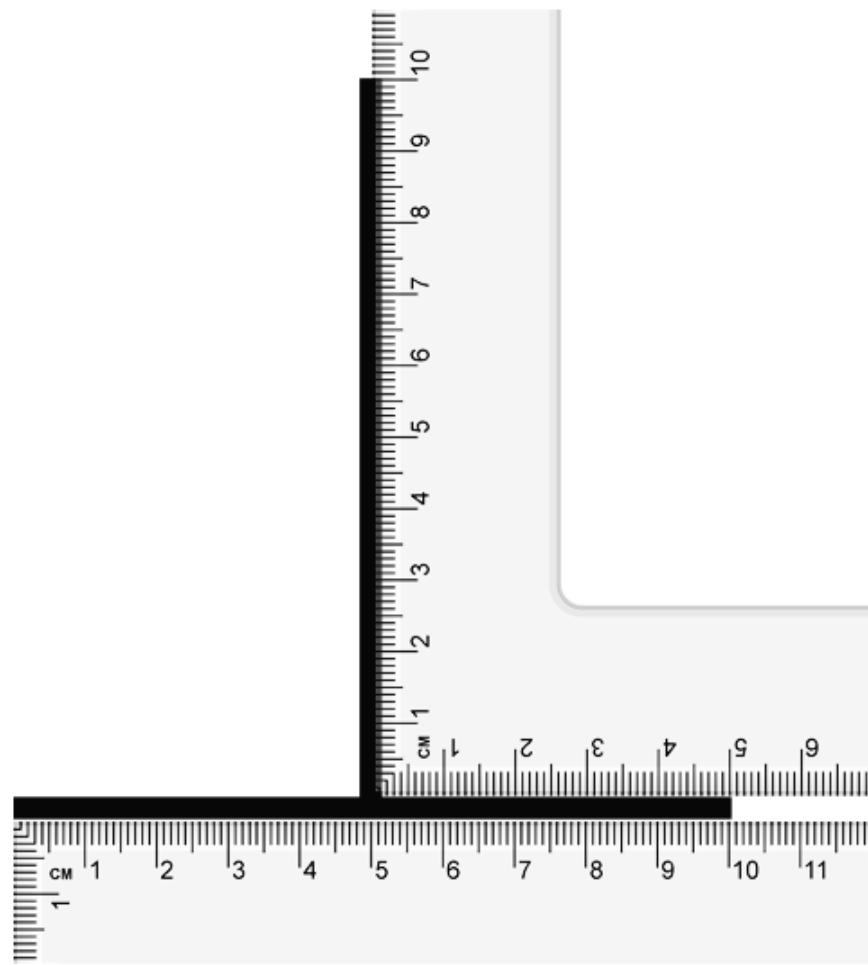
- Expectations or goals
- Previous experiences
- Context (including the physical organisation of things close to that which is perceived)
- Moods
- Cultural norms

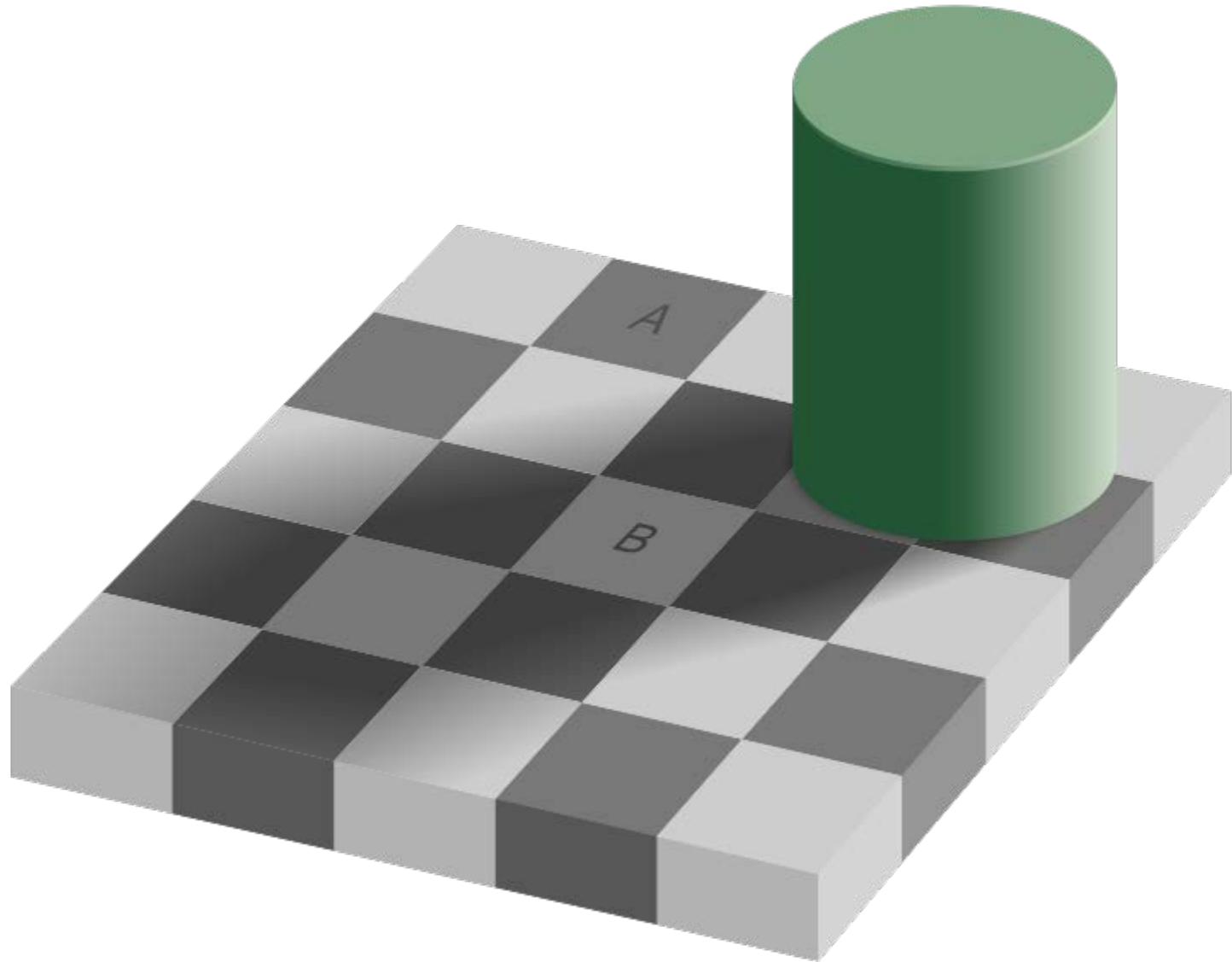
Discussion: How can this impact interface design or a usability evaluation experiment?



