User Interfaces: Usability

USER INTERFACE

COURSE 2020/2021

Usability

A property reflecting the ease-of-use of an information system

by R.B. Miller

A quality based on 5 basic components: 1) learnability, 2) efficiency, 3) memorability, 4) errors, 5) satisfaction

by J. Nielsen

The level of efficacy, efficiency and satisfaction reached by a product which is employed by a class of users in order to reach given goals in specific environments

by Bevan

Usability

The emotional side of design may be more critical to a product's success that its practical elements.

The Design of Everyday Things by Don Norman

Usability

Are you able to drink from it?

- Good design means that the objects are easy to understand and use
- Bad design means that the objects are difficult to use and frustrating

The Design of Everyday Things by Don Norman

Usability

The system has to use the user language

- Too many options means too much to learn, understand and look for. Consequently, it means more chances to make mistakes
- The information and operations should be accessed in a natural sequence
- Never use system terms, always use common practice words and icons
- Ensure good mappings between computer display and user's conceptual model
- Task analysis and understanding of users & their domain

Usability

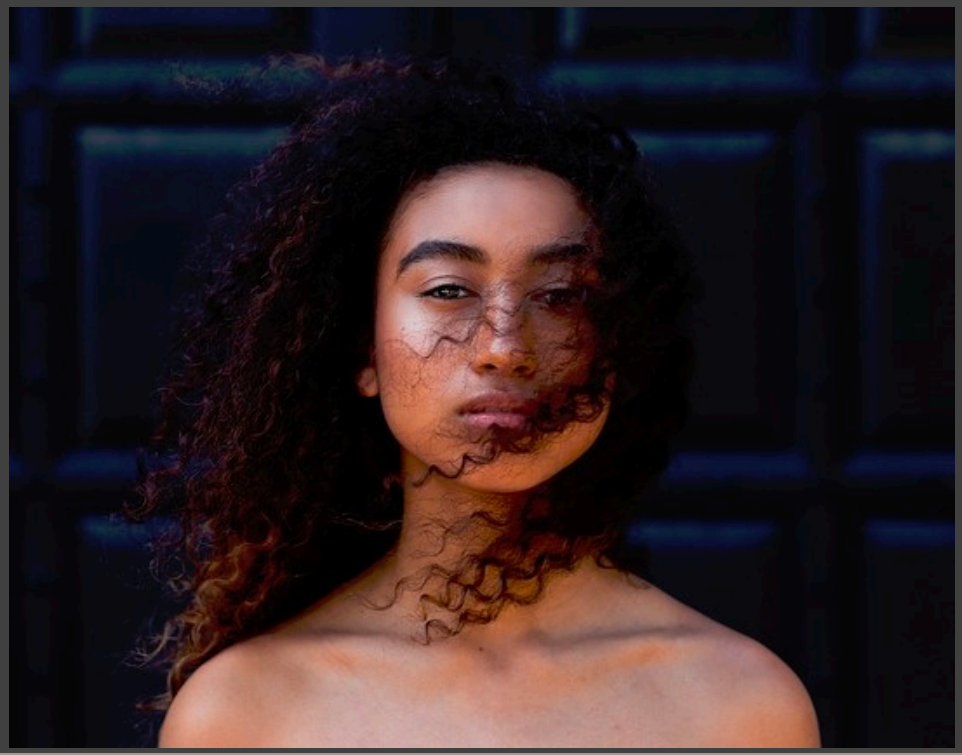
The User Interface Design is based on the definition of several metaphors

- Trash/paper-shredder/black hole icons are all metaphors to “delete” documents or other objects
- Metaphors could depend on the user context and cultural background → internationalization problems
- The definition of a new metaphor has to take into account the users’ background
- User evaluation are needed to evaluate the understandability of defined metaphors

The human being

It’s important to take into account several factors related to the human being to design a usable user interface

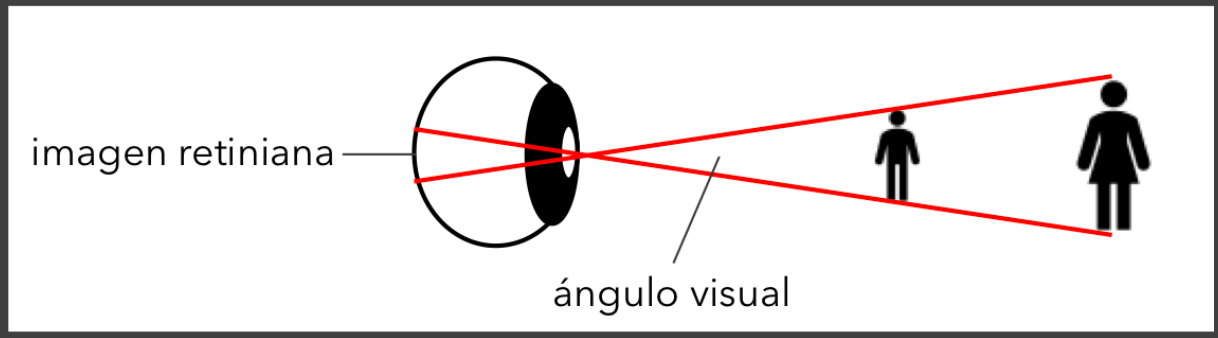
- Visual perception
- Reading
- Hearing
- Touch
- Movement
- Memory
- Thinking

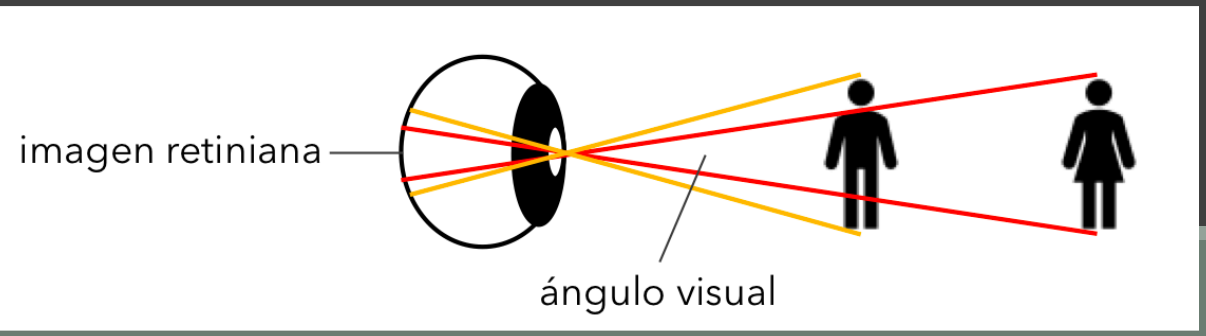


Visual perception

Size and depth perception depend on the visual angle

- Objects of the same size at different distances have different visual angles
- Objects of different sizes and at difference distances may have the same visual angle





Visual perception

The theories of visual perception or the Gestalt principles attempt to describe how people tend to organize and perceive visual elements

The whole is greater than the sum of its parts

- The law of closure: people perceive the whole by filling in the missing information.

