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SECOND EDITION

Laws of UX

USING PSYCHOLOGY TO DESIGN BETTER PRODUCTS & SERVICES

JON YABLONSKI

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Praise for *Laws of UX*, Second Edition

This is the book I didn't know I needed at the start of my career and the one I insist on for my students and staff.

—Andrés Currey Zapata, D.Sc.,
EVP, UX Strategy + Founder

Laws of UX serves as an excellent resource for both newcomers and professionals, encouraging them to delve into the deeper "why" behind design choices instead of merely imitating existing patterns.

—Chris Desjardins,
CEO, Tungsten

Jon has broken down common psychology principles in a way that makes it easier to apply in everyday designs across all industries.

—James Rampton,
Lecturer, University of Michigan

Laws of UX

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Using Psychology to Design Better Products & Services

Jon Yablonski

Beijing • Boston • Farnham • Sebastopol • Tokyo O'REILLY®

Laws of UX

by Jon Yablonski

Printed in the United States of America.

Published by O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472.

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- Interior Designer: Monica Kamsvaag
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- Illustrator: Kate Dullea

- May 2020: First Edition
- February 2024: Second Edition

Revision History for the Second Edition

- 2024-01-23: First Release

See *http://oreilly.com/catalog/errata.csp?isbn=9781098146962* for release details.

978-1-098-14696-2

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Preface

This book had its origins in what felt at the time like the most arduous point of my design career, while I was working on a very challenging client project. From the beginning, there were several indications that it would be an exciting, albeit difficult, project: a relatively short timeline and a somewhat unfamiliar space, but a well-known brand and the chance to help design something that'd be seen by many across the world. These kinds of projects have always been my favorite because they are the ones that offer the most opportunity to learn and grow, which I've always striven to do. But this project was somewhat unique in one specific way: I was being asked to justify a number of design decisions to project stakeholders, without any data to support them. Normally, when you have quantitative or qualitative data available to draw upon, this is a pretty straightforward task—but in this case the data wasn't available, so the process of justifying the decisions would have to be a little different. How do you validate initial designs without any proof that there is a need to change the existing designs to begin with? As you can imagine, design reviews quickly became a matter of subjectivity and personal bias, resulting in designs that were more difficult to validate.

Then it occurred to me: psychology, which provides a deeper understanding of the human mind, could be helpful in these circumstances. I quickly became immersed in the rich and expansive field of behavioral and cognitive psychology, and found myself reading through countless research papers and articles in order to find empirical evidence that supported the design decisions I was making. This research became quite useful in convincing project stakeholders to move in the proposed design direction, and I felt as if I had found a treasure trove of knowledge that would ultimately make me a better designer. There was only one problem: finding good reference material online quickly turned into an exhausting task. Searches led me to a vast array of academic papers, scientific research, and the occasional article in the popular press—none of which felt directly relatable to my work as a designer. I was looking for a designer-friendly resource that just wasn't available online, or at least not in the form I wanted it. Eventually I decided to dive in and produce the resource I was looking for myself, resulting in the creation of a website called Laws of UX (Figure P-1). This passion project became a way for me to both learn and document what I was discovering at this time.

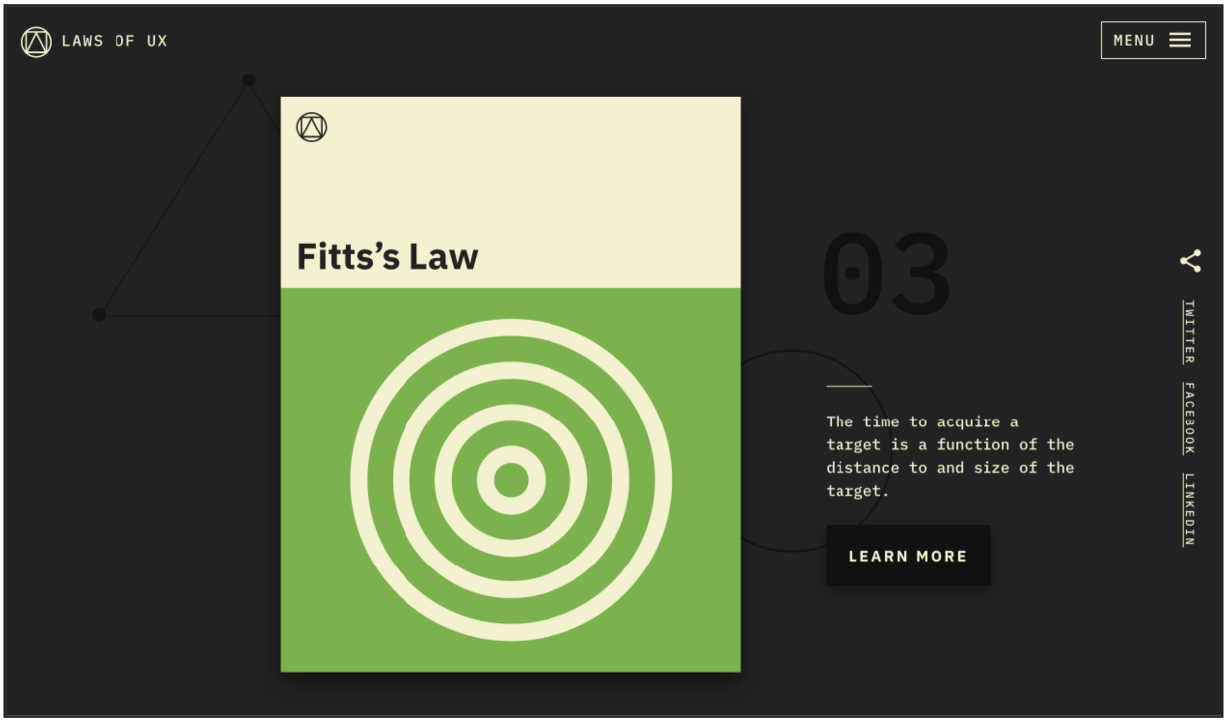

Figure P-1. Screenshot of the Laws of UX website, circa 2020

The absence of quantitative or qualitative data related to the project I was working on led me to look elsewhere, and what I discovered regarding the intersection of psychology and user experience (UX) design has been nothing short of transformative for my practice. While such data, where available, remains valuable, my foray into psychology helped form a solid foundation for my work grounded in an understanding of how people behave, and why. This book is an expansion of the Laws of UX website that focuses on various psychological principles and concepts that I've found particularly useful as a designer. It's important to note they are not actual laws intended to be strictly followed—rather, it's helpful to think of them as guidelines that help inform design decisions based on patterns of human behavior that've been observed time and time again. They're not a replacement for user research, but they can be incredibly valuable for interpreting why people behave a certain way in general.

Second Edition

The craft of design has a dynamic nature that keeps evolving along with technology. With every new technological advancement, new constraints and possibilities are introduced. Since the first edition of this book, LLMs (Large Language Models) have undergone significant advancements, AI-powered image generation tools have emerged, spatial computing has entered the mainstream, and smartphones have become even more powerful. However, the principles and concepts covered in this book remain timeless, and they provide a solid foundation for every designer, regardless of their level of expertise. To enhance the reader's experience, the second edition includes additional information linking these principles and concepts to psychology concepts, techniques, and key considerations. This edition also features updated examples throughout, making it a practical guide for designers who want to stay up to date with the latest trends and best practices in the field of design.

Why I Wrote This Book

I wrote this book in order to make complex laws of psychology accessible to more designers—specifically designers who don't have background knowledge in psychology or behavioral science. The intersection of psychology and UX design has become an increasingly relevant topic in an era when design roles are having an ever-stronger impact within organizations. Along with a growing focus on design, there has been an increase in debate around which additional skills designers should learn, if any, to increase their value and contribution. Should designers code, write, or understand business? Any of these skills could be valuable depending on the project, team, and industry. However, I would argue that every designer should learn the fundamentals of psychology.

As humans, we have an underlying "blueprint" for how we perceive and process the world around us, and the study of psychology helps us decipher this blueprint. Designers can use this knowledge to build more intuitive, human-centered products and experiences. Instead of forcing users to adapt to the design of a product or experience, we can use some key principles from psychology as a guide for designing in a way that is adapted to people. This is the fundamental basis of human-centered design, and it’s the foundation of this book.

But knowing where to start can be a challenge. Which principles from psychology are useful? What are some examples of these principles at work? There’s an endless list of laws and theories that occupy this space, but there are a few that I’ve found particularly helpful and widely applicable. In this book, I explore these concepts and present some examples of how they are effectively leveraged by products and experiences we interact with every day.

Who This Book Is For

This book is for anyone who wishes to improve their design craft, learn more about the intersection of psychology and design, or simply explore why people react to good design the way they do. It's aimed at designers who want to have a better understanding of psychology and how it impacts and overlaps with the work we do. It's for professional and aspiring designers alike: anyone who seeks to understand how the overall user experience is affected by an understanding of human perception and mental processes. While the book is specifically focused on digital design as opposed to the more traditional media of graphic or industrial design, the information it contains is broadly applicable to anyone responsible for shaping user experience. I should also mention that it isn't intended to be a comprehensive resource, but rather an accessible introduction to the psychology fundamentals that have a direct influence on design and how people process and interact with the interfaces we create. It's full of examples and intended to be easily read and referenced by designers who wish to incorporate this information into their daily work.

This book will also be relevant to anyone who seeks to understand the business value of good design and why good design is transformative for businesses and organizations. The field of UX design has grown and expanded into new areas thanks to the increase in investment by companies looking to gain a competitive advantage. With this new interest has come the expectation that products and services should be well designed, and simply having a website or mobile application is no longer enough. Companies must ensure their websites and applications, and any other digital experiences they offer, are helpful, effective, and well designed. In order to achieve this goal, designers can, I believe, use psychology as a guide, enabling them to design for how people actually perceive, process, and interact, not only with digital interfaces but also with the world.

What's in This Book

Chapter 1, "Jakob's Law"

Users spend most of their time on other sites, and they prefer your site to work the same way as all the other sites they already know.

Chapter 2, "Fitts's Law"

The time to acquire a target is a function of the distance to and size of the target.

Chapter 3, “Miller’s Law”

The average person can keep only 7 (± 2) items in their working memory.

Chapter 4, “Hick’s Law”

The time it takes to make a decision increases with the number and complexity of choices available.

Chapter 5, “Postel’s Law”

Be conservative in what you do, be liberal in what you accept from others.

Chapter 6, “Peak–End Rule”

People judge an experience largely based on how they felt at its peak and at its end, rather than on the total sum or average of every moment of the experience.

Chapter 7, “Aesthetic–Usability Effect”

Users often perceive aesthetically pleasing design as design that’s more usable.

Chapter 8, “Von Restorff Effect”

When multiple similar objects are present, the one that differs from the rest is most likely to be remembered.

Chapter 9, “Tesler’s Law”

Tesler’s law, also known as the law of conservation and complexity, states that for any system there is a certain amount of complexity that cannot be reduced.

Chapter 10, “Doherty Threshold”

Productivity soars when a computer and its users interact at a pace (<400 ms) that ensures that neither has to wait on the other.

Chapter 11, “Applying Psychological Principles in Design”

This chapter considers ways designers can internalize and apply the psychological principles we’ve looked at in this book and then articulate them through principles that relate back to the goals and priorities of their team.

Chapter 12, “With Power Comes Responsibility”

Here, we take a closer look at the implications of using psychology to create more intuitive products and experiences.

A Brief History of Psychology and Design

A little context can make a big difference, so I would like to begin this book by providing some history on the overlap between psychology and design. My intention is not to provide a comprehensive account but rather to offer a brief introduction that will enhance the upcoming chapters and place them in a historical context.