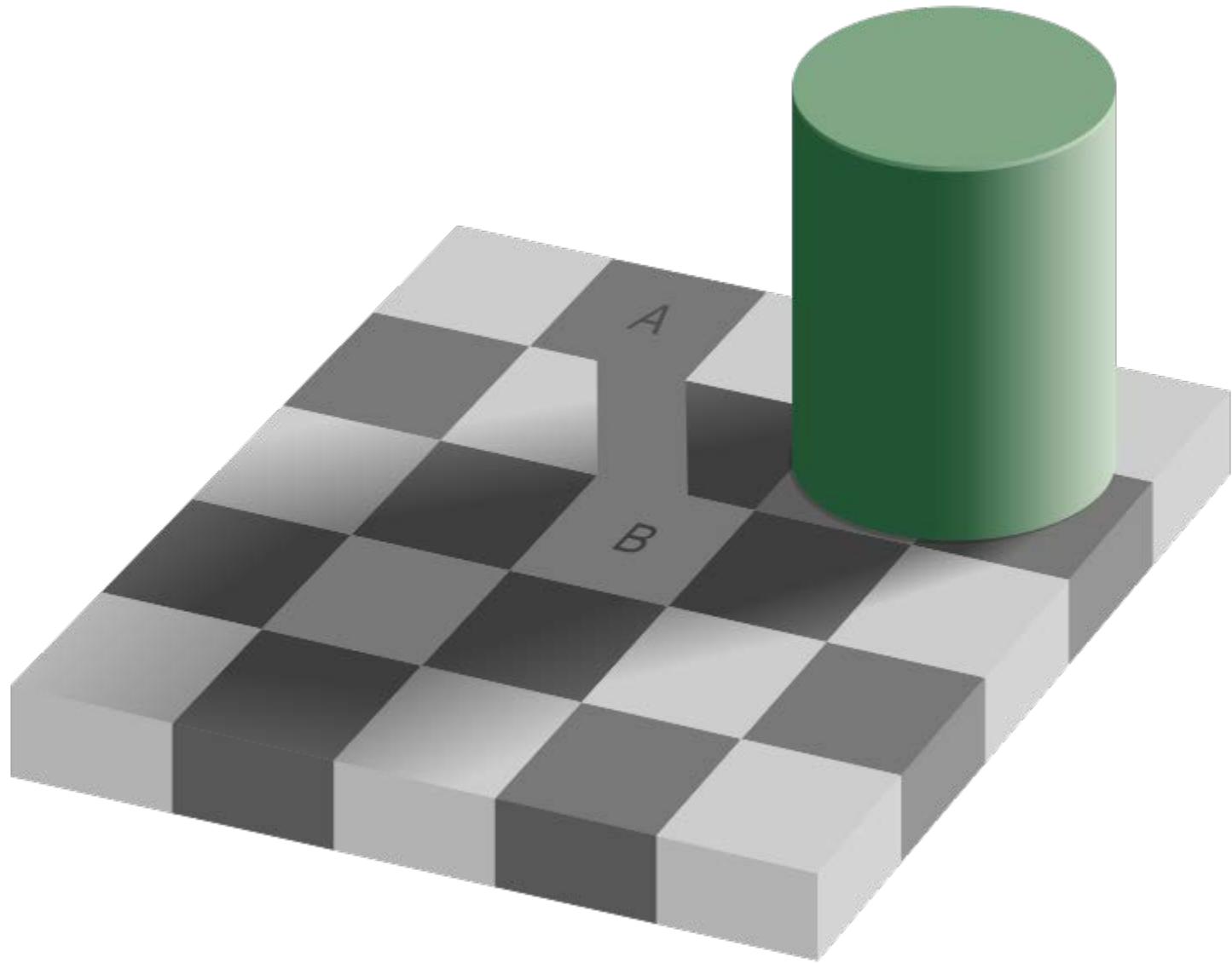






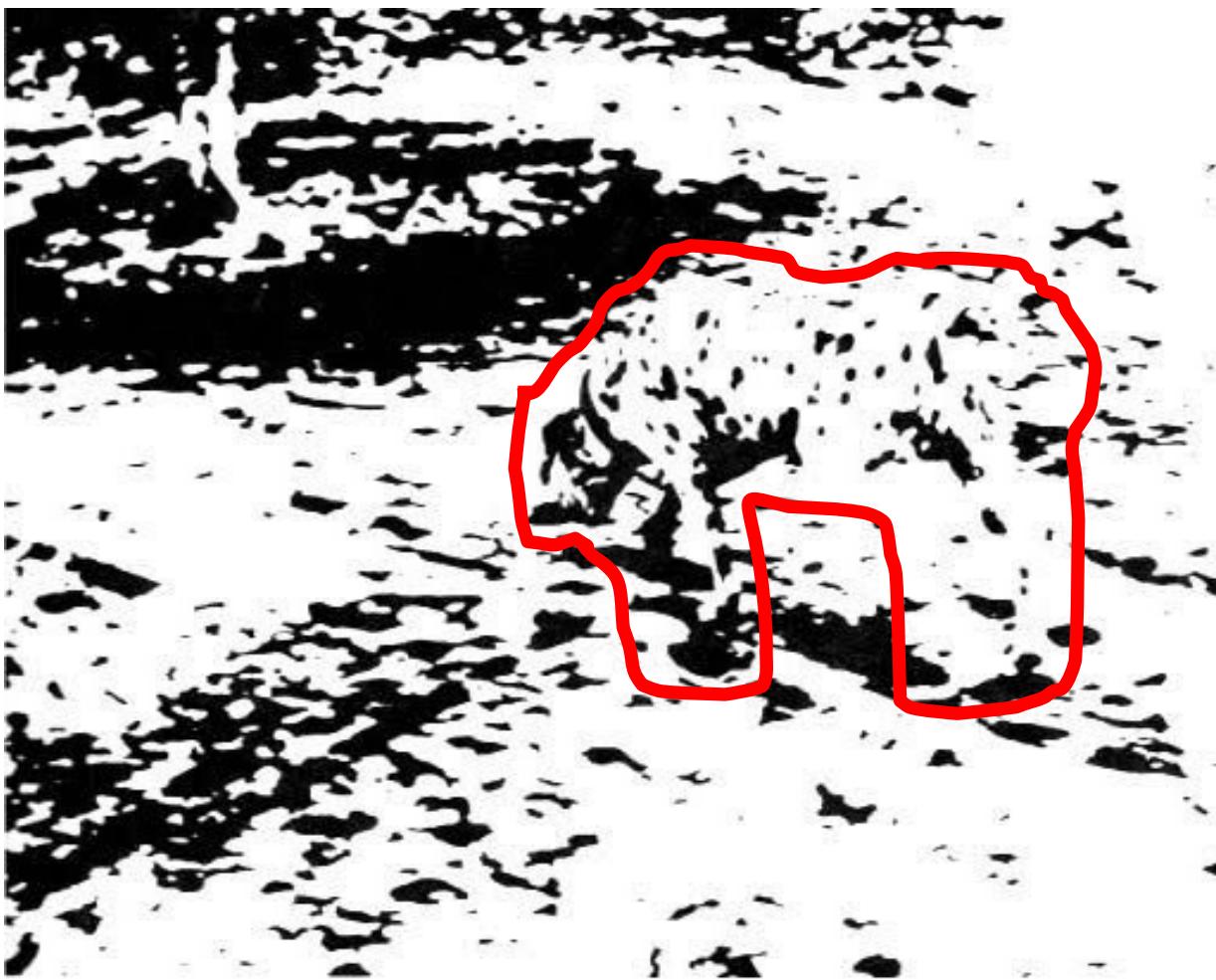


The blocks marked A and B are exactly the same colour









# PERCEPTION

Counting exercise

1  
G 0 G 3  
0 G E 0  
G G 0 / E  
G L 1 E  
0 E E / L  
2 2 2 1 0 2  
1 3 0 3 3 0  
2 0 3 0 2 0  
3 0 3 0 3 0  
0 0 0 0 0 0  
/ / / / / /  
1 0 1 0 1 0  
L 0 L 0 L 0  
1 0 1 0 1 0  
L 0 L 0 L 0

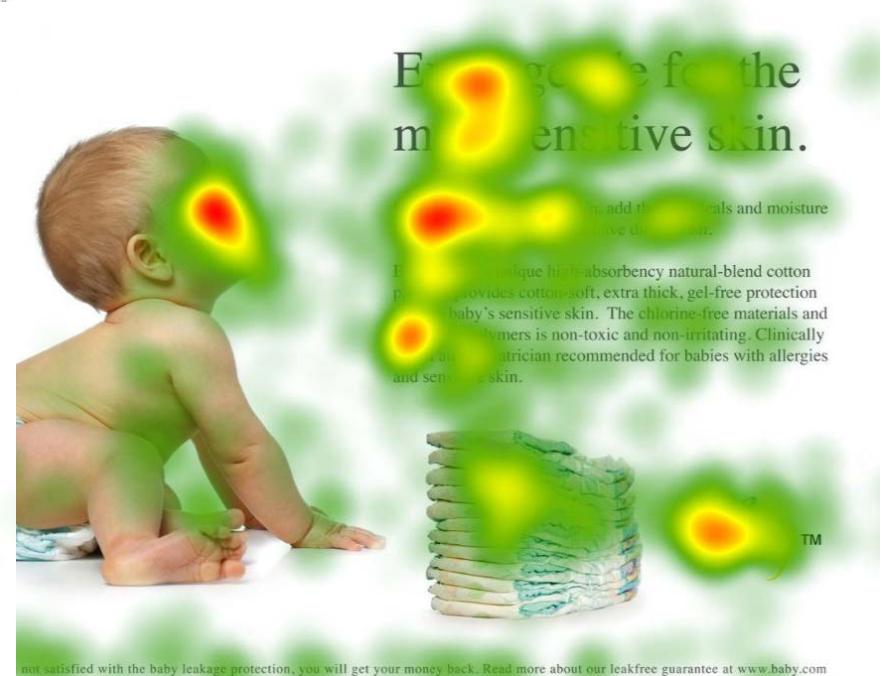
# ATTENTION

- Attention is the process of concentrating on something (e.g. an object, a task or a conversation) at a specific point in time.
- People differ in terms of their attention span. Some people's attention can be distracted easily while others can concentrate on a task irrespective of external disturbances.
- Attention is influenced by the way information is presented as well as by people's goals.



# ATTENTION

- People are drawn to faces on an interface
- Because of this, faces can have the unintended consequence of diverting attention away from information.