Visual perception

The theories of visual perception or the Gestalt principles attempt to describe how people tend to organize and perceive visual elements

The whole is greater than the sum of its parts

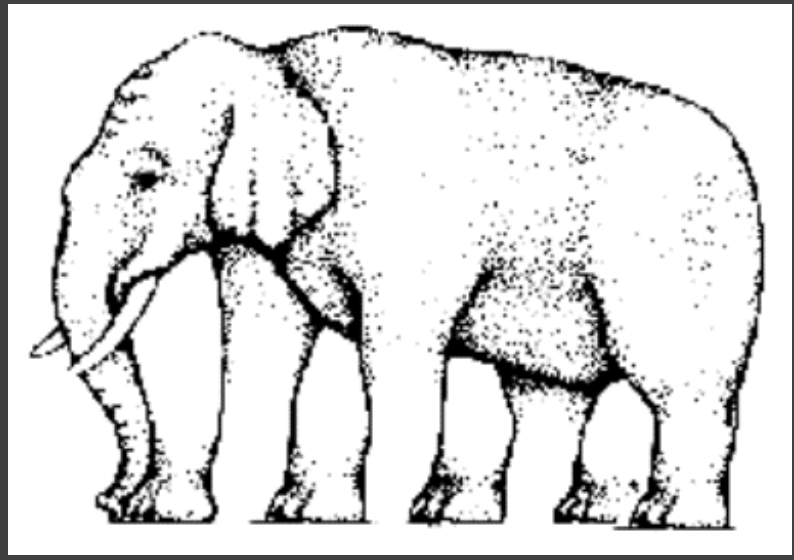
- The law of figure and ground: the eye differentiates an object from its surrounding area, perceived as ground (background).

Visual perception

The theories of visual perception or the Gestalt principles attempt to describe how people tend to organize and perceive visual elements

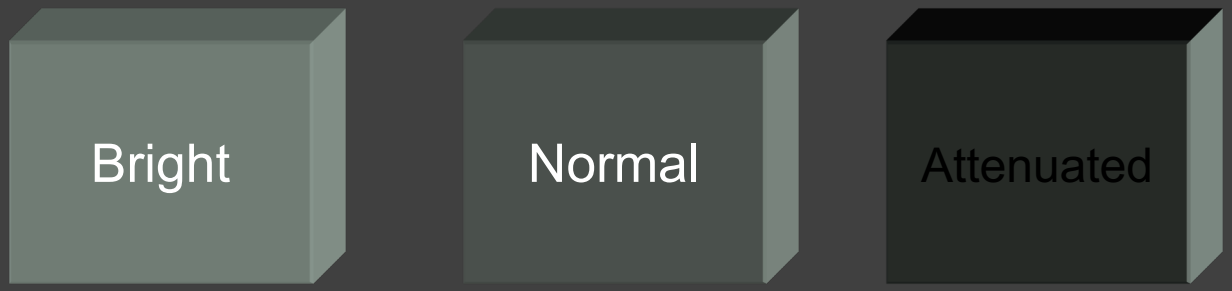
The whole is greater than the sum of its parts

- The law of simplicity: the mind wants to find the simplest solution to any visual problem.



Visual perception

- Brightness is a subjective reaction to levels of light. It is defined as the amount of perceived luminance – Luminance is the amount of light emitted by an object
- Higher luminance means greater visual acuity but also greater flicker frequency



Contrast: it is a function of the luminance of an object and the luminance of its background

- Positive contrast is better in terms of readability, but it can get one more tired

Positive contrast

Negative contrast

Visual perception

- Color is usually regarded as being made up of three components: hue (dominant wavelength), intensity (lightness or darkness) and saturation (amount of white added to the hue)
- It is best to use 5-7 colors. Light greys are good backgrounds
- Use colors to categorize, differentiate and highlight data NOT to give additional information
- Adding too much info to a user interface is distracting
- The interface may be used in black and white. Choose colors that color-blind users can use.
  - Color blindness affects 8% men and 1% women

Color theory

- There are no recipes for good color combinations but knowing the properties of color can help.
- Designers get inspiration from photos, real scenes, similar products, …
  - https://www.design-seeds.com/
  - https://uxplanet.org/create-a-color-scheme-around-any-color-in-8-easy-steps-a0229e1985c
  - https://colorhunt.co/
  - …
- … as well as the color theory.

Color theory

WARM COLORS

Passion, joy, enthusiasm and energy

COLD COLORS

Calmness and professional feelings

Color theory

PRIMARY COLORS

SECUNDARY COLORS

TERTIARY COLORS

Color theory

COMPLEMENTARY COLORS

- Opposite colors in the circle
- Used to generate strong contrast
- In web design, the dominant color is used as background and other more intense colors are used to highlight important elements

Color theory

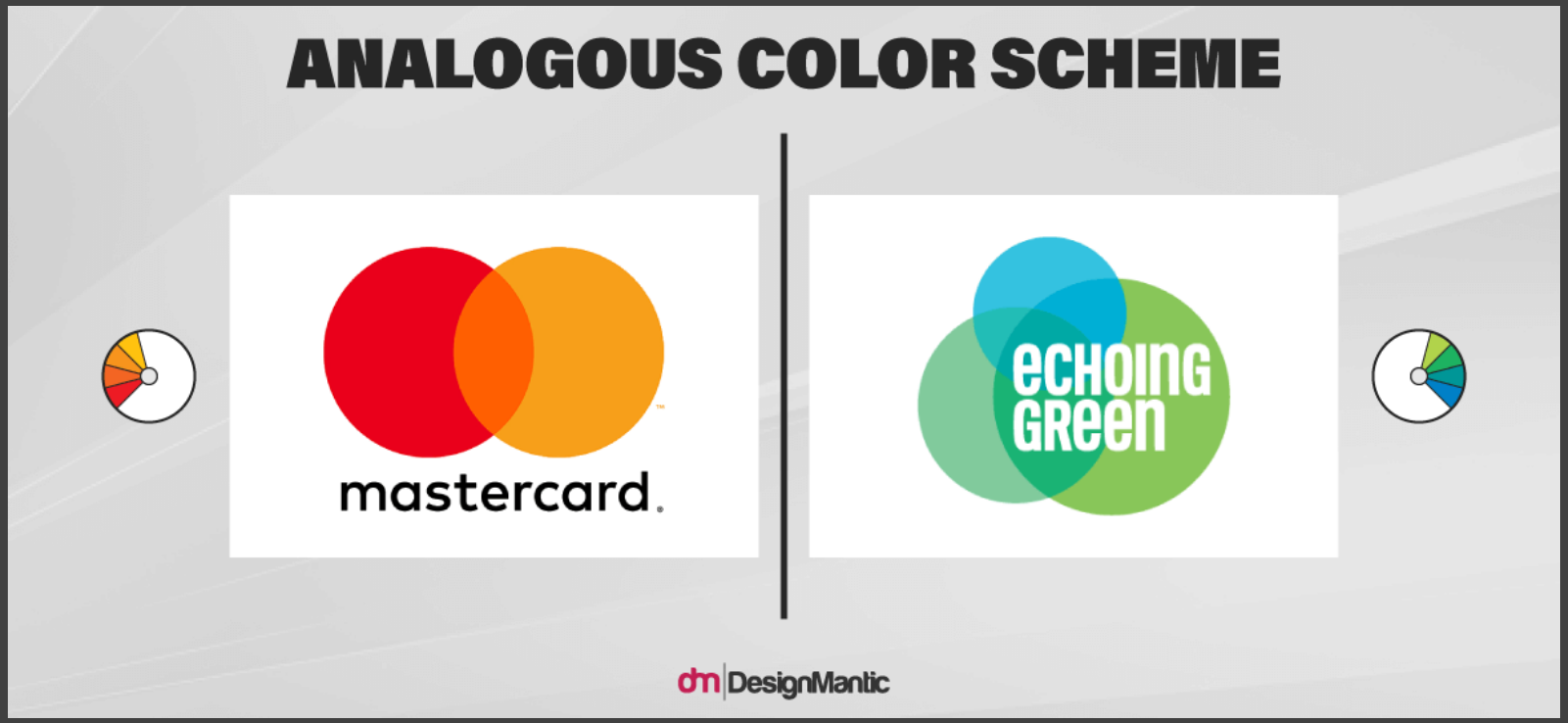
https://www.designmantic.com/how-to/how-to-select-color-for-your-logo-design

Color theory

ANALOGOUS COLORS

- Colors on either side of any color of the circle
- They are at the basis of the harmonic schemes.