Gestalt Psychology

We'll begin with Gestalt psychology, which is a psychological perspective that emerged in the early 20th century. It emphasized the idea that human perception and understanding of the world are not simply the sum of individual sensory experiences but rather a meaningful whole. Gestalt psychology pioneers such as Max Wertheimer, Kurt Koffka, and Wolfgang Köhler believed that individuals perceive and interpret stimuli by organizing them into patterns and structures, rather than perceiving them as isolated elements. They studied how individuals perceive visual illusions, problem solving, and the organization of sensory information. The principles of Gestalt psychology, such as the figure–ground relationship, similarity, proximity, and closure, continue to be influential in the field of design.

Human Factors Engineering

Psychology has played a crucial role in our understanding of the interaction between humans and machines. It was psychologists who established human factors engineering, a discipline that focused on designing tools, machines, and systems that take into account human capabilities, limitations, and characteristics. During World War II, the discipline gained significant momentum as the US military recognized the importance of optimizing equipment and cockpit interfaces for aircraft. Psychologists Paul Fitts and Alphonse Chapanis observed that humans are prone to errors, particularly when under stress, regardless of their training.[1] They also recognized that machines could be designed to align with human capabilities and limitations, thereby reducing these errors. This insight led to the development of principles that became fundamental to the discipline. After World War II, human factors engineering principles were applied and developed in the aviation industry to enhance safety and efficiency through studies on pilot performance, cockpit design, and human–machine interactions.

Human–Computer Interaction

Psychology has also played a fundamental role in shaping the development of computers and how we interact with them. The combination of psychology, systems analysis, and computer science became a defining characteristic of research institutes during the Cold War era, much of which was linked to the defense establishment and large mainframe computers. In these early years of computer science, computers were primarily engineered rather than designed, which meant that users had to adapt to how these computers operated. The concept of personal computing was still a distant dream that only a few dared to imagine, most notably Douglas Engelbart in his work at the Stanford Research Institute (resulting in the computer mouse, the development of hypertext, networked computers, and precursors to graphical user interfaces, to name a few outcomes).

Advancements in technology led to a recognition of the importance of designing systems that catered to human cognitive and physical abilities. Engineers started focusing on computer users and began developing new input methods and exploring different applications for the machines. It was during this period that the notion of ubiquitous computing would start taking shape at the Xerox Palo Alto Research Center (PARC), which explored how small and inexpensive internet-connected computers could help with everyday functions in an automated fashion. Founded in 1970 with the goal of inventing "the office of the future," Xerox PARC gave birth to numerous innovations, including laser printing, desktop computing, Ethernet, and natural language processing. A pivotal moment in the integration of psychology and computer science came from Xerox PARC with the publication of *The Psychology of Human–Computer Interaction* (CRC Press) in 1983 by Stuart K. Card, Thomas P. Moran, and Allen Newell, which had a profound impact on the development of personal computing, as they applied cognitive psychology to enhance human interaction with computers.

Another significant contribution from Xerox PARC was Smalltalk, an object-oriented programming language that enabled easy manipulation of multiple windows, mimicking the way people organize physical documents on a desk. Smalltalk established the metaphorical desktop that would become a mental model for future operating systems and was used in the development of the first graphical user interface (GUI). Alan Kay played a crucial role in the development of Smalltalk and in shifting the paradigm from a text-based office information system to a personal multimedia communication device.

Kay's inspiration for how we could interact with computers came from his visit to Seymour Papert's Logo project at MIT's

Artificial Intelligence Laboratory. Papert had spent five years working with Jean Piaget, a psychologist who studied the ways in which children learn, and was inspired to create the educational programming language with the goal of teaching children concepts in mathematics and computer programming. It was Papert's Logo project that convinced Kay that computer programming languages should be developed on a level that children could understand and use. Another significant influence on Kay was the work of psychologist Jerome Bruner, who studied different learning mentalities in children.

User Experience Design

User experience (UX) design emerged from the field of human–computer interaction (HCI) alongside the rise of the World Wide Web and the need for better interaction design. One of the key figures in the early development of UX design is cognitive scientist and psychologist Donald Norman, who began his career as part of a committee tasked with investigating the Three Mile Island nuclear disaster in 1979. Norman would later coin the term "user experience" to encompass all aspects of the end user's interaction with a system, including the interface, graphics, industrial design, physical interaction, and more, while at Apple. He emphasized the importance of designing products that not only are functional but also provide a positive and satisfying experience for the user.

Another influential figure who played a key role in shaping our understanding of design and its impact on user experience is Jane Fulton Suri, best known for pioneering the practice of human-centered design (HCD) at the renowned company IDEO. With a unique educational background in psychology and architecture, Suri's approach integrated ethnographic research, observation techniques, and cross-disciplinary collaboration into a blended approach to gain deep insights into user behaviors and needs. Her work has helped shape UX design into a discipline that deeply considers the human experience at its core.

Psychology continues to inform how we can design systems that align with how people actually are, rather than how we want them to be. While technology and our interactions with it will keep evolving, psychology offers a lens to decipher the fundamental "blueprint" of how we perceive and process the world. Armed with this understanding, designers can create more intuitive and user-centered products and experiences by shaping the technology to fit the user, rather than the other way around.

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O’Reilly Media, Inc.

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Sebastopol, CA 95472

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707-827-7019 (international or local)

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Acknowledgments

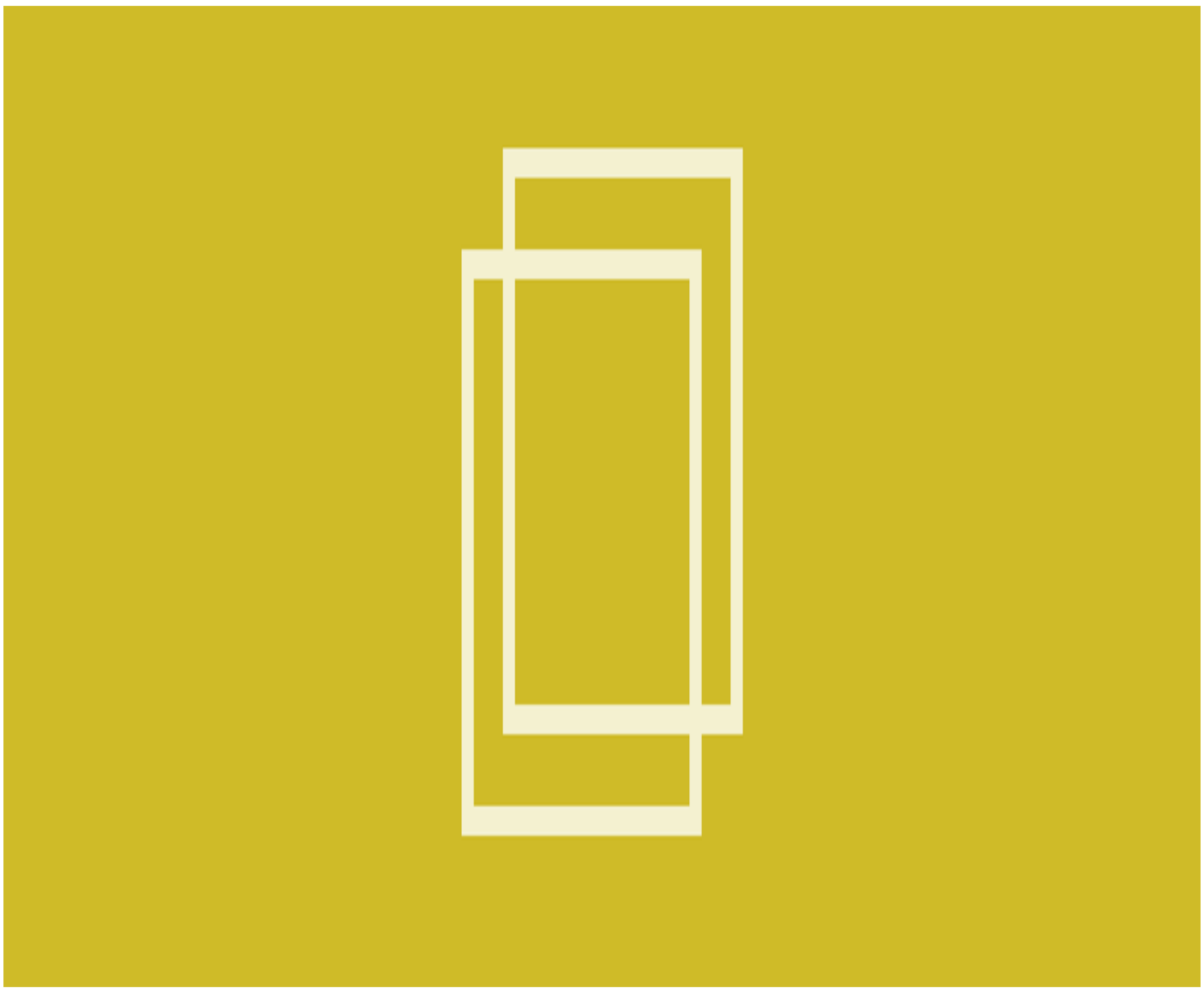
This book is dedicated to my mom, Charlotte Rollins, the strongest person I've ever known and the one who encouraged, supported, and enabled me to follow my dreams to begin with.

I’d like to also acknowledge and thank my wife Kristen, whose love and support have been both endless and critical in so many ways—without her this book would not have been possible. I must acknowledge James Rollins, a man I’m forever grateful to have in my life and in the lives of my family. I’d like to also acknowledge my design colleagues who helped with the book in some way or another: in no particular order, Jonathan Patterson and Ross Legacy for always-on-point design advice and feedback; Xtian Miller for the encouragement, feedback, and words of wisdom; and Jim and Lindsey Rampton, Dave Thackery, Mark Michael Koscierzynski, Amy Stoddard, Boris Crowther, Trevor Anulewicz, Clemens Conrad, and countless others for their support and encouragement. I also owe a debt of gratitude to all the individuals involved in the project that inspired this book and who therefore directly influenced its creation. I’d like to thank Jessica Haberman, who saw the potential in me to become an author and encouraged me to begin the endeavor of writing this book. And finally, I owe Angela Rufino a great deal of gratitude for all of her advice, patience, and feedback throughout the process.

[1] Cliff Kuang and Robert Fabricant, *User Friendly: How the Hidden Rules of Design Are Changing the Way We Live, Work, and Play* (New York: MCD/Farrar, Straus and Giroux, 2019), 86.

Chapter 1. Jakob’s Law

> *Users spend most of their time on other sites, and they prefer your site to work the same way as all the other sites they already know.*



KEY TAKEAWAYS

- Users will transfer expectations they have built around one familiar product to another that appears similar.
- By leveraging existing mental models, we can create superior user experiences in which the users can focus on their tasks rather than on learning new models.
- When making changes, minimize mental model mismatches by empowering users to continue using a familiar version for a limited time.

Overview

There is something incredibly valuable to be found in familiarity. Familiarity helps the people interacting with a digital product or service know immediately how to use it, from interacting with the navigation to finding the content they need to processing the layout and visual cues on the page in order to understand the choices available to them. The cumulative effect of mental effort saved ensures a lower cognitive load. In other words, the less mental energy users have to spend learning an interface, the more they can dedicate to achieving their objectives. The easier we make it for people to achieve their goals, the more likely they are to do so successfully.