# MEMORY

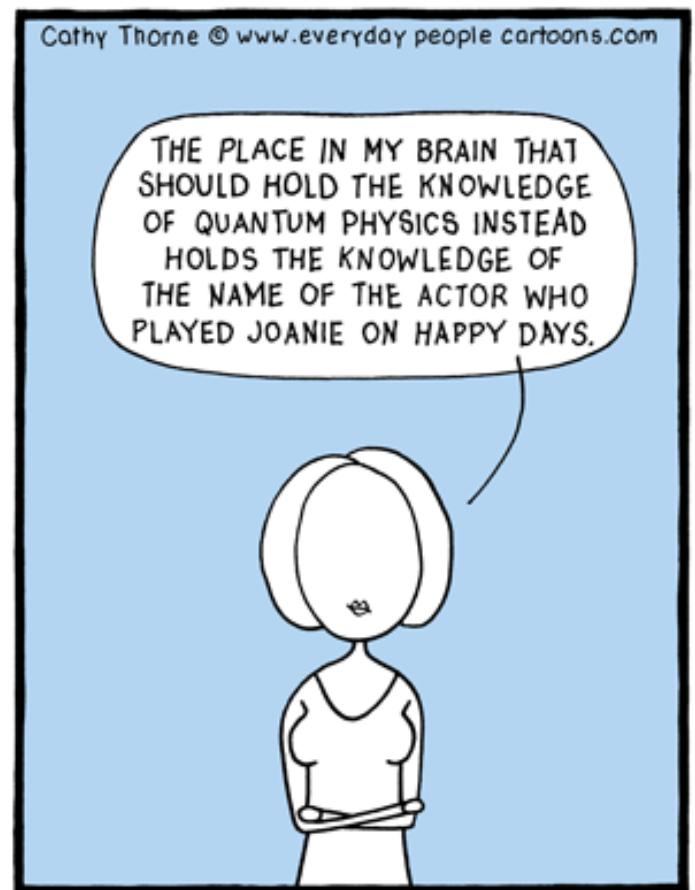
Short term vs. Long term memory.

Long term memory is accessed in different ways:

- Recall – retrieving information learned earlier. This can be hard.
- Recognition – identifying items previously encountered when presented with them.

Relates to “Knowledge in the Head” vs. “Knowledge in the World”.

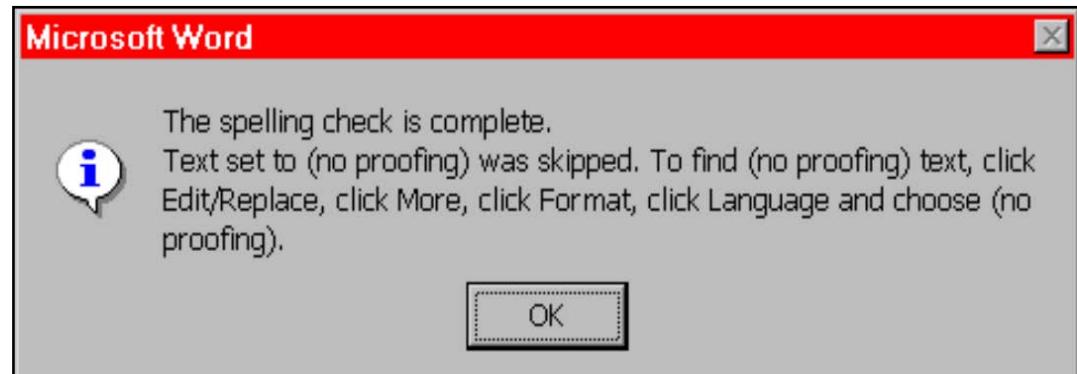
With Google and mobile phones, knowledge in the world has become almost infinite.



# MEMORY

## Memory and HCI

- Users should only be required to keep a few items of information in short term memory at any point during interaction (within the seven-item boundary).
- Users should not be compelled to search back through distant memories of training programs to operate the system.
- Support STM by including cues on the display (e.g. Menus).
- Help facilities are like LTM.
- Chunking information (like grouping credit card digits in fours) helps for items that exceed the STM limit.



# EMOTIONS

A mind and body's integrated response to a stimulus of some kind.



# EMOTIONS

Different theories about the relationship between mind and body during the experience of emotions:

James-Lange theory: experience of emotion is our awareness of our physiological responses to emotion-arousing stimuli.

Cannon-Bard theory: an emotion-arousing stimulus simultaneously triggers physiological responses and the subjective experience of emotion.

Schachter-Singer theory (two-factor theory): to experience emotion (1) one must be physically activated or affected (2) one must cognitively label or name the activation. I.e. when an emotion is felt, a physiological activation occurs and the person uses the immediate environment to search for emotional cues to label the physiological activation.

# EMOTIONS

ANOTHER EXPLANATION: It depends on how our brain processes the sensory input. There are two different routes, the high (slow) road and the low (fast) road.



Some emotion induces thinking.  
E.g. love and hate. It involves  
more parts of the brain.



Some emotions don't involve thinking. Don't have to put a name to the activator in order to feel the emotion, e.g. fear when you hear an explosion.

# EMOTIONS

Some implications for HCI:

When using psycho-physiological measurement instruments in UX evaluation we need to be aware of the following:

- Different people have different physical reactions to the same stimulus (some people sweat if they are anxious, others just shake)
- The same physical reaction can mean different things (your heart can start pounding because someone you love enters the room or when someone threatens you).

When trying to create a specific user experience, remember that what the user knows about the interaction, what happened just prior to the interaction, and what they expected to happen will affect their emotional reaction to it.

# THINKING and PROBLEM SOLVING

Successful problem solving ends in “insight” but we cannot rely on insight to always be correct, because people tend to look for and favour evidence that confirms their ideas and avoids or ignores evidence that refutes them (called **CONFIRMATION BIAS**).

How does confirmation bias affect design and usability evaluation?



# THINKING and PROBLEM SOLVING

**BELIEF PERSISTENCE:** Clinging to conceptions despite proof to the contrary. This relates to our reluctance to discard previously formed mental models.

**AVAILABILITY BIAS:** People believe an event will be more likely to occur if they can have clear examples or memories of it – especially if these memories are vivid, scary or awesome.  
(That is why casinos are successful.)

Thinking can be swayed by **FRAMING** – that is, how an issue is presented.  
Example: 95% chance of survival vs. 5 out of 100 people die.



# PART 2

# DESIGN PRINCIPLES and

# GUIDELINES

- Common design mistakes
- Design principles
- Web design guidelines

# COMMON DESIGN MISTAKES

Putting aesthetics before usability



# COMMON DESIGN MISTAKES

## Thinking for the user

People project their own feelings and beliefs onto others (e.g. mothers who force their children to wear jerseys because they themselves are cold).

Designers are no different – they will subconsciously build interfaces according to their own preferences and knowledge.

# COMMON DESIGN MISTAKES

## Mistaking the client for the user

Another common error is to mistake the client for the end user and base the designs on the requirements specified by the client (e.g. listening to university management rather than students when designing a learning management system like clickUP).

# COMMON DESIGN MISTAKES

# Cluttering the interface

JH (Johanna) Geldblom 091

**clickUP Home**   **Organisations**   **Teaching and Learning**   **clickUP Support**

**My clickUP**   **Notifications Dashboard**

**Add Module**   **Personalize Page**

**To all registered UP students**  
In view of the resumption of classes on the Hatfield, Groenkloof and Mamelodi Campuses of the University, it is necessary to bring a number of issues to the attention of all registered students, particularly with regard to the interdict obtained by the University and students' participation in unlawful protest action.  
[Kindly click here for a letter in this regard from the Registrar of the University.](#)

**Aan alle geregistreerde UP-studente**  
Met die oog op die hervatting van klasse op die Hatfield-, Groenkloof- en Mamelodikampus van die Universiteit, is dit belangrik om sekere aangeleenthede onder die aandag van alle geregistreerde studente te bring, veral ten opsigte van die interdict wat deur die Universiteit verkry is en studente se deelname aan onwettige protestaksie.  
[Klik asb hier vir 'n brief in hierdie opsig vanaf die Registraar van die Universiteit.](#)

**UNIVERSITY OF PRETORIA - ARRANGEMENTS FOR STRICT ACCESS CONTROL ON HATFIELD CAMPUS FROM 29 FEBRUARY**  
All staff, students and visitors should please take note of the [arrangements for strictly controlled access](#) to the Hatfield campus of the University, in the interests of safety. Please read the [strict access control document](#).  
All UP staff and students must please take note that access to the University is severely restricted. No student or staff member will be admitted without their student or staff card, and no visitors will be admitted without a prior appointment. Staff who have appointments with visitors who need to enter the campus must notify Security, and provide the names of the visitors. No visitors will be given access to the campus if Security has not been given prior information. Visitors will be asked to show the security staff at the entrance gates the letter or email from a member of UP staff inviting them to the campus.