Color theory



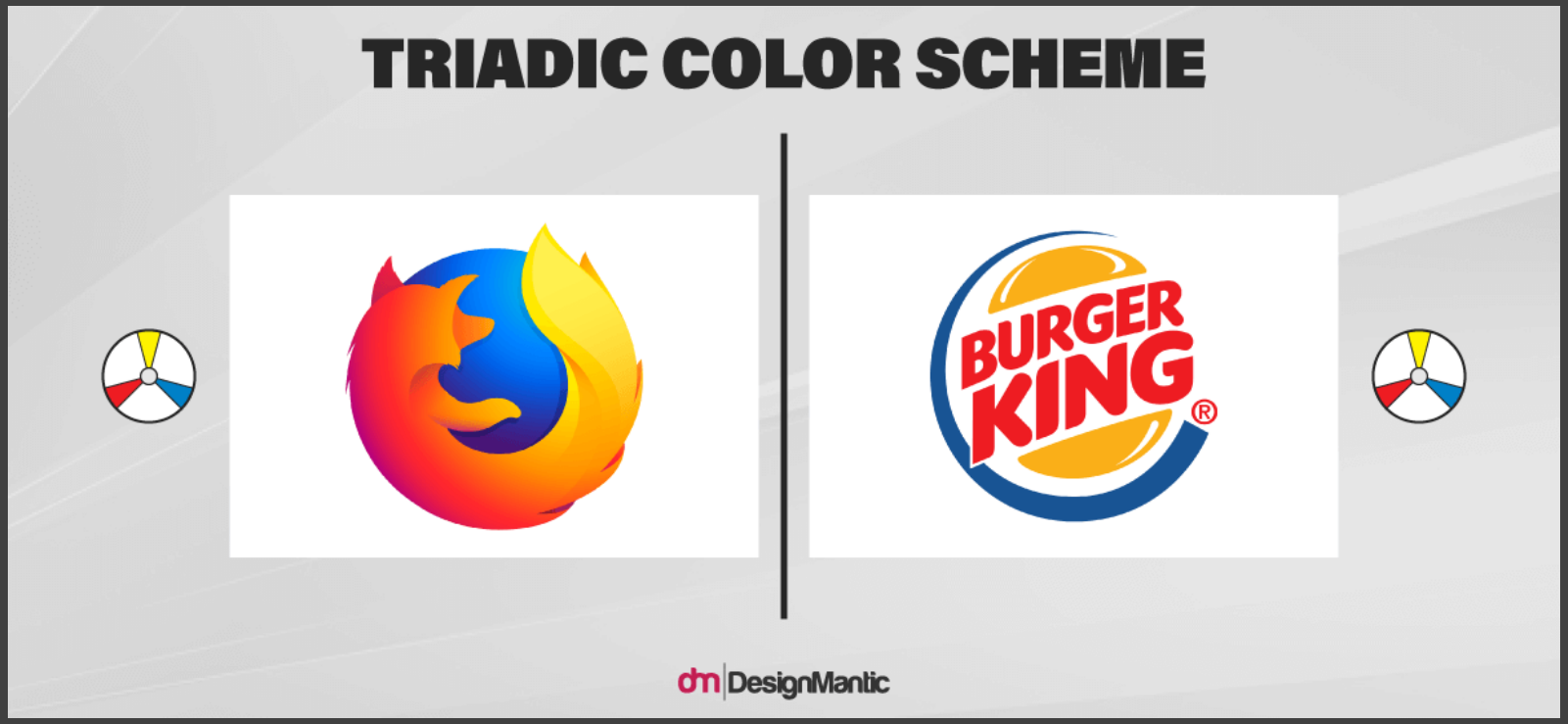
https://www.designmantic.com/how-to/how-to-select-color-for-your-logo-design

Color theory

TRIADIC COLOR SCHEME

- Three equidistant colors
- Harmonic and balanced scheme, but with high contrast

Color theory



https://www.designmantic.com/how-to/how-to-select-color-for-your-logo-design

Color theory

SPLIT-COMPLEMENTARY COLOR SCHEME

- One color and those adjacent to its complementary
- High contrast, without the tension of the complementary scheme

Color theory

https://www.designmantic.com/how-to/how-to-select-color-for-your-logo-design

Color theory

TETRADIC COLOR SCHEME

- Two pairs of complementary colors
- All four colors cannot be used for the same purpose
- One color must be the dominant one

Color theory

SQUARE COLOR SCHEME

- Many possible combinations
- May bring harmony problems
- Be careful when using this scheme

Movement

The are several relevant factors related to the movement of arms, hands or other body parts to take into account

- Reaction speed: e.g. Processing input and hitting a key
- Response accuracy (hitting the target – e.g. videogames)
- Both reaction speed and accuracy improve with practise → Effects of familiarity (e.g. levels in videogames)
- Tiredness affects reaction speed and accuracy

Memory

- Sensory memory: icons (visual stimuli), environmental (aural stimuli), touch
- Short-term memory (or working memory): temporal information
  - 7+-2 items or chunks
- Long-term memory: everything we know, episodic memory (events), semantic memory (skills, concepts)
  - E.g. old phone number when memorizing the new one, football players of previous seasons

THMRT EO WA SCH OEN IEN ROIMBEEH NERS

VS

THERE IS NO ONE WHO CAN REMEMBER THIS

Thinking

- Reasoning: we use the knowledge we have to draw conclusions or infer something new about the domain.
  - Deductive – logical, based on premises, might not be true: E.g. Peter is a person. People eat fish. Peter eats fish.
  - Inductive - generalization (from one case we have seen from other we have not): E.g. My car has three pedals, thus all the cars have three pedals
  - Abductive - to derive explanations from facts that have happened in the past: E.g. Santi drives his car very fast when he is drunk. If we happen to see Santi driving his car very fast, we conclude he has been drinking (what if he is in a hurry, or in an emergency?)
- Problem solving: the process of finding a solution to an unfamiliar task by using previously gained knowledge
- Users always gain skills while using (interactive) systems

  E.g. 3 pedals are a lot of pedals when learning to drive a car; sending SMS the first time…and now
- We need to offer controls and options that can be easily learnt

Usability

Usability is a quality of a system with respect to :

- How **easy or difficult it is to use**, which allows for multiple ways of exchanging information between the user and the system
- How **easy or difficult it is to learn**, for novice or more frequent users, which should allow them to have an effective interaction
- The **satisfaction** of using it, enabling the user to achieve his/her goals

(Rosson & Carroll, 2002)

Usability

- Easy to use
- Easy to learn
- Effective
- Efficient
- Useful
- Secure

Usability

The benefits of usability include:

- Reduced maintenance and learning costs
- Decreased training and support costs
- Increased customer satisfaction
- Increased sales and revenues
- Better quality of life of end-users
- Reduced development time and costs
- Increased productivity

Design principles

Design principles are generalizable abstractions that aim to guide designers in various aspects of their design

- These principles stem from theory, previous experience, and common sense
- There is no golden rule that always works - why?

Design principles

- To understand the user
- To understand the domain of the tool/application
- Aim for clarity and simplicity
  - Guarantee visible controls and options
  - Design intuitive controls and options
- To be consistent
  - Similar controls and options have to achieve similar objectives

1	2	3
4	5	6
7	8	9
	0	

(a) phones, remote controls

7	8	9
4	5	6
1	2	3
0		

(b) calculators, computer keypads

Not consistent

Design principles

- Provide visual and hearing cues
  - Organize controls and options logically (the most used the nearest)
  - Hide or disable the ones that can not be used in the current state
  - Provide feedback about the current state of the system
- Foster legibility
- Provide accessibility (input/output devices)
- Task-oriented design of the UI to achieve a specific function

Design principles

How can we apply these basic principles to the design of a screen and of error messages?