As designers, it is our objective to ensure people successfully achieve their goals when using the interfaces we've built by eliminating as much friction as possible. Not all friction is bad—in fact, sometimes it is even necessary. But when there is an opportunity to remove or avoid extraneous friction, or friction that doesn't provide value or serve a purpose, then we should do so. One of the primary ways designers can remove friction is by leveraging common design patterns and conventions in strategic areas such as page structure, workflows, navigation, and placement of expected elements such as search. When we do this, we ensure people can immediately be productive instead of first having to learn how a website or app works. In this chapter, we'll take a look at some examples of how this design principle can be achieved—but first, let's look at its origins.

Origins

Jakob's law (also known as "Jakob's law of the internet user experience") was put forth in 2000 by usability expert Jakob Nielsen, who described the tendency for users to develop an expectation of design conventions based on their cumulative experience from other websites.[1] This observation, which Nielsen describes as a law of human nature, encourages designers to follow common design conventions, enabling users to focus more on the site's content, message, or product. In contrast, uncommon conventions can lead to people becoming frustrated, confused, and more likely to abandon their tasks and leave because the interface does not match up with their understanding of how things *should* work.

The cumulative experience that Nielsen refers to is helpful for people when visiting a new website or using a new product because it informs their understanding of how things work and what's possible. This underlying factor is perhaps one of the most important in user experience, and it is directly related to a psychological concept known as *mental models*.[2]

PSYCHOLOGY CONCEPT

MENTAL MODELS

A mental model is what we think we know about a system, especially about how it works. Whether it's a digital system such as a website or a physical system such as a checkout line in a retail store, we form a model of how a system works, and then we apply that model to new situations in which the system is similar. In other words, we use the knowledge we already have from past experiences when interacting with something new.

Mental models are valuable for designers because we can match our designs to our users' mental models to improve their experience by enabling them to easily transfer their knowledge from one product or experience to another, without the need to first take the time to understand how the new system works. Good user experiences are made possible when the design of a product or service is in alignment with the user's mental model. The task of shrinking the gap between our own mental models and those of the users is one of the biggest challenges we face, and to achieve this goal we use a variety of methods: user interviews, personas, journey maps, empathy maps, and more. The point of these various methods is to gain a deeper insight into not only the goals and objectives of our users but also users’ preexisting mental models and how all of these factors apply to the product or experience we are designing.

Examples

Have you ever wondered why form controls look the way they do (Figure 1-1)? It’s because the humans designing them had a mental model of what these elements should look like, which they based on control panels they were familiar with in the physical world. The design of interactive elements like form toggles, radio inputs, and even buttons originated from the design of their tactile counterparts and, therefore, builds upon the conceptual model of what these elements should do and how they should work. The *affordance*[3] of these elements, which is the relationship between them and the user in regard to what actions are possible, is clear due to the mapping between them and similar controls in the physical world.

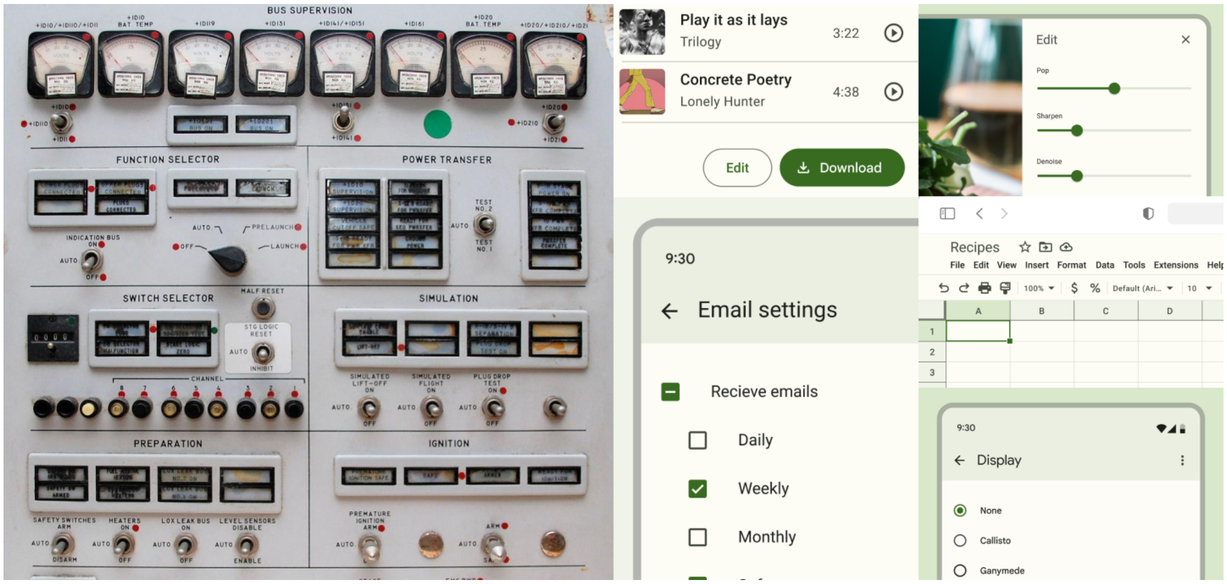


Figure 1-1. Comparison between control panel elements and typical form elements (source: Jonathan H. Ward [left], Google's Material Design, 2023 [right])

When our designs do not align with the user's existing mental model, such as when a familiar product is suddenly changed, it's likely the user will become confused. A mismatch of mental models can affect not only how users perceive the products and services we've helped build but also the speed at which they understand them.

One notorious example of mental model mismatch is the 2018 redesign of Snapchat. Instead of gradually introducing changes through slow iteration and extensive beta testing, the company launched a major overhaul that dramatically changed the familiar format of the app by combining watching stories and communicating with friends in the same place. Unhappy users immediately took to Twitter and expressed their disapproval en masse. Even worse was the subsequent migration of users to Snapchat's competitor, Instagram. Snap CEO Evan Spiegel had hoped that the redesign would reinvigorate advertisers and allow for ads to be customized to users, but instead it caused ad views and revenue to drop and led to the app's user count dramatically shrinking. Snapchat failed to ensure the mental model of its users would be aligned with the redesigned version of the app, and the resulting mismatch caused a major backlash.

But major redesigns don't always drive users away—just ask Google. Google has a history of allowing users to opt in to redesigned versions of its products, like Google Calendar, YouTube, and Gmail. When the company launched a new version of YouTube in 2017 (Figure 1-2) after years of essentially the same design, it allowed desktop users to ease into the new Material Design UI without having to commit. Users could preview the new design, gain some familiarity, submit feedback, and even revert to the old version if they preferred it. The inevitable mental model mismatch was mitigated by simply empowering users to switch when they were ready.

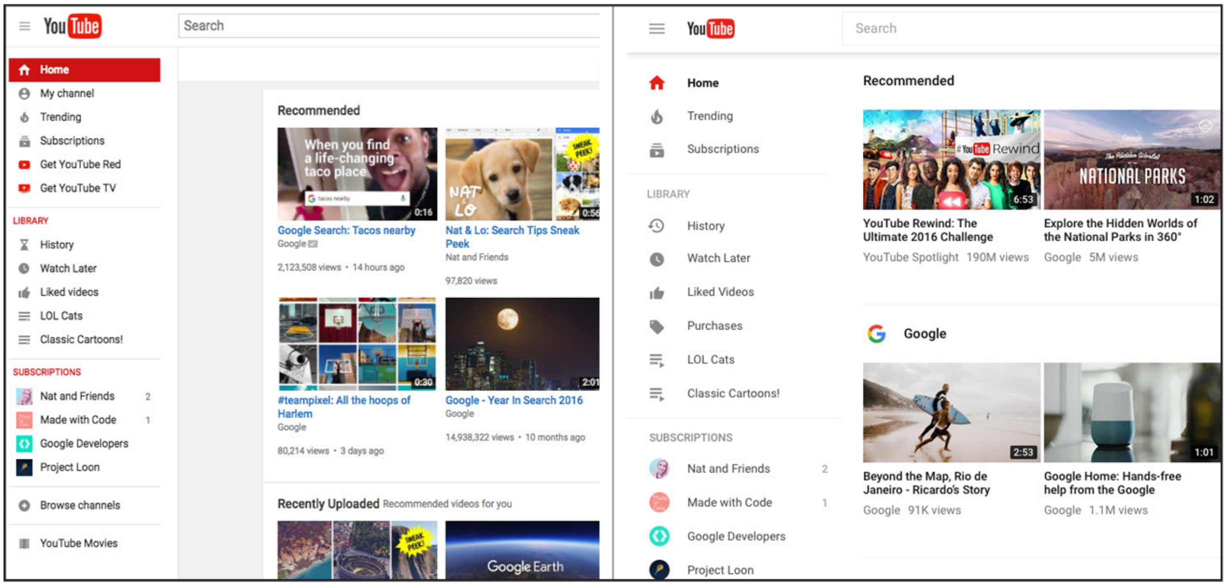


Figure 1-2. Before (left) and after (right) comparison of YouTube redesign in 2017 (source: YouTube)

Most ecommerce websites also leverage preexisting mental models. By making use of familiar patterns and conventions, shopping sites such as Etsy (Figure 1-3) can effectively keep customers focused on the important stuff—finding and purchasing products. By conforming to users' expectations about the process of selecting products, adding them to the virtual cart, and checking out, designers can ensure users are able to apply their accumulated knowledge from previous ecommerce experiences; the whole process feels comfortable and familiar.

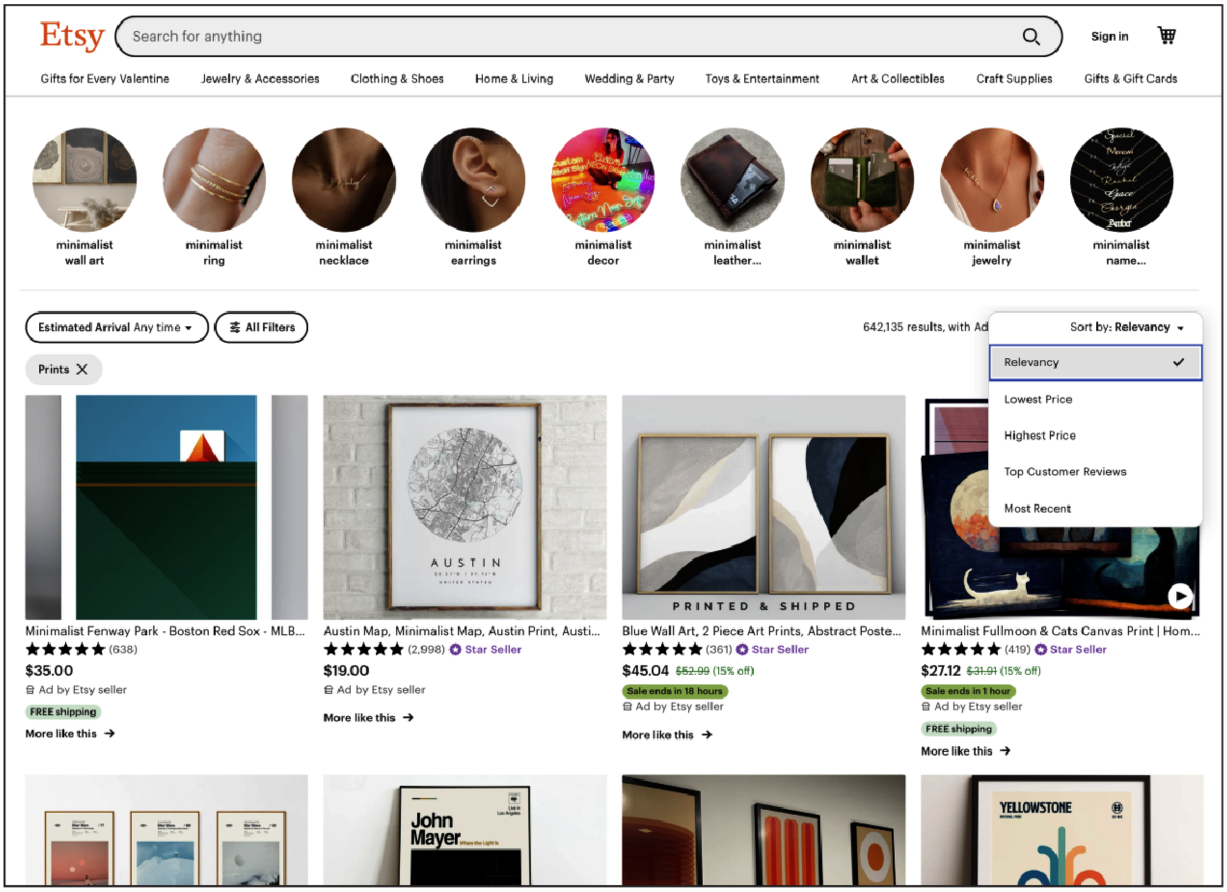


Figure 1-3. Etsy leverages preexisting mental models to keep customers focused on purchasing products rather than on learning new interaction patterns (source: Etsy, 2023)

The use of mental models to inform design isn't isolated to the digital space. Some of my favorite examples can be found in the automotive industry, specifically in regard to controls. Take, for instance, the 2023 Mercedes-Benz EQS SUV (Figure 1-4). The seat controls found on the door panel next to each seat are mapped to the shape of the seat. The resulting design makes it easy for users to understand which part of their seat they can adjust by identifying the corresponding button. It's an effective design because it builds on our preexisting mental model of a car seat and then matches the controls to that mental model.