**University Management**

**COMMUNICATION TO STUDENTS REGARDING THE USE OF SOCIAL MEDIA**  
In the light of recent events of a violent and disruptive nature on University campuses, much of which was fuelled by ongoing commentary on Facebook, Twitter and other social media, the following urgent communication is brought to the attention of all staff and students.  
Students and staff should take note that not only "posts" or "tweets", BUT ALSO "likes", "tagging" and "re-tweets" of posts on social media, which incite violence, harm or constitute "hate speech" are in contravention of the University's Disciplinary Code. Students and South African legislation and constitute grounds for criminal and civil action.  
Please note that if you allow your name to be coupled with any "likes", "tags" or "re-tweets" of this nature, you are equally liable and that disciplinary action and possible suspension or expulsion from the University, and/or criminal or civil action may follow.  
You are personally responsible for the use of your name on any social media platform. If your handle or name is attached to certain content, you are responsible for its publication. UP Management

**clickUP Courses**  
Courses where you are: Instructor  
**INF 154 S1 2014 (not currently available)**  
**INF 154 S1 2015 (not currently available)**  
**INF 154 S1 2016**  
Announcements:  

- 1 INF 154 Cheat Sheet
- 1 Updated schedule now available
- 1 Looking for group project members?
- 1 homework 3 submission date

  
**INF 164 S2 2014 (not currently available)**  
**INF 164 S2 2015**

**clickUP Lecturer News**  
Dear lecturer,  
Although UP is closed for this week (22-26 Feb), clickUP remains available to all staff and students who have access to the internet.  
**Access:**  
If you struggle with UP Portal access, you can access clickUP directly via <https://clickup.up.ac.za>. Use an "u" in front of your EMPLID (staff number) as username, and your portal password to gain access.  
**"Hybrid lectures"**  
We made available resources to help you create a "hybrid" solution to classes that you could not present this week, if you want to make use of such a solution. These are available on the "clickUP support" tab, once you have logged into clickUP. Then click on the "Collaborate moderators" sub-tab.  
**The human touch**  
Although not on campus, we are still able to assist you. If you need more assistance, feel free to contact the instructional designer allocated to your faculty via e-mail, or write an email to [e-support@up.ac.za](mailto:e-support@up.ac.za).  
Best wishes,



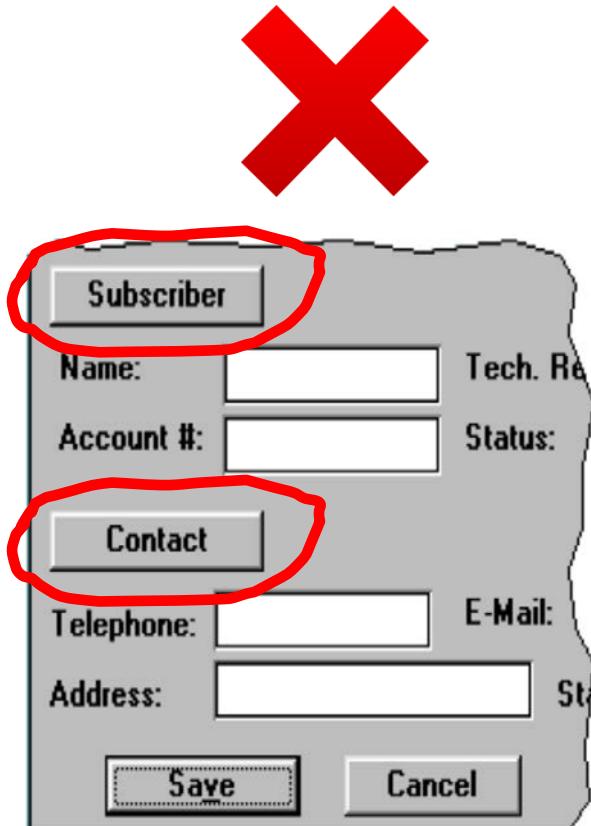
07:30

# DESIGN PRINCIPLES

- **Affordance** – appearance tells the user how the object should be used
- **Constraints** – restrict the user's behaviour to what is allowable (physical, cultural)
- **Mapping** – enables user to determine the relationship between the possible actions and the results
- **Visibility** – visible signs give the user clues as to what actions are possible or required (sound can also make something 'visible')
- **Feedback** – information sent back to the user about what action was performed
- **Consistency** – Likeness in input-output behaviour arising from similar situations or similar task objectives.

# PERCEIVED AFFORDANCE

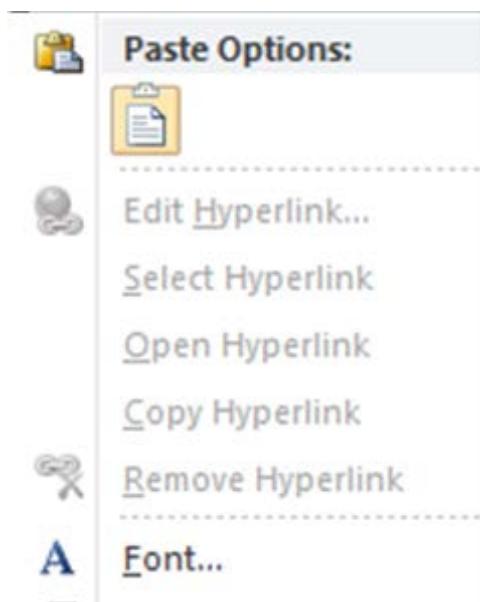
Perceived affordance – tells the user how to use the object



# CONSTRAINTS

**Constraints** – force the user to do the right thing

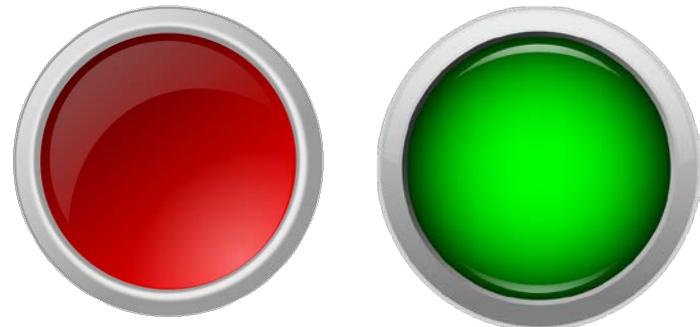
## Physical constraints



The user cannot choose dimmed options.

## Psychological constraints

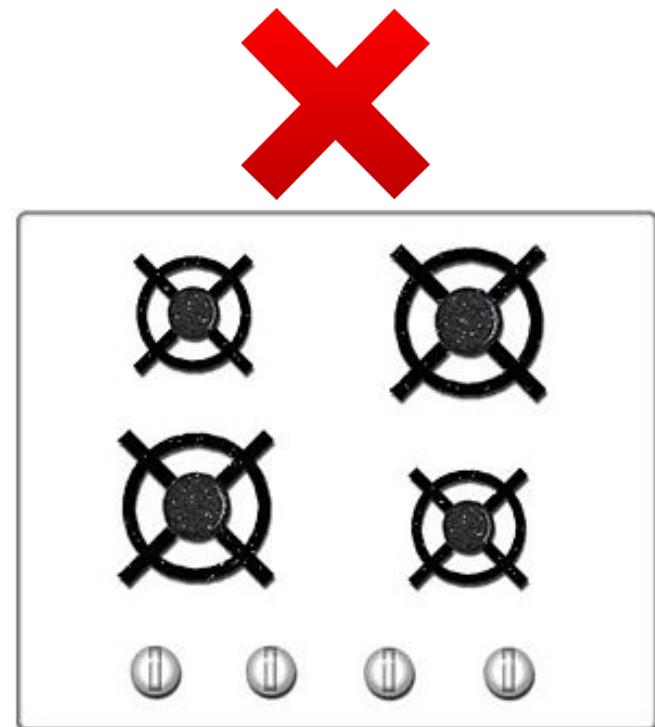
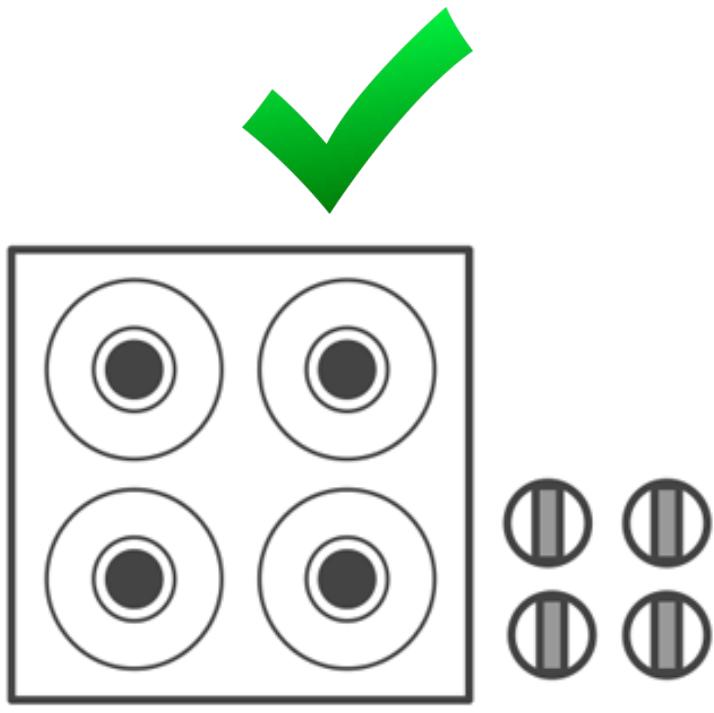
Symbols and conventions



Which of these is associated with danger, stop, go, safety, warning?