Screen design

Aesthetics – artistic elements: good graphic design and attractive displays can increase users' satisfaction and thus improve productivity.

Basic principles to follow in order to display elements on the screen:

- Elegance and simplicity
- Information should be grouped, respect hierarchies /relationships, and be balanced.
  - If things logically belong together, then we should normally physically group them together
  - Decorative features like font style, text, background color can be used to emphasize groupings
- Scale, contrast and proportion
- Visual organization and structure. The elements must be clear, keep harmony between them and the activity they carry out

Screen design

Let’s consider the following visualization techniques for the same information

PÉREZ,MARIA23456789ZJUAN PEDRO DÍAZ
ANA230193TOMAS021090LUISA301299

1

Worker: MARIA PÉREZ
ID:23.456.789Z
Partner: JUAN PEDRO DÍAZ
Children: First Name and birth date
TOMAS 02-10-90
ANA 23-01-93
LUISA 30-12-99

2

Screen design

Worker: **María Pérez** ID: **23.456.789Z**

Partner: **Juan Pedro Díaz**

Children:

Nº	First Name	Birth Date
1	**Tomás**	**02-10-1990**
2	**Ana**	**23-01-1993**
3	**Luisa**	**30-12-1999**

3

Screen design

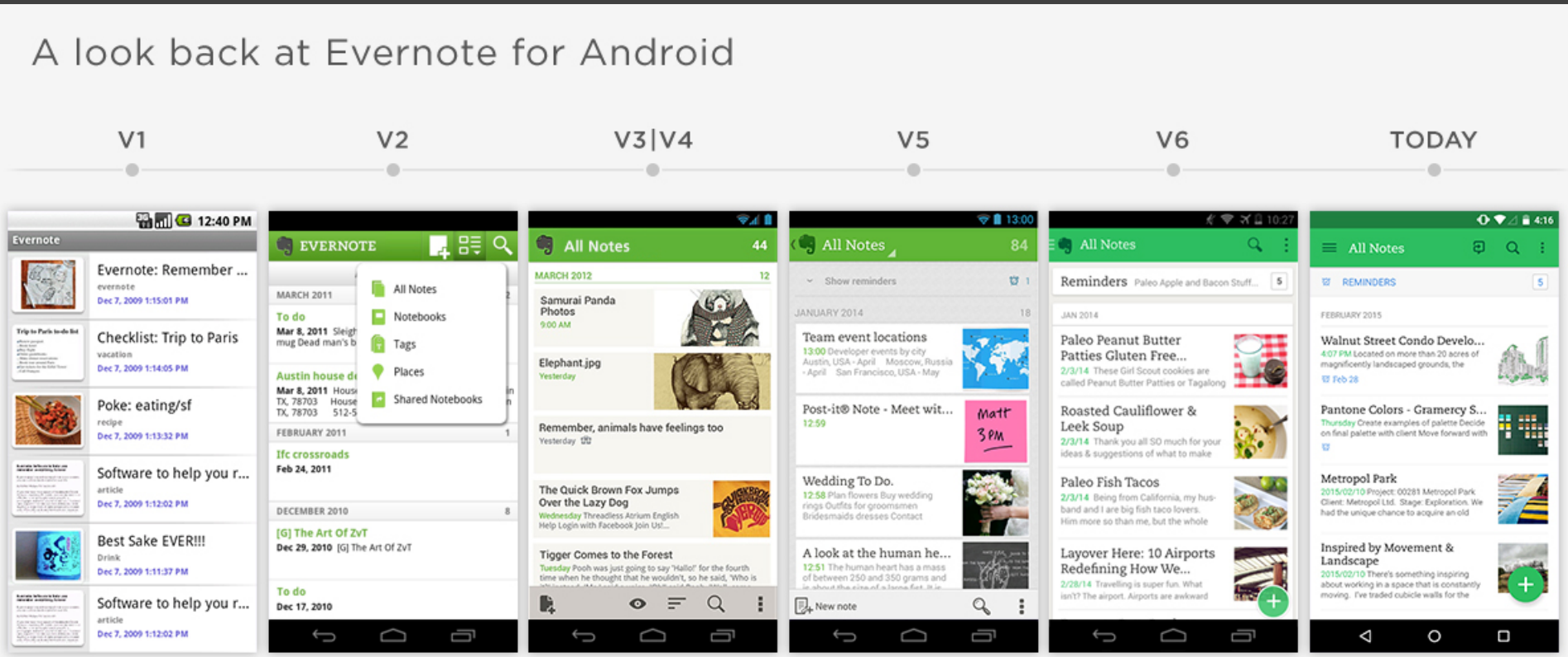
- Which is the most understandable?
- Why?