Figure 1-4. Seat controls in the 2023 Mercedes-Benz EQS SUV, informed by our mental model of a car seat (source: Mercedes-Benz, 2023)

Building upon existing mental models through the use of common components and interaction patterns to ensure familiarity is an effective way to introduce people to new technology as well. Take, for example, Apple's Vision Pro, which makes use of components like sidebars, tabs, and search fields that people recognize and already understand how to use (Figure 1-5). Content is placed inside "windows" that live in your space and feel like part of the surroundings. The glass material that makes up windows provides contrast with the world, gives people more awareness of their surroundings, and adapts to different lighting conditions. The system provides controls to move, close, and resize windows, enabling users to place content comfortably in their physical environment.

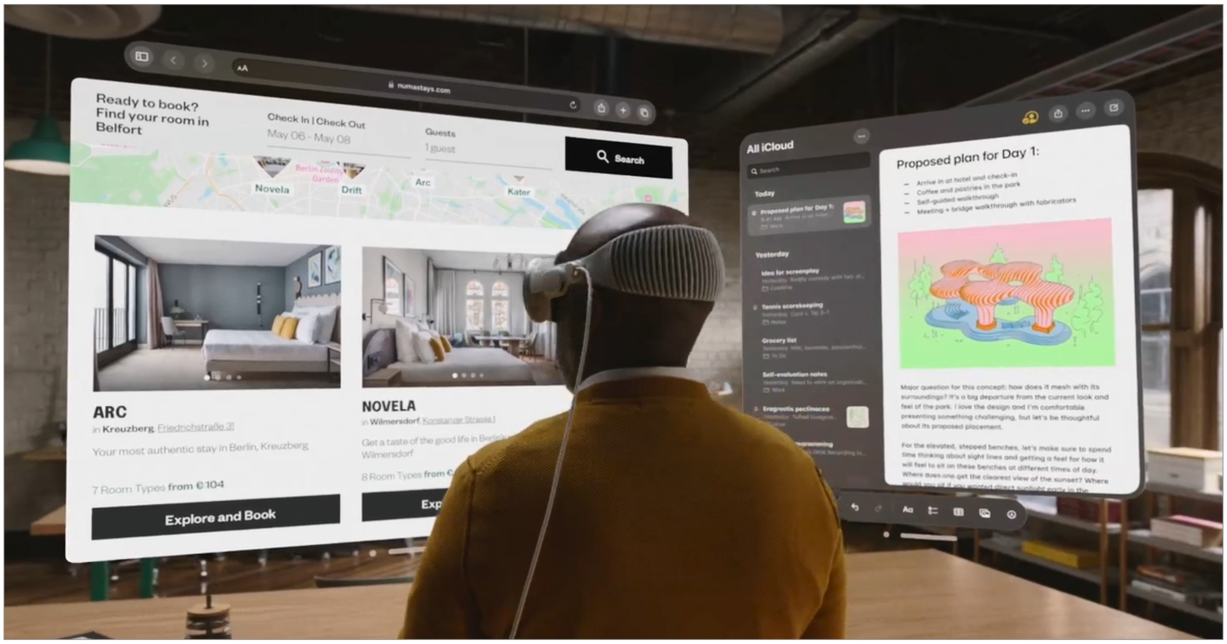


Figure 1-5. Apple's Vision Pro makes use of common components and interaction patterns (source: Apple, 2023)

TECHNIQUE

USER PERSONAS

Have you ever heard another designer within your company or organization refer to "the user," but it wasn't quite clear who exactly this elusive person was? The process of design becomes more difficult when a design team lacks a clear definition of its target audience, leaving each designer to interpret it in their own way. User personas are a tool that helps solve this problem by framing design decisions based on real needs, not the generic needs of the undefined "user." These fictional representations of a specific subset of the target audience are based on aggregated data from real users of a product or service (Figure 1-6).

Personas are intended to foster empathy and serve as memory aids, as well as to create a shared mental model of the traits, needs, motivations, and behaviors of a specific kind of user. The frame of reference that personas help to define is incredibly valuable for teams: it helps team members move away from self-referential thinking and focus on the needs and goals of the user, which is useful for prioritizing new features.

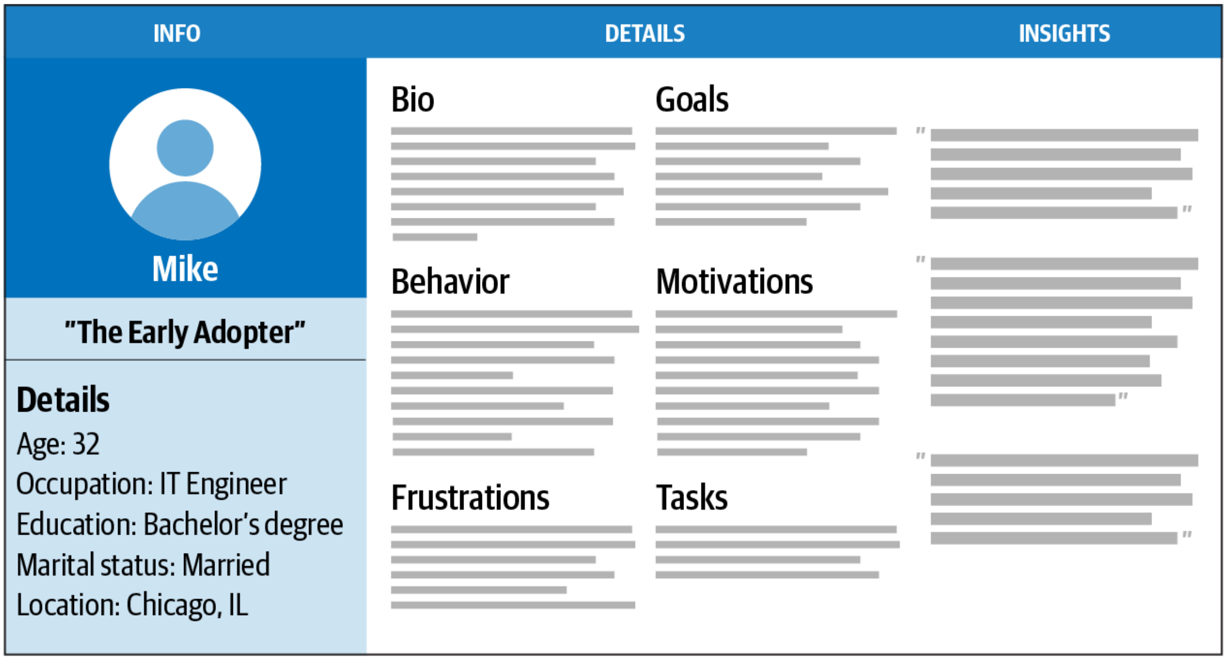


Figure 1-6. User persona example

Any details about the user that are relevant to the feature or product you're building will be useful as long as they're based on research that's been conducted with real users—completely fictional personas can be useful in guiding the team in the same direction, but it might not be the right direction if it's not grounded in research from your actual users. The items common to most personas include the following:

Info

Items such as a photo, memorable tagline, name, age, and occupation are all relevant for the information section of a persona. The idea here is to create a realistic representation of the members of a specific group within your target audience, so this data should be reflective of the similarities they share.

Details

The information within the details section of a user persona helps to build empathy and align focus on the characteristics that impact what is being designed. Common information here includes a bio to create a deeper narrative around the persona, behavioral qualities that are relevant, and frustrations this particular group might have. Additional details could include things such as goals and motivations, or tasks the user might perform while using the product or feature.

Insights

The insights section of a user persona helps to frame the attitude of the user. The intention here is to add an additional layer of context that provides further definition of the specific persona and their mindset. This section often includes direct quotes from user research.

KEY CONSIDERATION

SAMENESS

The examples we explored demonstrate how we can leverage users' existing mental models to enable them to become immediately productive. In contrast, failure to consider the mental model a user has formed can result in confusion and frustration. The conclusion here also invites an important question: does Jakob's law argue that all websites or apps should behave identically? Additionally, does it suggest that we should use only preexisting UX patterns, even when there's a more appropriate solution that's new?

I know what you're thinking: if all websites or apps followed the same design conventions, that would make everything quite boring. This is a completely valid concern, especially given the ubiquity of specific conventions that can be observed today. This pervasive sameness can be attributed to a few factors: the popularity of frameworks to speed up development, the maturity of digital platforms and resulting standards, clients' desire to emulate their competition, and just plain lack of creativity. While much of this sameness is purely based on design trends, there is a good reason we see patterns with some conventions, such as the placement of search, navigation in the footer, and multistep checkout flows.

Let's take a moment to consider the alternative: imagine that each and every website or app that you used was completely different in every regard, from the layout and navigation down to the styling and common conventions like the location of the search feature. Considering what we've learned about mental models, this would mean that users could no longer rely on their previous experiences to guide them. Their ability to be instantly productive in achieving the goal they wanted to accomplish would immediately be thwarted because they would first have to learn how to use the website or app. Every task that they'd want to accomplish would require some degree of exploration to find what they were looking for and then experimentation to understand how it works. Take, for example, something as simple as navigation—finding it would require precious mental energy when it's not where they'd expect, and even worse would be the trial and error that would result when it doesn't function the way they'd expect. It takes no stretch of the imagination to see that this would not be an ideal situation, and conventions would eventually emerge out of pure necessity.

That's not to say that creating something entirely new is never appropriate—there's certainly a time and a place for innovation. Some rules are made to be broken, and breaking them could even become a way to differentiate from competitors. Designers must determine the best approach by taking into consideration user needs and context, in addition to any technical constraints, before reaching for something unique, and they must take care not to sacrifice usability by rigorously testing their work.

Conclusion

Jakob's law isn't advocating for sameness in the sense that every product and experience should be identical. Instead, it is a guiding principle that reminds designers that people leverage previous experience to help them in understanding new experiences. It is a not-so-subtle suggestion that (when appropriate) designers should consider common conventions that are built around existing mental models to ensure users can immediately be productive instead of first needing to learn how a website or app works. Designing in a way that conforms to expectations allows users to apply their knowledge from previous experiences, and the resulting familiarity ensures they can stay focused on the important stuff: finding the information they need, purchasing a product, etc.