# MAPPING

**Mapping** – shows what action can be performed with an interface element



# MAPPING

Mapping – shows what action can be performed on/with an interface element



Good mapping for  
“page forward and backward”

Bad mapping for  
“back to menu”



# VISIBILITY

**Visibility** – the part of the interface that is relevant to interaction is detectable

- Look out for “false bottoms” – when there is content below the end of the screen.
- Content hinting – give cues that say there is more to see.
- Don’t assume a scrollbar will give users a hint – it’s a static object outside of their direct field of vision.
- **What is visible on the page without requiring any action is what encourages us to scroll ... anything that’s hidden and that the user must uncover will only be seen if the user deems it worth the hassle.”**  
[\(http://www.nngroup.com/articles/page-fold-manifesto/\)](http://www.nngroup.com/articles/page-fold-manifesto/)

# VISIBILITY

The screenshot shows a web browser window with the following details:

- Top Bar:** Shows various pinned tabs: Apps, Clock, Free Online YouTube, and Online converter - c...  
Navigation links: AT HOME, MOBILE (highlighted in blue), BUSINESS, MY TELKOM SERVICES.
- Header:** Shop, Our Network, Help, My Telkom Mobile.
- User Information:** Logged on: [Redacted], LOGOUT.
- Left Column (MyAccounts):**
  - Accounts:** Shows a large blue button with a circular loading icon.
  - Add Another Account:** Link another account.
  - Manage Subscriptions:** Managing detail around your subscription.
- Right Column (MyStore):**
  - Redeem Airtime Voucher:** Allows you to redeem airtime vouchers.  
Form fields: Mobile Number (redacted), Voucher PIN (redacted).  
Red circle highlights the "Mobile Number" field.  
**REDEEM** button.
  - Warning:** Please note that your account will be added to the recharge blacklist after 3 consecutive unsuccessful attempts to redeem airtime voucher. Call 081 180 for support.
  - Credit Card Airtime TopUp:** Allows you to buy airtime using your credit card.
  - Purchase Bundle:** Allows you to purchase bundles using airtime, spend limit or credit card.
- Bottom Status Bar:** Waiting for home.8ta.com...  
Taskbar icons: Windows, File Explorer, Internet Explorer, Google Chrome, Control Panel, and others.  
System tray: Volume, Network, Battery, and Date/Time (10:25, 2015/04/11).

# FEEDBACK

**Feedback – reaction to the user's action**

Acknowledge interaction – let users know they have been heard or felt or seen.

Failing to acknowledge can lead to unnecessary repetition of actions.

## EXAMPLES:

- The success message that appears after a web form has been submitted.
- The sound some cell phones make when a message has been sent (or the icon that shows it has been sent).
- The sense of a Wii controller vibrating when simulating a machine gun being fired.

# **CONSISTENCY**

**Consistency** – Likeness in input-output behaviour arising from similar situations or similar task objectives.

# WEB DESIGN PRINCIPLES

- Home page
- Page layout
- Navigation
- Headings, titles and labels
- Links
- Text
- Graphics
- Search

# THE HOME PAGE

- The home page should convey the characteristics of the organisation.
- In the short time users spend on a home page, the value of the website (and the company) must be conveyed effectively. The purpose of the website should be clearly communicated .
- Text should be kept to a minimum.
- A link back to the home page should be available from every page of a website.

# PAGE LAYOUT

- Order of items reflects their relative importance.
- Items should be positioned consistently, aligned appropriately (horizontally or vertically) and organised hierarchically throughout the website.
- Important items should appear towards the top and center of the page.

# NAVIGATION

- Users should find it easy to return to the homepage to start new information seeking task.
- Pages that require scrolling should provide anchor links at the top of the page.
- Breadcrumbs are effective indication of the current location and lead users to the next step.
- Navigation should be supported by matching a link's text to the destination page heading (as a form of feedback), formatting URLs to relate to the user's location on the website, and changing the colour of selected links.
- Content should be accessible from various locations to support different preferences.

# HEADINGS, TITLES and LABELS

- Most users scan rather than read when they spend time on a website. Well-designed and descriptive headings, titles and labels aid users in scanning and reading effectively.
- Descriptive headings can provide context to the information or functions that follow them and improve users' interpretation.
- Labels that properly represent the function they signify, assist users to quickly and easily evaluate the available actions .
- Less descriptive or representative labels force users into exploratory learning and trial and error interaction that will slow them down.

# LINKS

- Effective links have meaningful labels, consistent clickable cues and they change appearance when clicked.
- Single word labels might not provide enough information about the intended destination, but long descriptors might be difficult and time consuming to read.
- Clickable elements should clearly afford clicking and those that are not links should not appear like links.
- Links should be easily identifiable, they should be made visible by avoiding clutter and placing them high up on the page, and they should clearly indicate their destination.
- Closely matched link descriptions and destinations provide feedback to the users so that they do not have to spend time scanning the destination page to determine if they are on the right track.

# TEXT

- Text appearance influence reading speed and ease of learning. Mixed-case elicits faster reading and should be used for text if users need to read large portions of information .
- Familiar font types achieve the best reading speed.
- Black text on a plain, high-contrast, non-patterned background is most successful.
- Visual consistency reduces task completion and learning time (i.e. consistent use of colour, size and spacing of characters, size and location of labels, and fonts and backgrounds).
- Bold text should be used sparingly. Variation between bold and non-bold text influences search time and accuracy and should only be used to draw attention to specific information.
- Sans serif fonts are read more easily.

# GRAPHICS

- Graphics used appropriately can add value, but if not, it can be detrimental to a website. Graphics should be kept simple and should not resemble banner advertisements .
- Text placed over a background image may cause strain. Preferably the only image that should be present on every page is the company logo that links back to the homepage .
- Ideally, the company logo should be in the same location on every page to serve as a frame of reference for users to confirm that they are still on the intended website. The most common position for a logo is in the top left corner.

# SEARCH

- Websites often provide users with the ability to search for information through a search box to enter one or more keywords. Users should be presented with search results that match their expectations, fit the context and are in a usable format.
- Search results should solve users' problems, and not confuse or frustrate them. Search should not be used as a substitute for good content organisation, but can be added to every page on a content-rich website.
- It should allow simple keyword searches as well as more complex Boolean searches .

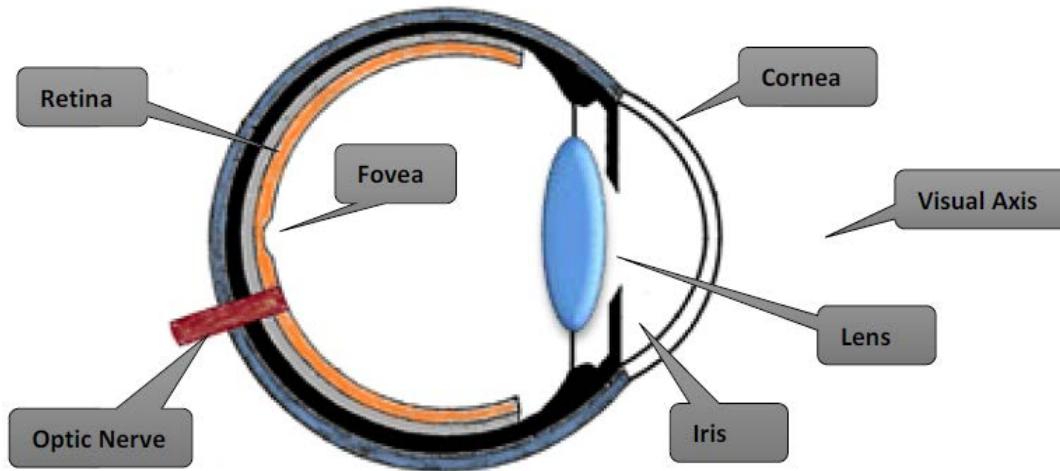
# PART 3

# EYE TRACKING

- Eye tracking basics
- Six lessons from practical experience
- Who should do it?