1

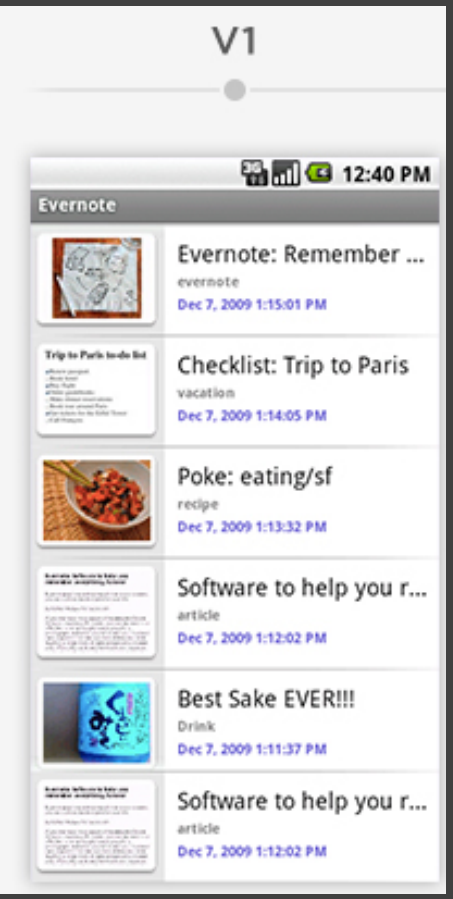
2

3

Screen redesign – Example 2

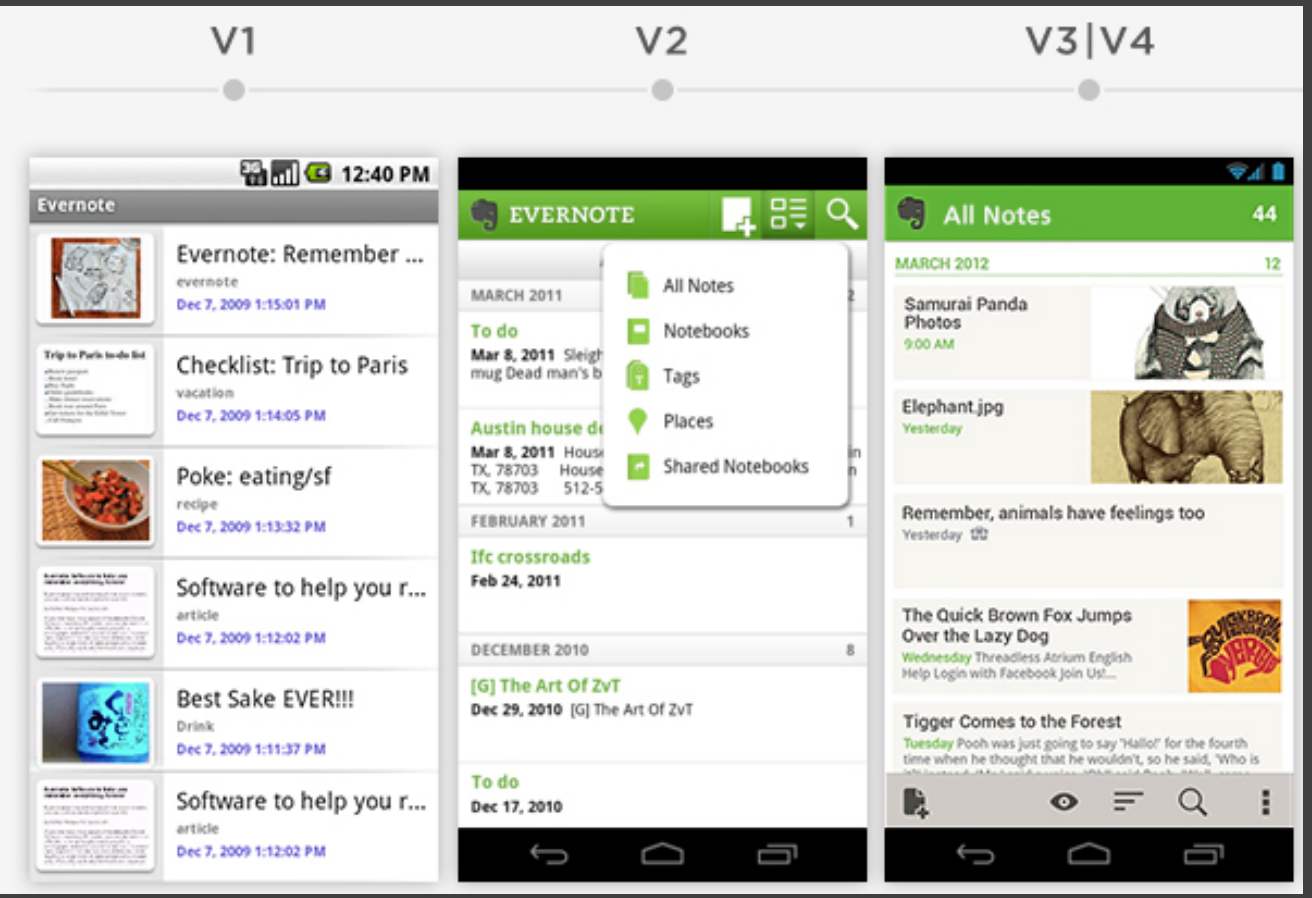


Screen redesign

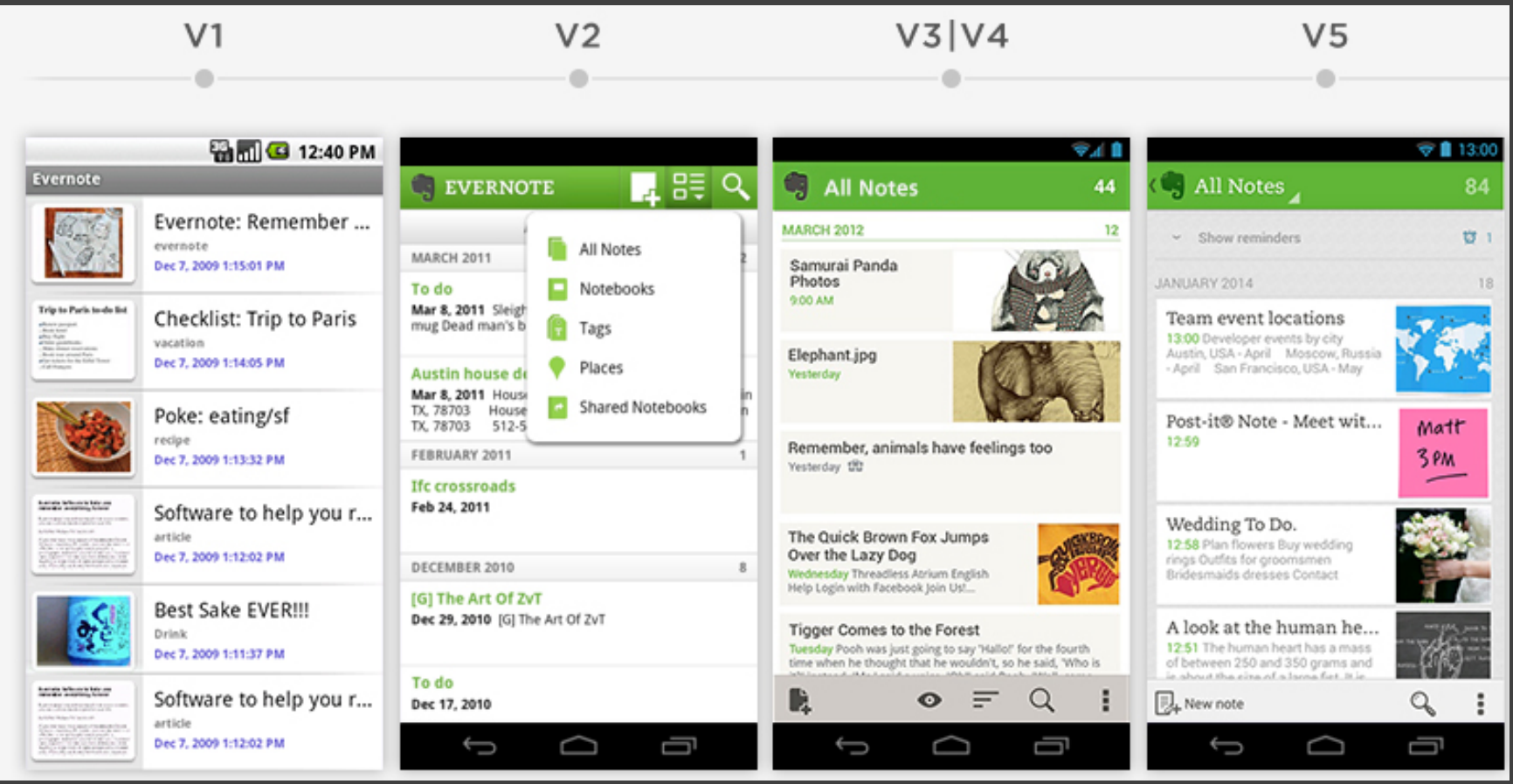


Screen redesign

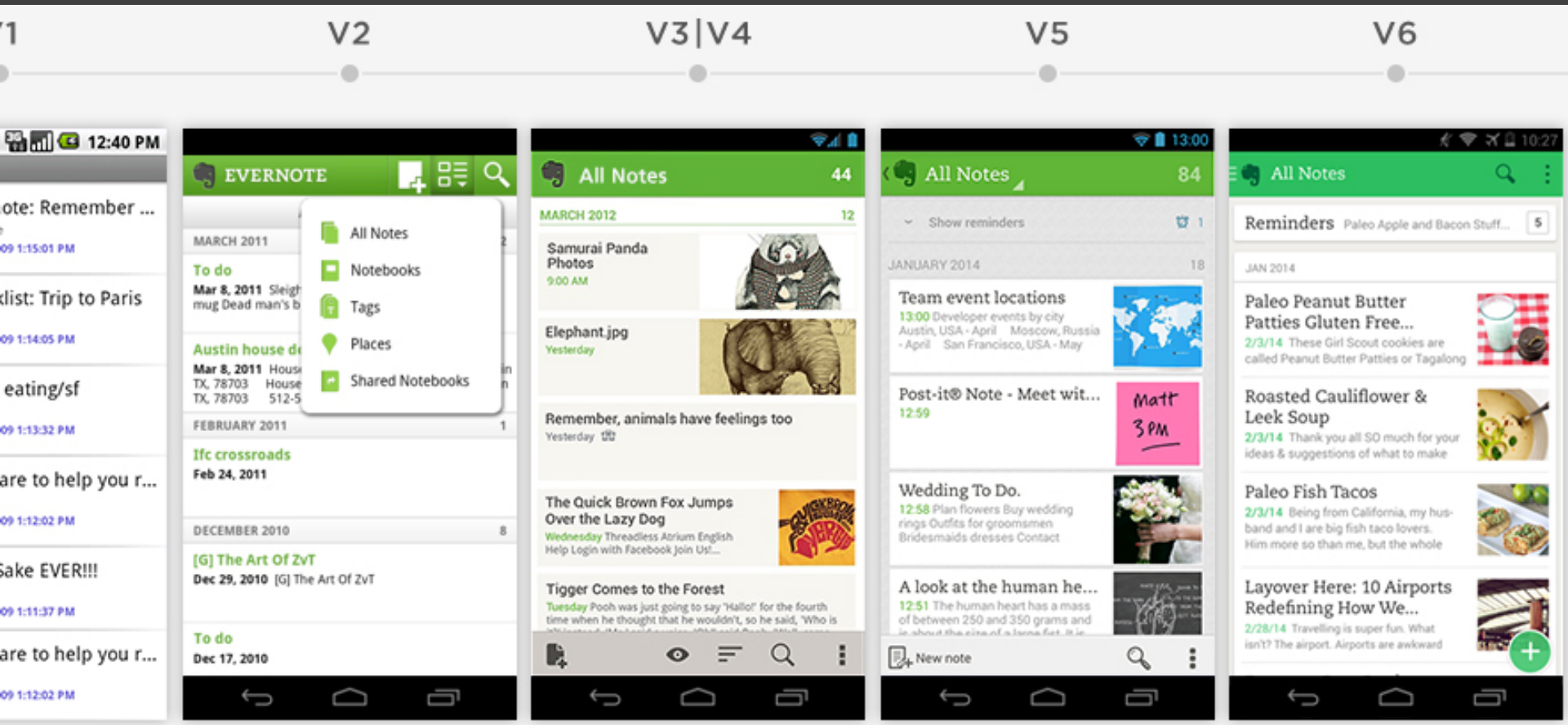
Screen redesign



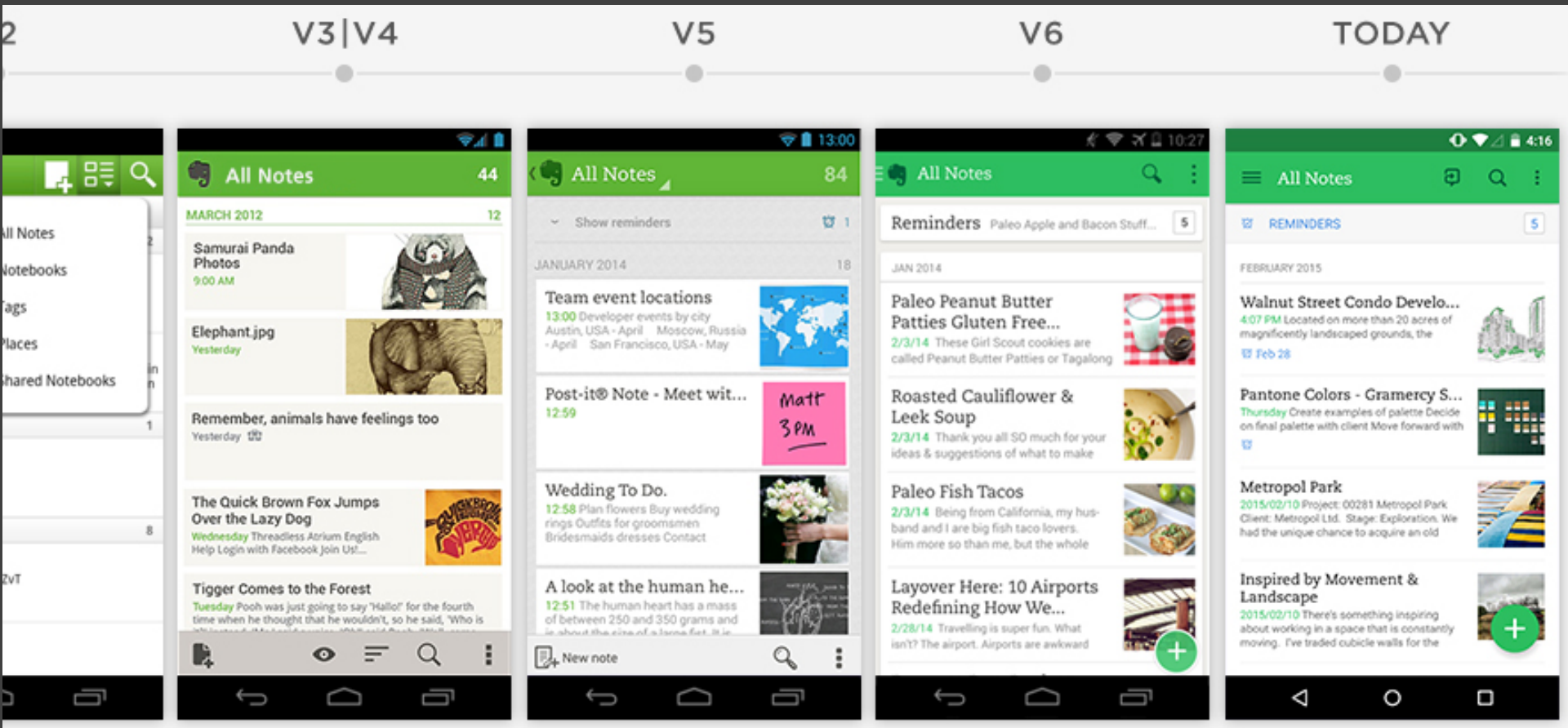
Screen redesign



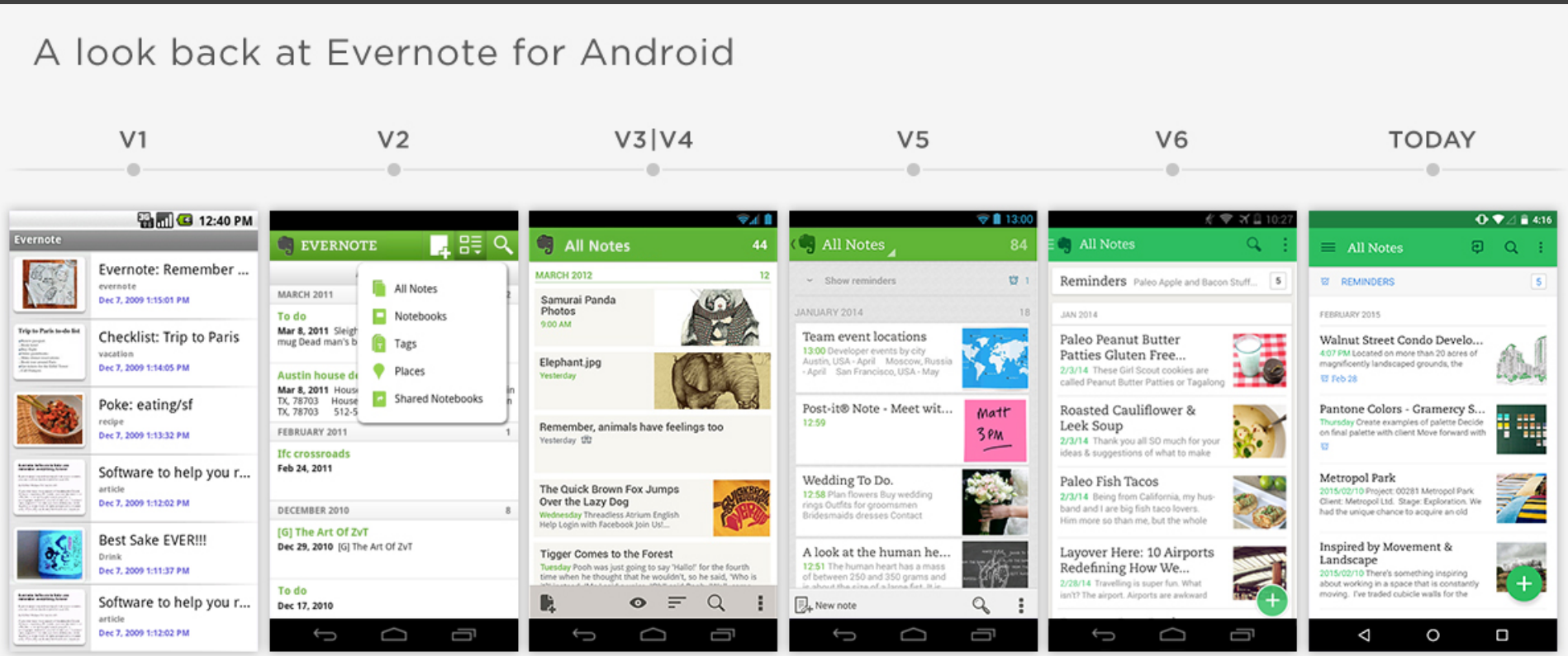
Screen redesign



Screen redesign



Screen redesign



Error messages

- Error messages should help the user to detect the problem and to solve it
- Error messages should be expressed in plain language, precisely indicate the problem and constructively suggest a solution
- Bad error messages will result in bad user experiences
- The design of these messages should be included in the development process.

Error messages

Some recommendations:

- Messages must be specific
  - "Syntax error"→ "Missing left parenthesis"
  - "Incorrect file name"→ "Filename should start with a letter (a-z)"
- Messages must contain constructive advice and tone must be positive
  - "Wrong label" → "Please, define labels before using them"
- User-centred messages
  - Contextual aids, comprehensible messages, appropriate physical format, positioning of error messages, use of sounds, ...

Design principles

Types of artifacts

- Heuristics: It is an easily learned and easily applied procedure for approximately calculating or recalling some value, or for making some determination
- Design guides: Design recommendations based on experimentations and aimed at improving the user experience of the interface
- Design patterns: Solutions to common problems which have been written systematically
- Inspection methods: Methods for evaluating the usability of an user interface

Heuristics