The best piece of advice I can give in regard to Jakob's law is to always begin with common patterns and conventions, leveraging tools like a design system when available, and depart from them only when it makes sense to. If you can make a compelling argument for making something different to improve the core user experience, that's a good sign that it's worth exploring. If you go the unconventional route, be sure to test your design with users to ensure they understand how it works.

[1] Jakob Nielsen, "End of Web Design," *Nielsen Norman Group*, July 22, 2000, *https://oreil.ly/-kfBV*.

[2] Jakob Nielsen, "Mental Models," *Nielsen Norman Group*, October 17, 2010, *https://oreil.ly/2zrw7*.

[3] Donald A. Norman, *The Design of Everyday Things: Revised and Expanded Edition* (New York: Basic Books, 2013), 10.

Chapter 2. Fitts's Law

The time to acquire a target is a function of the distance to and size of the target.

KEY TAKEAWAYS

- Touch targets should be large enough for users to accurately select them.
- Touch targets should have ample spacing between them.
- Touch targets should be placed in areas of an interface that allow them to be easily acquired.

Overview

Usability is a key aspect of good design. It implies ease of use, which means the interface should be easy for users to understand and navigate. Interaction should be painless and straightforward, requiring minimal effort. The time it takes for users to move to and engage with an interactive object is a critical metric. It's important that designers size and position interactive objects appropriately to ensure they are easily selectable and meet user expectations with regard to the selectable region—a challenge compounded by the differing precision of the range of input methods available today (mouse, finger, etc.) and the variable dexterity of users.

To aid in this endeavor, we can apply Fitts's law, which states that the time it takes for a user to engage with an object is relative to its size and the distance to it. In other words, as the size of an object increases, the time to select it goes down. Additionally, the time to select an object decreases as the distance that a user must move to select it decreases. The opposite is true as well: the smaller and further away an object is, the more time it takes to accurately select it. This rather obvious concept has far-reaching implications, which we'll unpack in this chapter. We'll also take a look at some supporting examples.

Origins

The origins of Fitts's law can be traced back to 1954, when American psychologist Paul Fitts predicted that the time required to rapidly move to a target area is a function of the ratio between the distance to the target and the width of the target (Figure 2-1). Today, Fitt's law is regarded as one of the most successful and influential mathematical models of human motion, and it's widely used in ergonomics and human–computer interaction to model the act of pointing, either physically or virtually.[1]

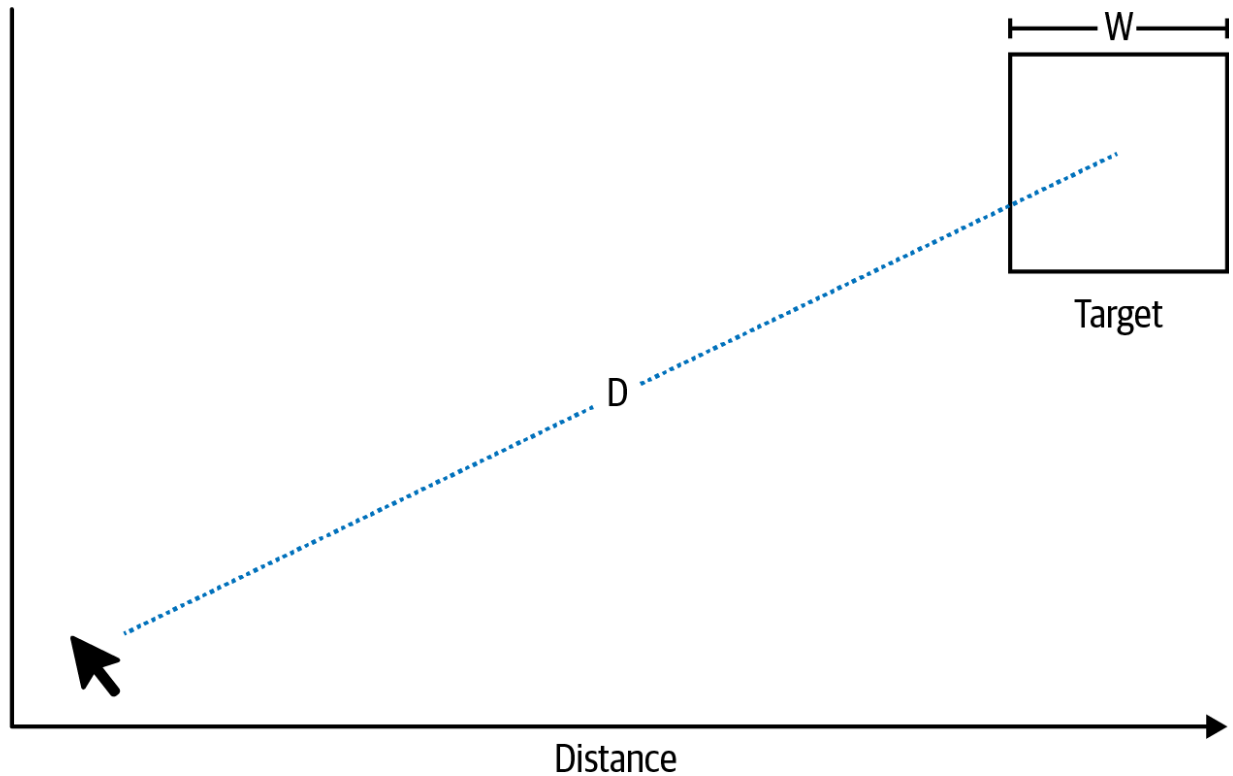


Figure 2-1. Diagram depicting Fitts's law

Fitts also proposed an *index of difficulty* metric to quantify the difficulty of a target selection task in which the distance to the center of the target (*D*) is like a signal and the tolerance or width of the target (*W*) is like noise:

$$\mathrm{ID} = \log_2\left(\frac{2D}{W}\right)$$

KEY CONSIDERATION

THE HUMAN FACTOR

The American military was plagued with accidental deaths and crashes during World War II. In just one 22-month period of the war, the Air Force reported an astounding 457 crashes, most of which were typically attributed to "pilot error." Paul Fitts was assigned by the Air Force to diagnose the cause and noticed that crash data was not random, which would have been expected if the root cause was "accident-prone" pilots. He intuited that something was behind the reason for the crashes—something more than pilot error. Fitts and his colleague Alfonse Chapanis interviewed pilots regarding these crashes and discovered the cause: a majority were directly a result of pilots under duress confusing the flap and landing gear controls, which looked identical to one another.

To resolve this issue, Chapanis devised a system known as "shape coding": differentiating knobs and levers with distinct shapes to make it easy to distinguish the controls of the plane merely by feel. This would help eliminate confusion, even under extreme conditions like flying in the dark. In the process, they invented a new paradigm for viewing human behavior known as *human factors*. The premise for this new approach emphasized the importance of designing machines that account for human limitations and behavior, rather than assuming perfect conditions and rationality. In other words, designing better machines meant figuring out how people acted without thinking while they were distracted, confused, or irrational as a result of stressful circumstances.

The lessons learned by Fitts and Chapanis are invaluable to this very day. The discovery that designing better technology meant adapting to humans and all our idiosyncrasies and limitations, rather than forcing us to adapt to a rigid system that must be operated in a specific way, laid the foundation for what we know now as “human-centered design.” It’s a lesson that we must continuously remind ourselves of: to design better technology means to design for humans, and to design for humans means to anticipate our emotions, limitations, and preconceptions.

Examples

Fitts’s law was established as a model for understanding human movement in the physical world before the invention of the graphical user interface, but it can also be applied to movement through a digital interface. We can derive three important guidelines from Fitts's law. First, touch targets should be large enough that users can easily discern them and accurately select them. Second, touch targets should have ample space between them. Last, touch targets should be placed in areas of an interface that allow them to be easily acquired.

As obvious as it might seem, touch target sizing is of vital importance: when touch targets are too small, it takes users longer to engage them. The recommended size varies (Table 2-1), but all recommendations indicate awareness of the importance of sizing.

Table 2-1. Minimum touch target size recommendations

Company/Org	Size
Spatial interfaces—Human Interface Guidelines (Apple)	60 × 60 pt
Touch interfaces—Human Interface Guidelines (Apple)	44 × 44 pt
Material Design guidelines (Google)	48 × 48 dp
Web Content Accessibility Guidelines (WCAG)	44 × 44 CSS px
Nielsen Norman Group	1 × 1 cm

It's important to keep in mind that these recommendations are minimums. Designers should aim to exceed these target touch sizes whenever possible to decrease the need for precision. Adequate touch target size not only ensures interactive elements are easily selectable but also can reinforce users' perception that the interface is easy to use. Small touch targets add to the perception that an interface is less usable, even if the user is able to avoid errors when attempting to select a target.

Another consideration that affects the usability of interactive elements is the spacing between them. When the space between elements is too small, the likelihood of touch target errors increases. The MIT Touch Lab conducted a study that showed that the average adult human's fingertips are 16–20 mm in diameter.[2] It's inevitable that a user will partially touch outside touch targets at least some of the time—and if additional touch targets are too close together, they might be accidentally selected, causing frustration and decreasing the user's perception of the interface's usability. To mitigate the false activation that can happen when targets are too close, Google's Material Design guidelines recommend that "touch targets should be separated by 8dp [density-independent pixels] of space or more to ensure balanced information density and usability."

In addition to sizing and spacing, the position of touch targets is key to how easily selectable they are. Placing touch targets in areas of the screen that are harder to reach will, in turn, make the targets harder to select. What isn't always obvious is where exactly these hard-to-reach areas of a screen are, as it changes depending on the context of the user, the device used, etc. Take smartphones, for instance, which come in a range of form factors and which people hold in a variety of ways depending on the task and availability of both hands. Some areas of the screen can become difficult to reach when the user is holding the device in one hand and using the thumb to select items, while holding the phone in one hand and selecting elements with the other greatly reduces this difficulty. Even with one-handed use, accuracy does not increase linearly from the lower right to the upper left of the screen; according to research by Steven Hoober,[3] people prefer to view and touch the center of the smartphone screen, and this is where accuracy is the highest (Figure 2-2). They also tend to focus on the center of the screen, as opposed to scanning from the upper left to the lower right as is common on desktop devices.