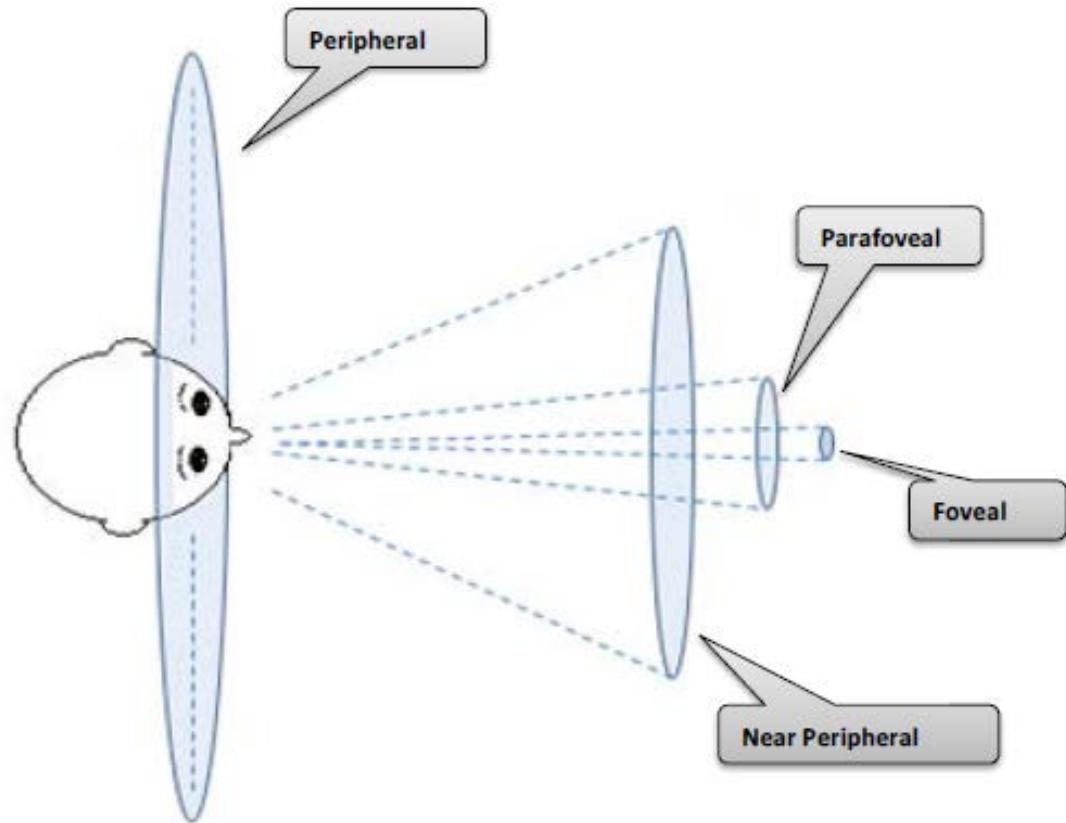
# How do we see?

- First step in seeing an object is registering the light reflected from that object with our retina, a light-sensitive layer at the back of our eyes.
- The small part of the retina called the fovea registers the external world far more sharply than any other part of the retina.
- To see an object with 100% acuity, we adjust our eyes so that the light reflected from the object falls onto the fovea.



# EYE TRACKING BASICS

- The fovea is less than 1% of the retina but takes up over 50% of the visual cortex in the brain.
- Peripheral vision is mainly good at picking up movements and contrasts



# EYE TRACKING BASICS

- To compensate for narrow foveal vision, we constantly scan our visual field with rapid ballistic eye movements called **saccades**.
- Saccadic eye movements can be small (i.e., cover short distances e.g., during reading) or large (e.g., looking around a room).
- We do not process visual information during saccades; processing happens when gaze is kept relatively steady for short periods to reposition a new image onto the fovea – this is a **fixation**.
- These fixations take up the majority of our viewing time (about 90%)

# EYE TRACKING BASICS

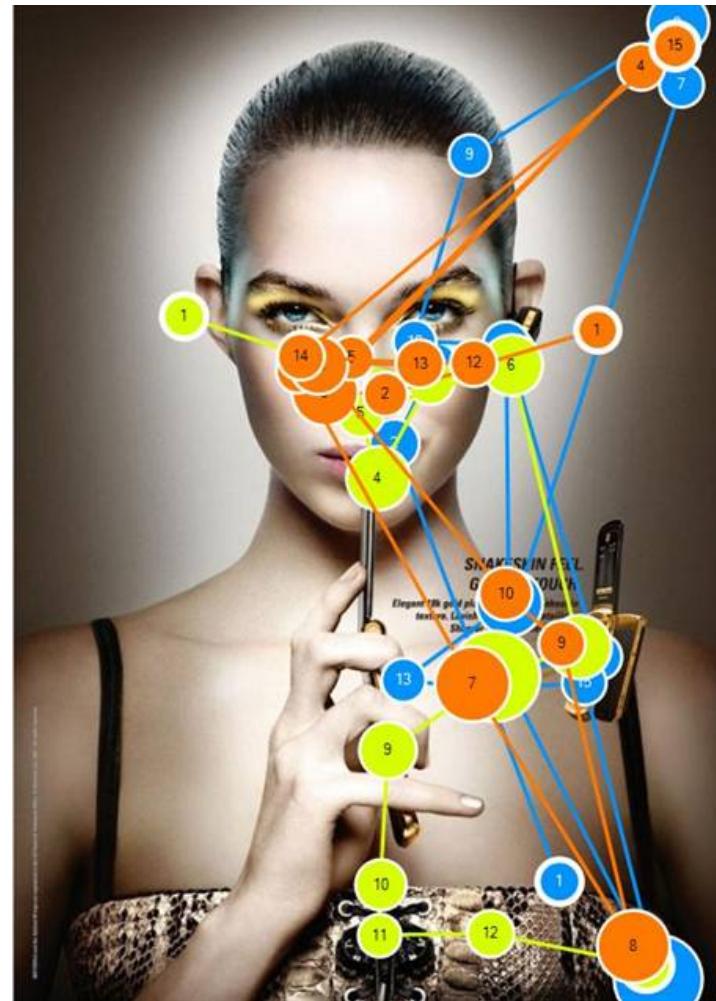


# EYE TRACKING BASICS



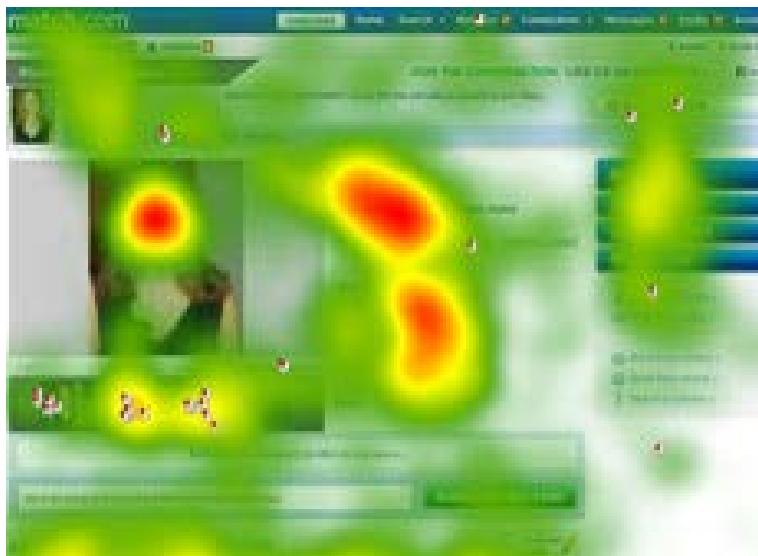
# EYE TRACKING BASICS

- Gaze plots are graphs showing a user's sequence of fixation.
- Gaze videos show an animated path of the user's fixations.



# EYE TRACKING BASICS

Heat maps indicate which parts of an object users looked at and how intensely they looked.



- Red denotes the most intense fixations, yellow moderate ones, and green the least intense ones.
- Areas with no colour indicate that users did not fixate on those parts of the stimulus.

# SIX LESSONS FROM PRACTICE

1. Revealing mismatched mental models
2. Identifying visibility problems
3. Revealing problems with copy and language
4. Comparing different user groups
5. Comparing competing products
6. Convincing the client of design problems



# 1. MISMATCHED MENTAL MODELS



The Rustica system (SAP Innovation)

# 1. MISMATCHED MENTAL MODELS



## 2. IDENTIFYING VISIBILITY PROBLEMS

**Retirement**

**Question** Given that you are saving for retirement, please select the statement that best applies to you when you add up your projected savings and valuable assets:

**Answer**

- My total projected savings and valuable assets will be able to replace my household income after retirement.
- My total projected savings and valuable assets will not completely be able to replace my income ~~after retirement~~, but it will be manageable by adjusting my stand
- My total projected savings and valuable assets will not be sufficient to replace my income after retirement, and it will be difficult to lower my standard of living to compensate.
- My total projected savings and valuable assets will be so little that retirement is not really an option for me.