Jakob Nielsen studied 249 usability problems and from those formulated 10 heuristics

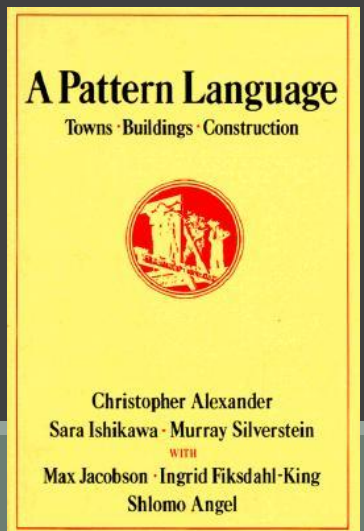
Nielsen's heuristics:

- Visibility of system status
- Match between system and the real world
- User control and freedom
- Consistency and standardization
- Error prevention
- Recognition rather than recall
- Flexibility and efficiency of use
- Aesthetic and minimalist design
- Help users recognize, diagnose, and recover from errors
- Help and documentation

http://www.useit.com/papers/heuristic/heuristic_list.html

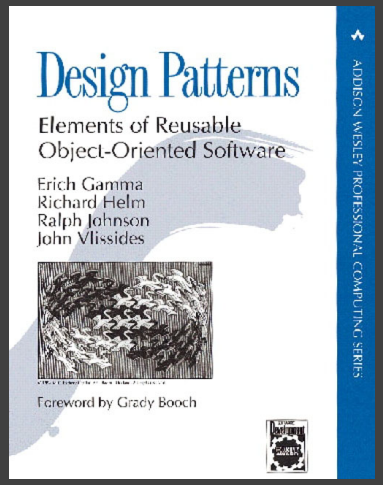
Design patterns

- Key idea behind patterns: capturing experience
- Patterns communicate insights into design problems, capturing the essence of the problems and their solutions in a compact form, making it possible to reuse the same experience over and over in different applications.
- Such "a repository" can have many benefits:
  - Avoiding same errors of previous projects
  - Introducing new team members to a project
  - Training and education of newcomers to the field
- In 1977, “A Pattern Language” by Cristopher Alexander (for urban architecture)

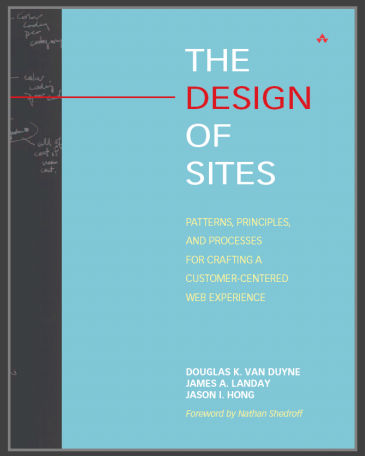


Design patterns

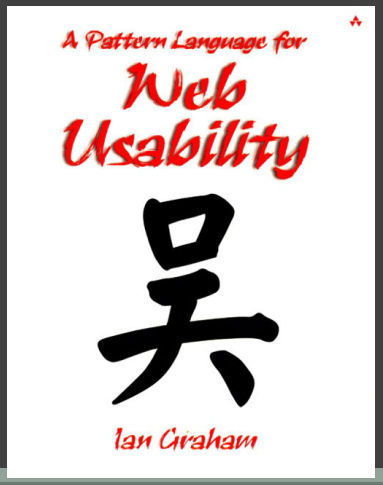
In 1987, Design patters for OO Software



In 1996, Design patterns in hypermedia community



In 1998, Usability patterns in HCI area



Design patterns

- Capture design practices, not a theory
- Capture common properties in good design examples
- Different levels of knowledge of interface design
  - social, organization, conceptual, detailed
- Intuitive and easy to read
- Can be used as a communication tool within a multidisciplinary team
- A pattern language should allow us to generate and assist us in the development of complete designs