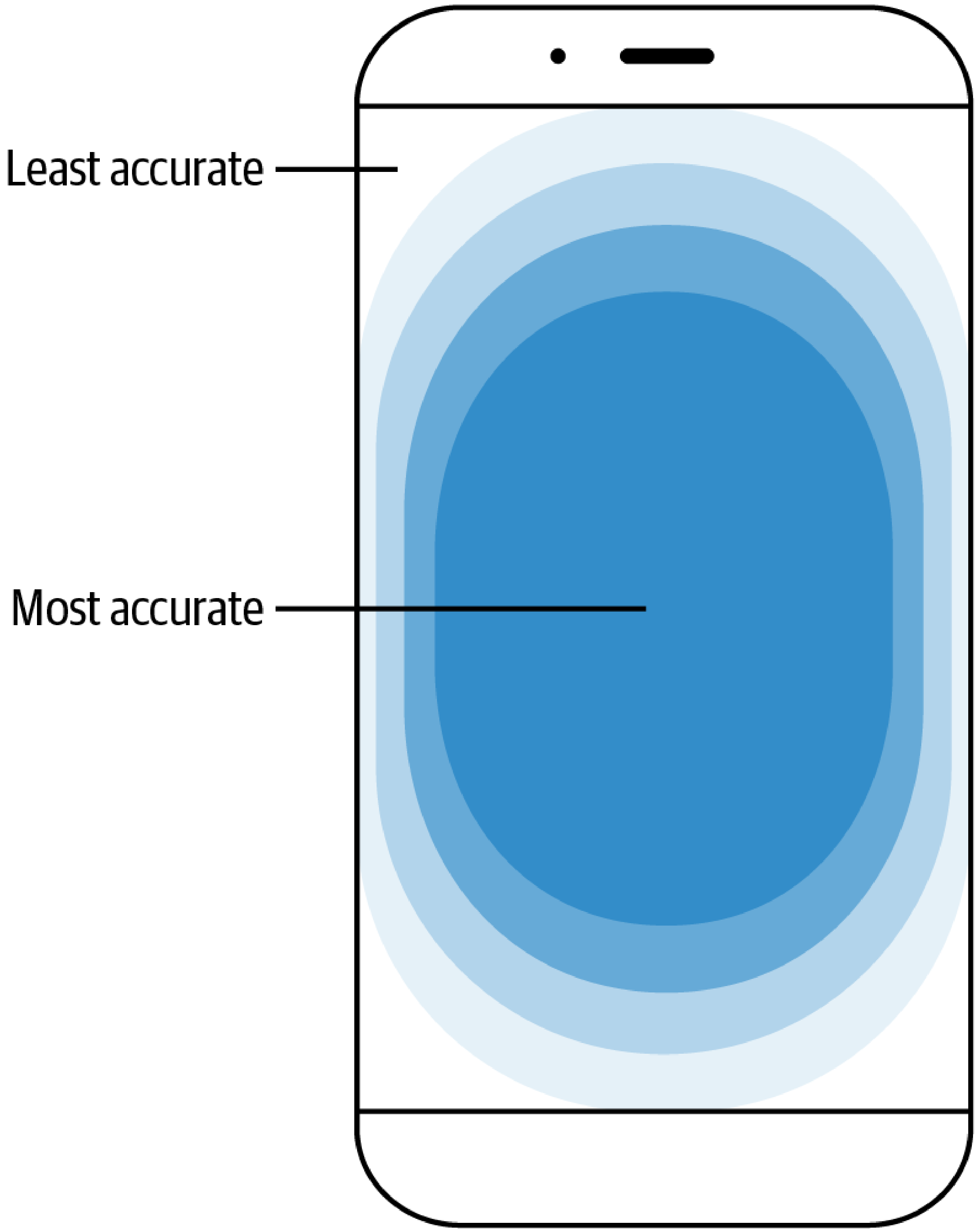


Figure 2-2. Smartphone touch accuracy (illustration based on research by Steven Hoober)

Next, let‘s look at a common example of Fitts’s law: form text labels. By associating a text label element with an input, designers and developers can ensure that taps or clicks on the label will perform the same function as selecting the input (Figure 2-3). This native feature effectively expands the surface area of the form input, making it easier for users to focus on the input with less precision. The net effect is a better user experience for desktop and mobile users alike.

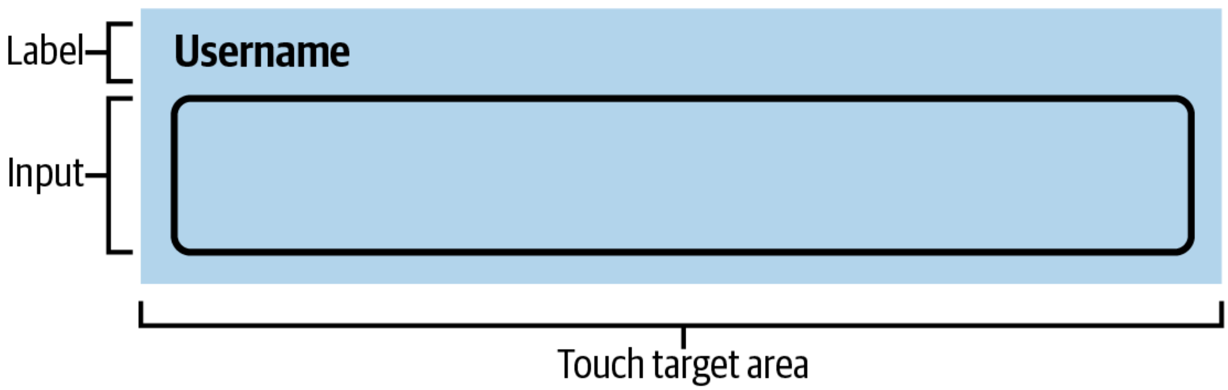


Figure 2-3. Touch target area on text label and form input

Continuing with forms, another common example of Fitts’s law can be found in the placement of form submission buttons. These buttons are usually positioned in close proximity to the last form input (Figure 2-4), because buttons that are intended to complete an action (such as filling out a form) should be close to the active element. This positioning not only ensures that the two types of input are visually related but also ensures that the distance the user must travel from the last form input to the submission button is minimal.

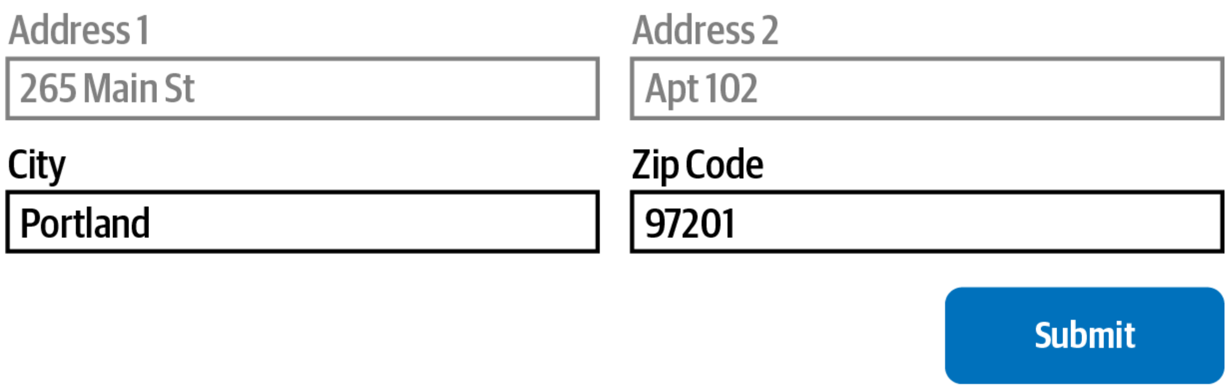


Figure 2-4. Form submission buttons are placed in close proximity to the last form input

The spacing between interactive elements is also an important consideration. Take, for example, the connection request confirmation screen in LinkedIn's iOS app (Figure 2-5), which places the "accept" and "deny" actions together on the right side of a dialog. The actions are so close together that users must make a significant effort to focus on selecting the action they wish to perform without accidentally selecting the other. In fact, each time I see this screen I know it means I have to switch to using two hands to avoid misselecting "accept" with my thumb.

Smartphones, laptops, and desktop computers aren't the only interfaces we interact with on a daily basis. Take, for example, infotainment systems, which can be found in the vehicles many use every day. The Tesla Model 3 features a 15″ display mounted directly on the dashboard. Most of the vehicle’s controls are located on this screen and do not provide haptic feedback when the user engages with them. This of course requires the driver to divert their attention from the road to the screen to access these controls, so Fitts’s law is of critical importance.

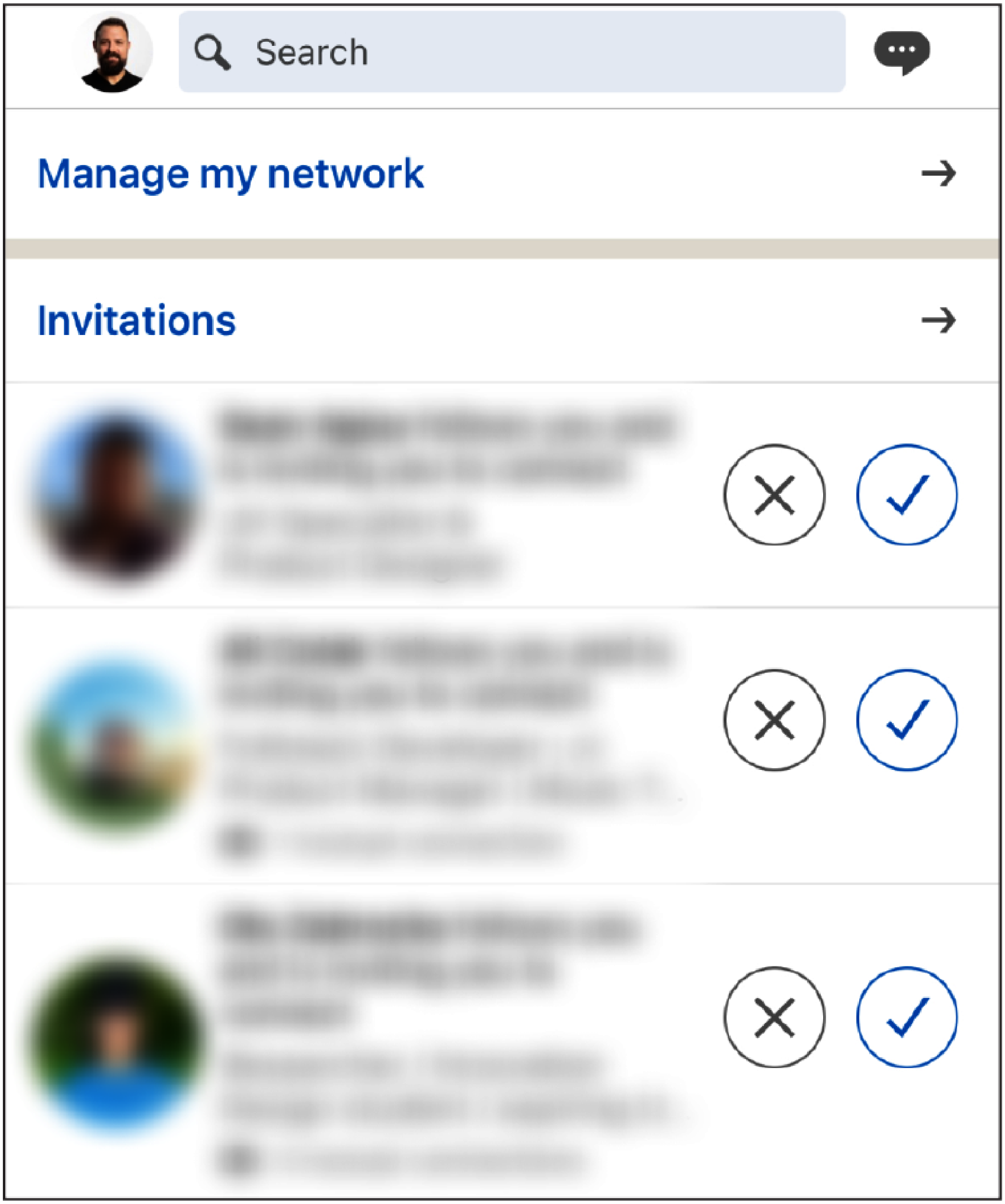


Figure 2-5. Lack of ample space between actions increases the likelihood of accidental selection (source: LinkedIn, 2023)

Apple CarPlay follows Fitts's law, providing ample space between interactive elements (Figure 2-6). This mitigates the risk of accidental selection of adjacent actions.