**Your progress**

17% done

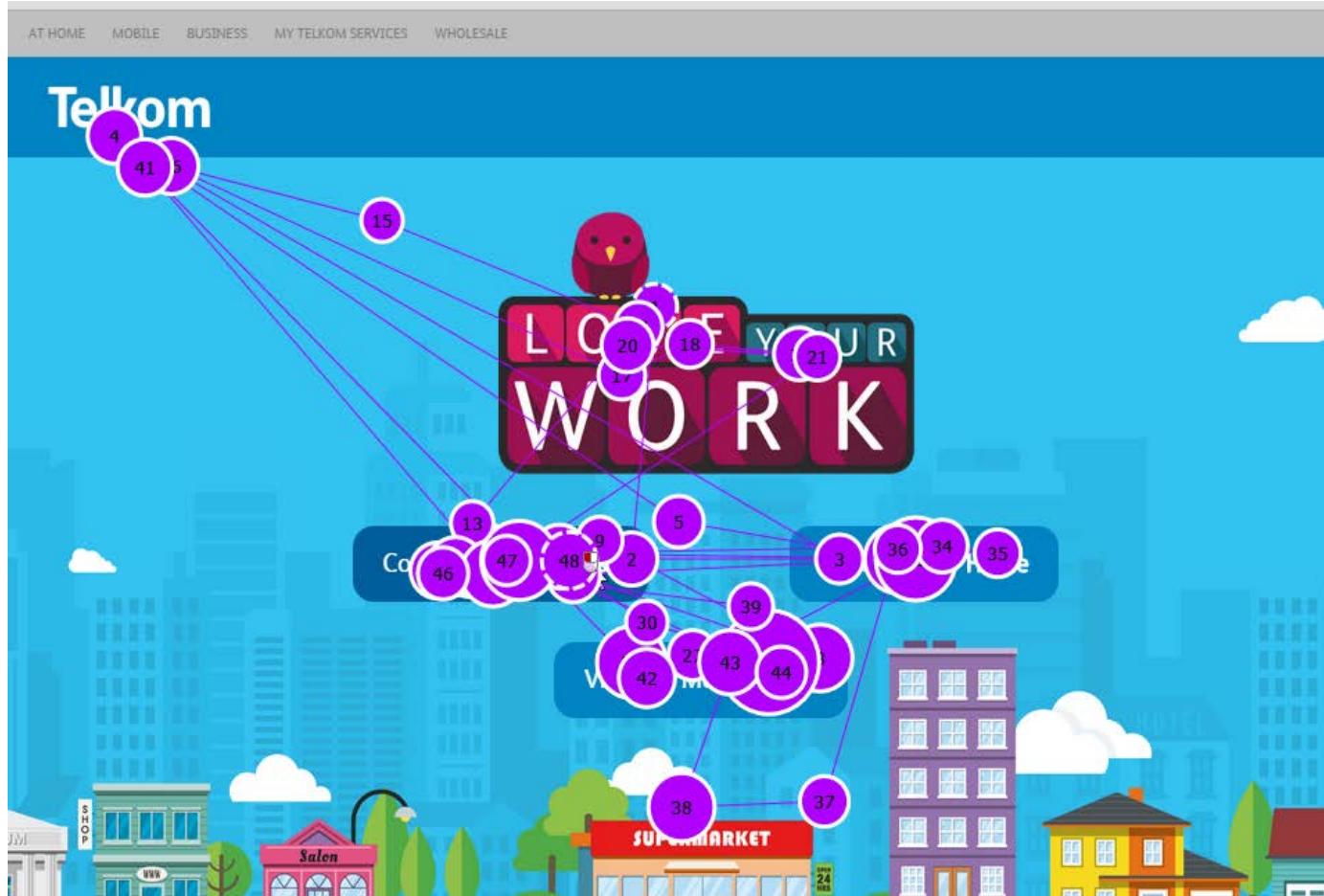
**RESTART** ← PREVIOUS NEXT →

**Hint**

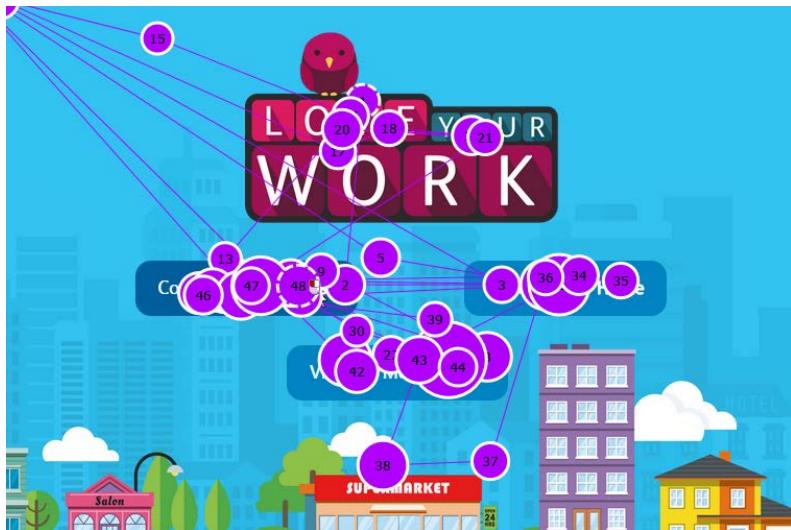
Assets are those items that would be sold to generate an income, therefore they exclude any property that would still be occupied. An example of this type of asset would be investments and/or additional cars/properties. Click on the calculator button for assistance to convert a lump sum into an income (including inflation).