Design patterns

Patterns have a predefined format:

- Pattern name (and ID)
- Problem: stated as a concise statement in boldface of the specific problem that this pattern addresses
- Solution or set of solutions, along with the grounding of the pattern. Different versions of the pattern can also be added.
- Discussion on advantages and disadvantages of the solution/s
- Examples about how this pattern has been applied
- Related patterns and the type of relationship they have

Design patterns

H1 PROCESS FUNNEL

H1.1 (www.dell.com, May 18, 2002)

Figure H1.1

Dell uses a process funnel consisting of several logical steps that guide customers to quickly configure and purchase a personal computer. Information in a pop-up window shows additional details but keeps customers in the funnel so that they can continue to completion.

BACKGROUND

All Web applications that lead visitors through stepped tasks—PERSONAL E-COMMERCE (A1), SELF-SERVICE GOVERNMENT (A4), WEB APPS THAT WORK (A10), and ENABLING INTRANETS (A11)—need ways to help people succeed at completing the tasks.

A1 A4 A10 A11

PROBLEM

Customers often need to complete highly specific tasks on Web sites, but pages with tangential links and many questions can prevent them from carrying out these tasks successfully.

People enjoy completing the tasks they start. Yet all kinds of distractions—including links that lead off the critical path, extra steps, and extra

content—can inadvertently lead them away from accomplishing their goals. These diversions can have legitimate purposes, however, such as providing continuity, giving visitors opportunities to explore, providing instructions, or providing extra details. Striking a balance between these various forces and the actual task can be challenging.