Figure 2-6. Providing sufficient space between items increases usability, minimizing the chances of selecting the wrong action (source: Apple, 2023)

I mentioned thumb zones with regard to touch target positioning earlier, and how positioning touch targets in hard-to-reach areas of the interface makes them harder to select. With the arrival of the larger iPhone 6 and iPhone 6 Plus, Apple introduced a feature that aimed to mitigate the difficulty of one-handed use. The feature, called Reachability, enables users to quickly bring items at the top of the screen down to the lower half of the screen via a simple gesture (Figure 2-7). It effectively enables easy access to parts of the screen that would otherwise be difficult for one-handed users to interact with.

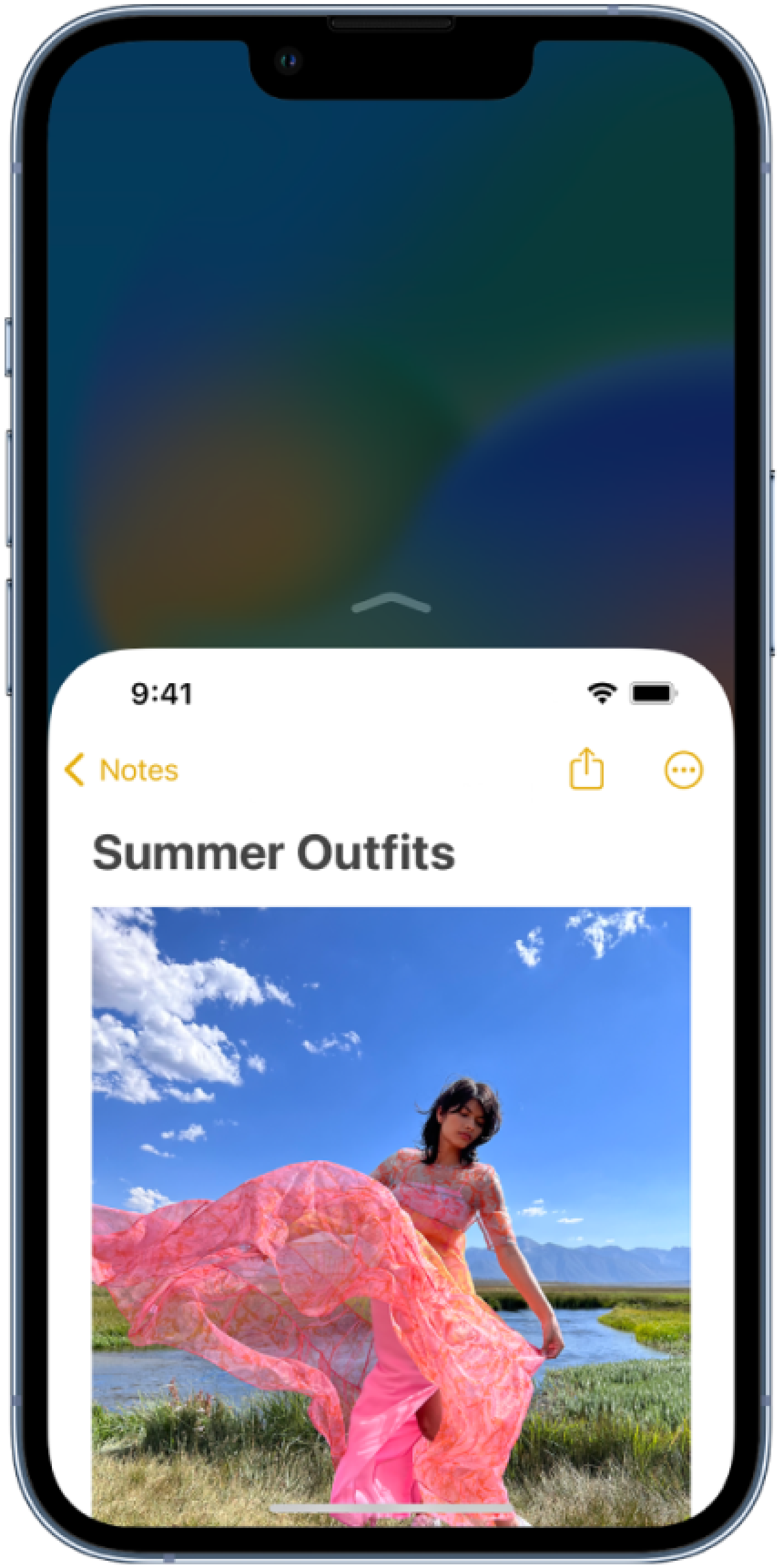

9:41
Notes
Summer Outfits

Figure 2-7. The iPhone's Reachability feature enables easy access to the top half of the screen (source: Apple, 2023)

Fitts's law can also be observed with infinite targets. There is no need to worry about overshooting the target, as it doesn't matter where the pointer stops its movement, as long as the target area has been reached. The edges of the screen act as natural walls for the cursor, allowing users to reach targets on the edge of the screen more easily. Consider example targets along the screen edge of desktop operating systems such as macOS (Figure 2-8), where designers have taken advantage of infinite targets by placing the app bar along the bottom of the screen and the application menu at the top of the screen, making it easy for users to access both quickly without slowing down to hit the options accurately.

Figure 2-8. The macOS app bar found at the bottom edge of the screen and the application menu found in the upper left edge are examples of infinite targets, which are easy for users to access quickly without sacrificing accuracy (source: Apple, 2023)

Fitts's law isn't limited to mouse or touch input. Spatial computing breaks outside the constraints of screens and allows interfaces to occupy people's physical space. Focus with our eyes can be an additional means of signaling interactional intent and can even become a means of targeting interaction elements. Take, for example, Apple's visionOS, which enables users to interact with the system through a combination of input from their eyes and hand gestures (see Figure 2-9). The time to acquire a target is optimized through placing primary content within the center of the field of view relative to the user's head and keeping interactive content at the same depth, minimizing neck and body movement and preventing the eyes from having to adapt to new spatial depth. Additionally, Apple recommends rounding interaction elements to increase precision because sharp-edged target areas tend to focus our eyes to the edges, decreasing precision.

Figure 2-9. Apple's visionOS recommends placing primary content within the center of the field of view relative to the user's head, keeping interactive content at the same depth, and rounding interactive elements (source: Apple, 2023)

TECHNIQUE

CONTEXTUAL INQUIRY

Fitts and Chapanis's novel approach to understanding user behavior, which we covered above, was an early form of *contextual inquiry* an ethnographic field study that involves in-depth observation and interviews of a small sample of users in their natural environments in order to gain a robust understanding of work practices and behaviors. The goal of this approach is to uncover hidden insights about the observed participants' work that may not be available through other research methods, such as user interviews alone. User interviews rely on the users' ability to recall and explain a process that they are removed from at that moment. In contrast, contextual inquiry allows for direct observation of the work as it happens, providing a more accurate and detailed understanding of the process.

Primer

To ease the participant into the session, begin by introducing yourself, stating the goals of the inquiry, and communicating what the participant can expect. Be sure to let participants know their feedback is confidential!

Contextual interview

Transition into the contextual interview portion of a meeting by explicitly explaining what will happen and what you need. Let the user know that you will watch while they work and may interrupt to discuss interesting observations. Also let them know that if it's a bad time for interruption, they can communicate this to you.

Once the interview begins, follow a process of watching and learning, then initiating discussion when needed. Be sure to watch and learn while stopping the participant to discuss observations that you'd like to explore further or clarify. Ask open-ended questions that let the participant give you details about why they took a certain action. The focus is on understanding underlying processes and external resources being used. Standard steps and uncommon variations should be discussed, and interpretations of tasks and workflows should be confirmed or corrected by the user. It's a good idea to avoid asking participants to validate your interpretations too often as it may bias their future behaviors, but remember them for the final phase of the interview.

Wrapping up

End by asking any clarifying questions and summarizing your interpretation of the observed processes in order to get final clarifications and correct your understanding. Be sure to review your notes and summarize what you understood from the interview. This is an opportunity for your users to correct and clarify any misunderstandings about the observed processes.

Conclusion

A key responsibility we have as designers is to ensure the interfaces we create augment human capabilities and experiences and don't distract from or deter them. Mobile interfaces are especially susceptible to Fitts's law due to the limited screen real estate available and the relative inaccuracy of fingers compared to a mouse. We can ensure interactive elements are easily selectable by making them large enough for users to discern and accurately select them, providing ample space between controls to avoid accidental selection of adjacent actions, and placing the controls in areas of the UI that allow them to be easily selected.

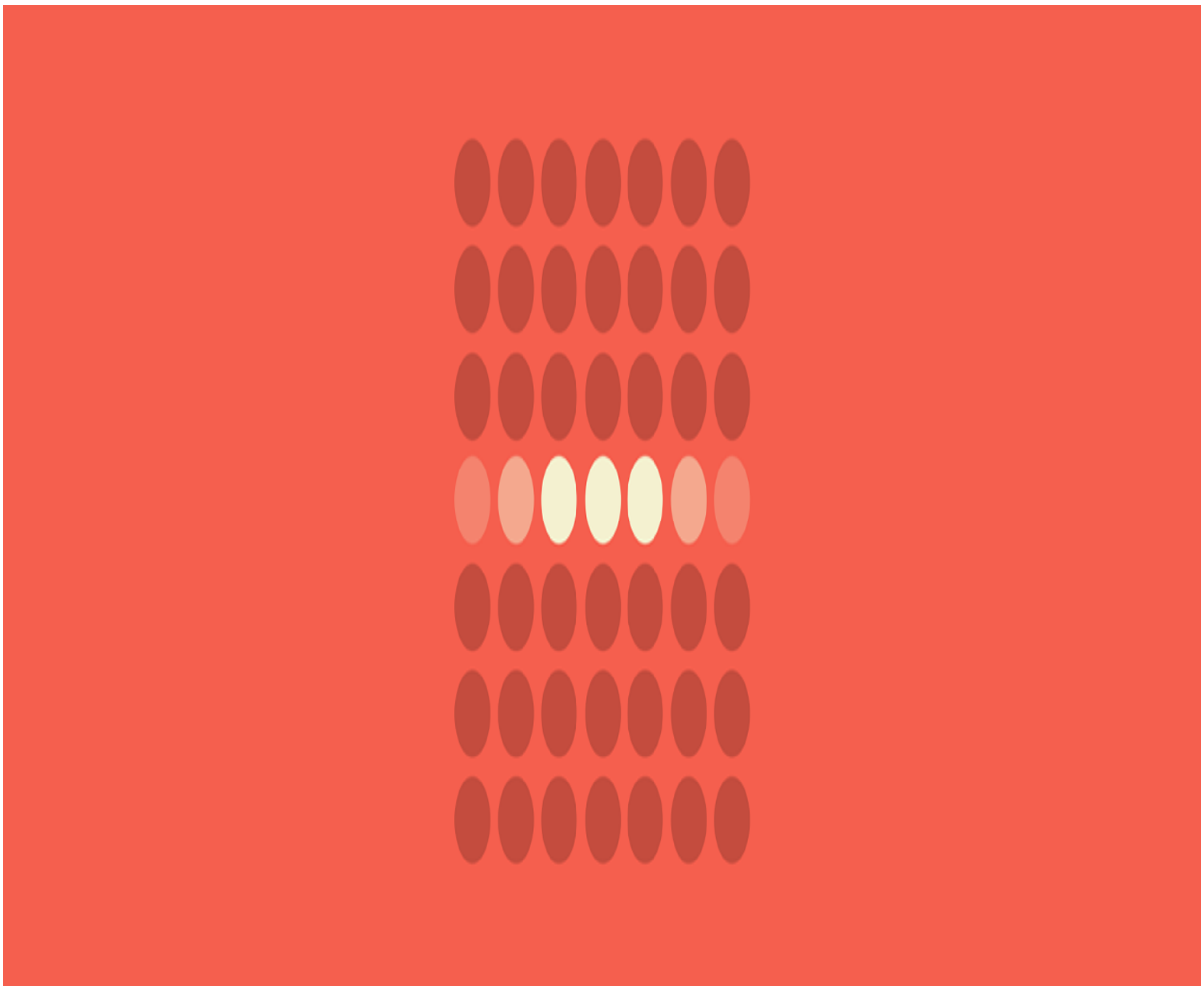
[1] Paul M. Fitts, "The Information Capacity of the Human Motor System in Controlling the Amplitude of Movement," *Journal of Experimental Psychology* 47, no. 6 (1954): 381–91.