## 2. IDENTIFYING VISIBILITY PROBLEMS



### 3. PROBLEMS WITH LABELS AND LANGUAGE



Connect your Business

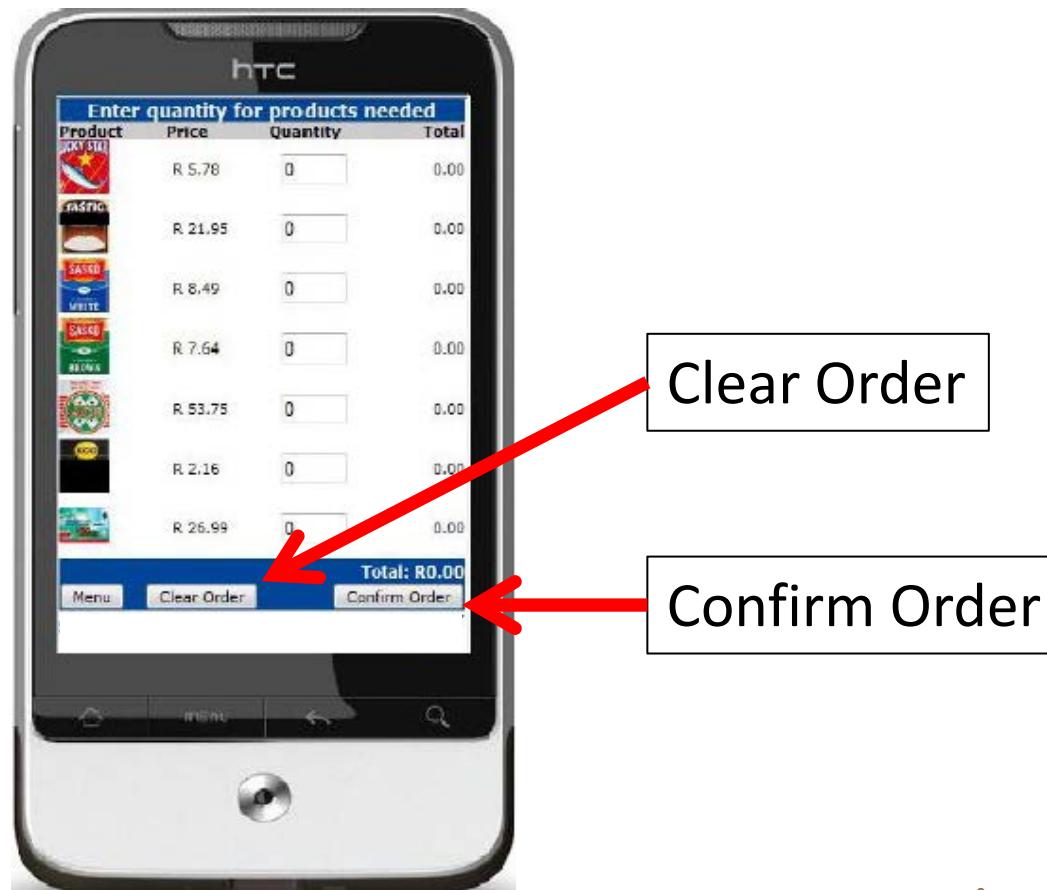
Connect your Home

View our Mobile Deals

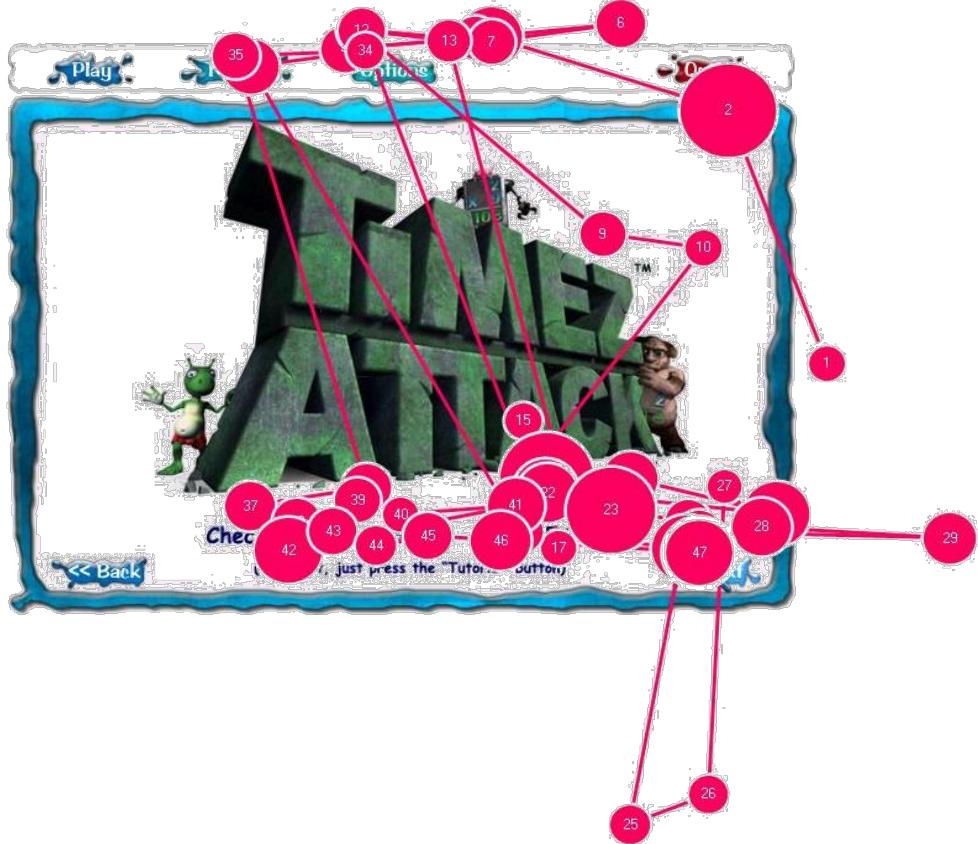


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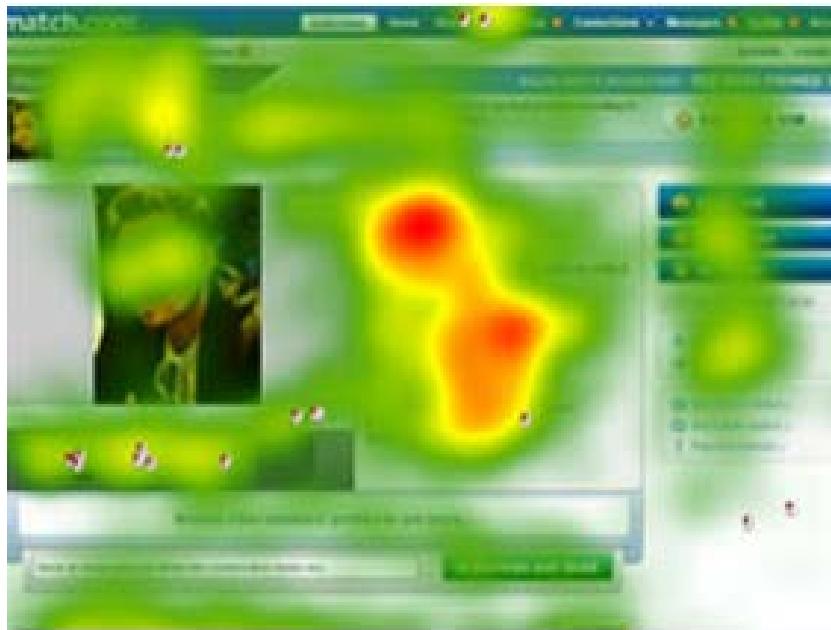
### 3. PROBLEMS WITH LABELS AND LANGUAGE



## 4. COMPARING USER GROUPS



## 4. COMPARING USER GROUPS



From Tobii.com

## 5. COMPARING COMPETING PRODUCTS

Mobile data top-up on three major SPs

Number of fixations until first click

	 vodacom		Telkom
Min	5	7	12
Median	36	57	36
Max	67	244	117

## 5. COMPARING COMPETING PRODUCTS

Number of screens visited (no of users in brackets)

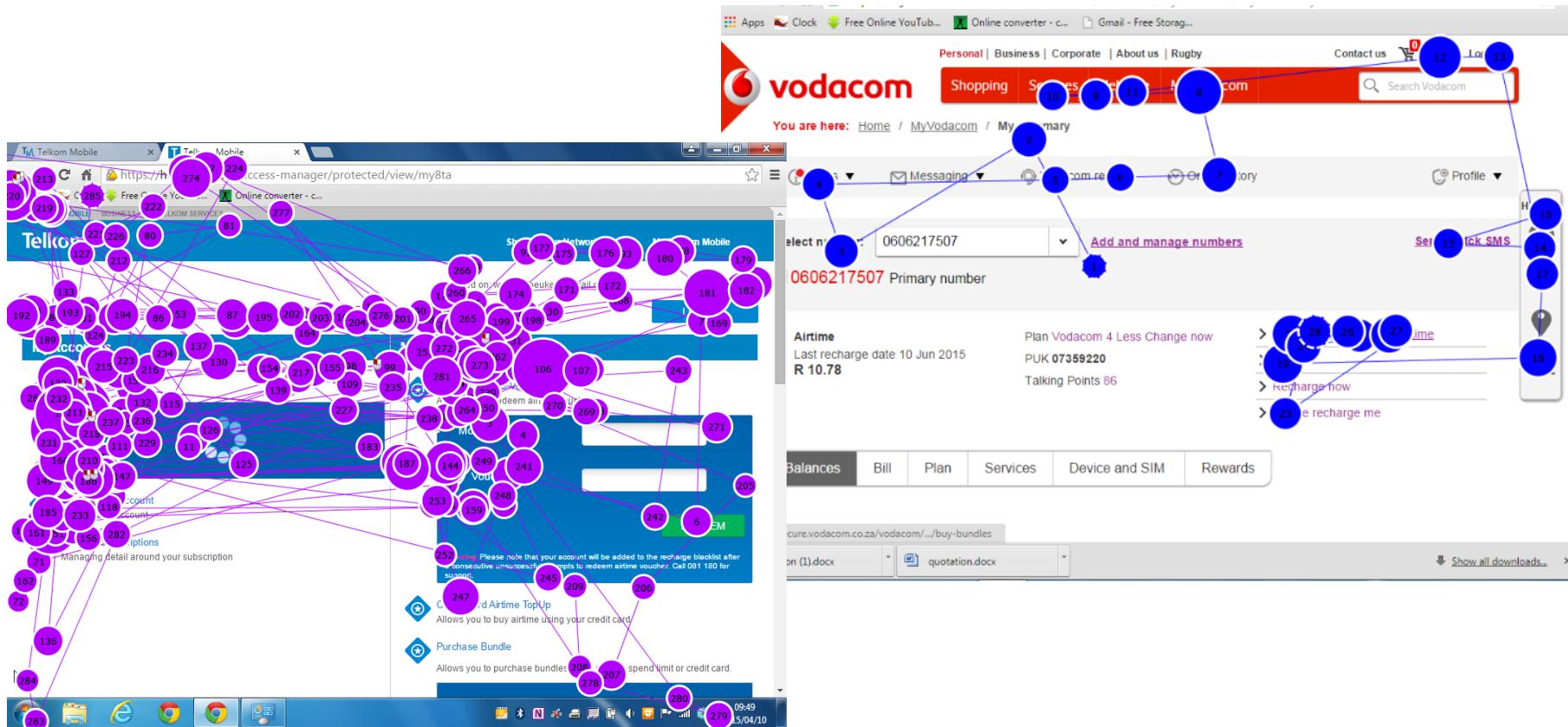
	 vodacom		Telkom
Most	10 (1)	10 (1)	16 (1)
Median	2	3	9
Optimum	2 (13)	2 (5)	4 (3)

## 5. COMPARING COMPETING PRODUCTS

Time on last screen until target clicked (min:sec)

	 vodacom		Telkom
Slowest	00:12	00:26	03:06
Median	00:07	00:09	00:41
Quickest	00:04	00:04	00:26

## 5. COMPARING COMPETING PRODUCTS



## 6. CONVINCING THE CLIENT

Proper eye tracking data provide objective evidence of usability problems that may otherwise be difficult to prove.



- Requires a unique skill set
- Capturing the data is easy – what to do with it is the difficult part
- Inter-department “politics”
- Examples of underutilised equipment



# Questions?

For a demo of our eye tracker, contact  
me at [helene.gelderblom@up.ac.za](mailto:helene.gelderblom@up.ac.za)