Minimize the Number of Steps Required to Complete a Task • Customers find tasks daunting if there are too many steps. A process funnel should have just two to eight discrete steps. Anything less than two steps is not a process, and a process of more than eight steps is unmanageable. If there are more than eight steps, try to split the process into two or more separate process funnels, or try combining multiple steps into one page. However, this is not always a viable solution because one choice may precede another, and not every page can hold all the information that customers might need at certain points.

Provide a Progress Bar to Let Customers Know Where They Are in the Process Funnel • Showing a progress bar at each step lets your customers know how much farther they need to go to complete the task (see Figure H1.2). It is often not worth your time to make the individual steps on the progress bar clickable because doing so adds more complexity but little benefit for customers.

Remove Unnecessary Links and Content While Reinforcing the Brand • Removing links and content unrelated to the task at hand will reduce the number of distractions, making it more likely that your customers will successfully complete their tasks. Remove all NAVIGATION BARS (K2), TAB ROWS (K3), LOCATION BREAD CRUMBS (K6), and EMBEDDED LINKS (K7), leaving only the links and ACTION BUTTONS (K4) that help visitors reach their goals. Take out any content that is superfluous to the task.

K2 K3 K6 K7 K4

Reinforce the Web site brand to minimize any disorientation customers might feel from sudden changes in navigation options. Use the same fonts, images, colors, layout, and logo throughout the Web site so that no matter where they are, people know they're still on the same site.

H1.2 (www.half.com, October 24, 2001)

Figure H1.2

Many Web sites use a progress bar to let customers know where they are in the process funnel and how much farther they have to go.

Design patterns

Use Pop-Up Windows to Provide Extra Information, without Leading Visitors Out of the Process Funnel • Sometimes customers need additional information that you have not provided on a page, such as extra help or product details. Provide a link to a POP-UP WINDOW (H6) containing CLEAN PRODUCT DETAILS (F2) (see Figure H1.1), CONTEXT-SENSITIVE HELP (H8), or information from the FREQUENTLY ASKED QUESTIONS (H7) page, to make the extra information less intrusive. Your challenge is to implement this extra content without detracting from the main purpose.

Make Sure the Back Button Always Works • Customers often use the **Back** button on browsers to modify answers they have typed in on previous pages. However, if the Web site is not implemented correctly, the information they have already entered may be lost when they hit the **Back** button, forcing them to type everything again. In the worst case, people get a cryptic error message saying that the posted information was lost. You can address this annoying problem by temporarily storing the information they type in on each page, redisplaying this information if customers hit the **Back** button, and then overriding the temporarily stored information on the page if it is changed.

Always Make It Clear How to Proceed to the Next Step • Some Web pages are longer than can be displayed on a customer's Web browser. The problem is that people sometimes get lost if the critical ACTION BUTTON (K4), the one that takes them to the next step, is hidden below the fold. Place HIGH-VISIBILITY ACTION BUTTONS (K5) both high *and* low on the page, ensuring that at least one of the critical action buttons will always be visible without scrolling.

Prevent Errors Where Possible, and Provide Error Messages Whenever Errors Do Occur • People will always make mistakes, even with the best of designs. You can provide good customer service if you use structured fields and sample input to help PREVENT ERRORS (K12). At the same time, provide MEANINGFUL ERROR MESSAGES (K13) whenever errors do occur.

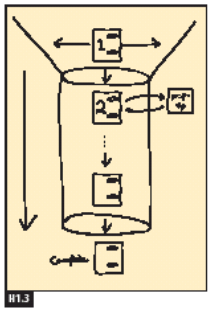
SOLUTION

Minimize the number of steps required to complete a task, keeping them between two and eight. Remove unnecessary and potentially confusing links and content from each page, while reinforcing the brand to maintain a sense of place. Use pop-up windows to provide extra information, without leading people out of the process funnel. Make sure the Back button always works so that customers can correct errors. Make it clear how to proceed to the next step

with high-visibility action buttons. Prevent errors where possible, and provide error messages whenever errors do occur.

Figure H1.3

A process funnel lets people complete their goals by breaking down complicated tasks into a small number of steps, using pop-up windows for detailed information, and reducing the number of links to only the critical ones, so that people are never distracted.



CONSIDER THESE OTHER PATTERNS

Many kinds of Web sites use process funnels, including sites for PERSONAL E-COMMERCE (A1), SELF-SERVICE GOVERNMENT (A4), WEB APPS THAT WORK (A10), and ENABLING INTRANETS (A11). Customers use process funnels when they finalize purchases through QUICK-FLOW CHECKOUT (F1), when they create new accounts through SIGN-IN/NEW ACCOUNT (H2), and when they post new messages to a RECOMMENDATION COMMUNITY (G4), to name some examples.

Remove NAVIGATION BARS (K2), TAB ROWS (K3), irrelevant ACTION BUTTONS (K4), LOCATION BREAD CRUMBS (K6), and EMBEDDED LINKS (K7) to ensure that customers stay on their paths. However, keep strong SITE BRANDING (E1) so that customers still know where they are.

Design process funnels to PREVENT ERRORS (K12), and provide MEANINGFUL ERROR MESSAGES (K13) when errors do occur.

Track your customers through PERSISTENT CUSTOMER SESSIONS (H5) to avoid problems with the **Back** button, and to save customer-entered information.

Move extra content, such as CONTEXT-SENSITIVE HELP (H8) and FREQUENTLY ASKED QUESTIONS (H7), to POP-UP WINDOWS (H6) to keep the main task page on the screen. Make the next action visible by keeping it ABOVE THE FOLD (I2) and by using HIGH-VISIBILITY ACTION BUTTONS (K5).

Design patterns

Separate Metadata and Data

Comment on this pattern

Abstract:

When documents contain content and data about the content, the two types of data should be clearly separated.

Problem:

A document contains two distinct types of data, the content of the document, and data about the content. The data about the content is referred to as metadata. Since a document contains these two different types of data, it is not always to distinguish between the two types of data. For example:

```
<ArticleSummaries>
<Author>Phred Smith</Author>
<Name>Patterns of Stereo Design</Name>
<Author>J.R. Dolby</Author>
<Summary>
Use of patterns to arrange stereo components.
</Summary>
</ArticleSummary>
```

Here there are two instances of the Author element, and at first glance it might not be possible to tell what the first instance of Author represents. Is it the author of the article being summarized? Is it the author of the article itself? It can be difficult to distinguish metadata from data.

Context:

Data about the data needs to be included in a document. This could be things like the author's name, the creation date, security levels of the data, namespace information, schema information, or identification attributes for use with cross references.

Forces:

A clear separation is needed between what is metadata and what is data that forms the body of the document. This affects ease of authoring and processing of the document because the context of the data is clear.

Solution:

The context of the data and the metadata should be made clear. The metadata should usually appear before the data that it describes. This makes it clearer what the metadata is about, and allows processing software to know about the data before it actually gets the data. For example the size of a table might be considered metadata. If the processing software gets the size of the table before the actual data, it can layout the table and then insert t he data in the proper place as it encounters it.

Examples:

See the Metadata in Separate Document, Head-Body patterns for examples.

Discussion:

The resulting context provides structures that clearly identify the metadata as metadata. Often this pattern introduces new constructs to the document, so the overall length of the document may be increased. Authors and processing software need to clearly distinguish between metadata and content. This is not always possible to tell from the element names or positions. It is better to provide a context that will disambiguate the types of data. Obviously the first step in using this pattern is to be able to identify the difference between metadata and data. This is not always an easy task.

Related Patterns:

Metadata in Separate Document, Head-Body are specializations of this pattern.

Known Uses:

The W3C Namespace Recommendation includes namespace information in attributes that make it clearer that this is data about the documents, and not really part of the document itself.

The XHTML DTD uses Head and Body elements to distinguish the metadata from the data.

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