[2] Kiran Dandekar, Balasundar I. Raju, and Mandayam A. Srinivasan, “3-D Finite-Element Models of Human and Monkey Fingertips to Investigate the Mechanics of Tactile Sense,” *Journal of Biomechanical Engineering* 125, no. 5 (2003): 682–91.

[3] Steven Hoober, “Design for Fingers, Touch, and People, Part 1,” *UXmatters*, March 6, 2017, *https://oreil.ly/piGSh*.

Chapter 3. Miller’s Law

The average person can keep only 7 (± 2) items in their working memory.



KEY TAKEAWAYS

- Organize content into smaller chunks to help users process, understand, and memorize easily.
- Remember that short-term memory capacity will vary per individual, based on their prior knowledge and situational context.
- Don't use the "magical number seven" to justify unnecessary design limitations.

Overview

It's likely that many designers will have heard of Miller's law, but there is also a high probability that their understanding of it is inaccurate. This commonly misunderstood heuristic has frequently been cited as justification for design decisions such as "the number of navigation items must be limited to no more than seven" and so forth. While there is value in limiting the number of options available to users (see Chapter 4, "Hick's Law"), it is misleading and inaccurate to attribute such dogma to Miller's law. In this chapter, we'll explore the origins of

Miller's "magical number seven" and the real value Miller's law has to provide to UX designers.

Origins

Miller's law originates from a paper published in 1956 by cognitive psychologist George Miller titled "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information."[1] Miller, a professor at Harvard University's Department of Psychology, discussed in his paper the coincidence between the limits of one-dimensional absolute judgment and the limits of short-term memory. Miller observed that memory span in young adults was approximately limited to 7, regardless of the stimuli, even if the stimuli consisted of vastly different amounts of information. This led him to the conclusion that bits, the basic unit of information, don't affect memory span as much as the number of information chunks being memorized. The term "chunks" in cognitive psychology refers to collections of basic familiar units that have been grouped together and stored in a person's memory.

Miller's paper is often interpreted as arguing that the number of objects an average human can hold in short-term memory is

7 ± 2. Miller himself only used the expression "the magical number seven" rhetorically and was surprised by its frequent misinterpretation. Later research on short-term memory and working memory revealed that memory span is not a constant, even when measured in "chunks."

Miller was an early pioneer in recognizing that the human mind can be understood using an information-processing model and that our working memory capacity has inherent limits. His insights helped move psychological research beyond the behaviorist methods that had dominated the field through the 1950s and laid the foundation for an important concept: *cognitive load theory.*

PSYCHOLOGY CONCEPT

COGNITIVE LOAD

When engaging with a digital product or service, a user must first learn how it works and then determine how to find the information they are looking for. Understanding how to use the navigation (and sometimes even finding it), processing the page layout, interacting with UI elements, and entering information into forms all require mental resources. While this learning process is happening, the user must also maintain focus on what they intended to do in the first place, which, depending on how easy an interface is to use, can be quite a challenge. The amount of mental resources needed to understand and interact with an interface is known as *cognitive load*.[2]

You can think of it like memory in a phone or laptop: run too many apps and the battery begins to drain, and the device slows down, or worst of all, it crashes. The amount of processing power available determines performance, and this depends on memory—a finite resource.

Our brains work similarly: when the amount of information coming in exceeds the space we have available, we struggle mentally to keep up—tasks become more difficult, details are missed, and we begin to feel overwhelmed. Our working memory, the buffer space (Figure 3-1) available for storing information relevant to the current task, has a specific number of slots in which to store information. If the tasks at hand require more space than is available, we begin to lose information from our working memory to accommodate this new information.

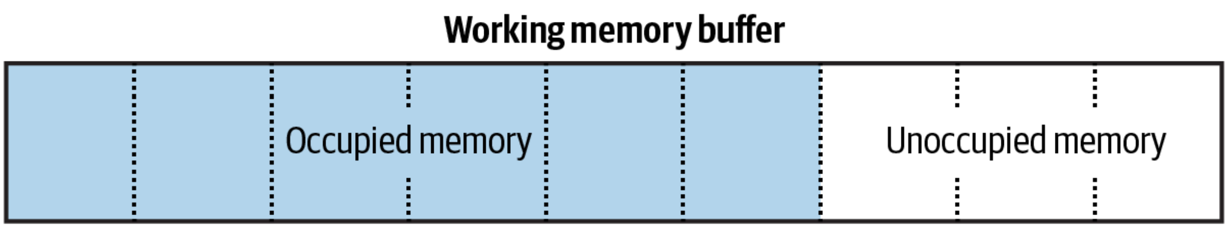


Figure 3-1. Working memory buffer illustration

This becomes problematic when the information lost is critical to the task that someone wishes to perform or is related to the information they want to find. Tasks will become more difficult and users might start to feel overwhelmed, ultimately leading to frustration or even task abandonment—both symptoms of a bad user experience.

TECHNIQUE

CHUNKING

Miller's fascination with short-term memory and memory span centered not on the number seven but on the concept of chunking and our ability to memorize information accordingly. He found that the size of the chunks did not seem to matter—seven individual words could be held in short-term memory as easily as seven individual letters. While there are factors that influence how many chunks a given individual can retain (context, familiarity with the content, specific capacity), the takeaway is the same: human short-term memory is limited, and chunking helps us retain information more effectively.

When applied to UX design, chunking informs an incredibly valuable approach to content. When we chunk content in design, we are effectively making it easier to comprehend. We can apply chunking by grouping related content and objects together and using design elements such as color, scale, dividers, and spacing to make these groups visually distinctive from other groups. Users can then scan the content, identify the information that aligns with their goal(s), and consume that information to achieve their goal(s) more quickly. By structuring content into visually distinct groups with a clear hierarchy, we can align the information we present with how people evaluate and process digital content.

Examples

The simplest example of chunking can be found in how we format phone numbers. Without chunking, a phone number would just be a long string of digits—sometimes significantly more than seven numbers—making it difficult to process and remember. A phone number that has been formatted (chunked) is much easier to both process and memorize (Figure 3-2).

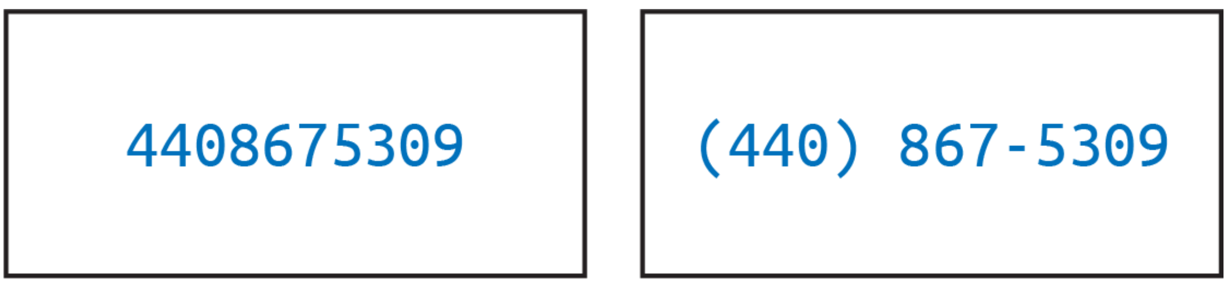


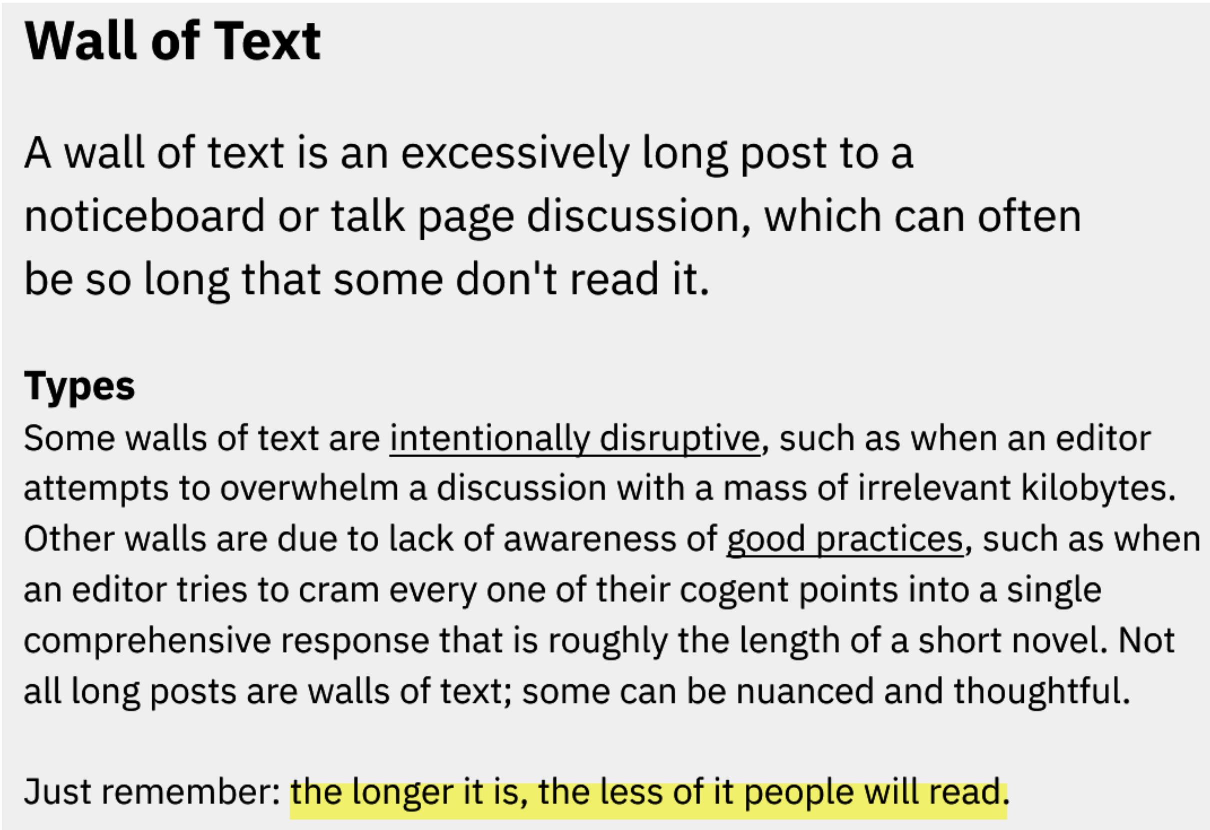
Figure 3-2. A (US) phone number with and without chunking applied

Let's move on to a slightly more complex example. When browsing the web, you'll inevitably be faced with the dreaded "wall of text" (Figure 3-3)—content that's characterized by a lack of hierarchy or formatting and that exceeds the appropriate line length. It can be compared to the unformatted phone number example just given, but on a larger scale. This content is more difficult to scan and process, which has the effect of increasing the cognitive load on users.

> A wall of text is an excessively long post to a noticeboard or talk page discussion, which can often be so long that some don't read it. Some walls of text are intentionally disruptive, such as when an editor attempts to overwhelm a discussion with a mass of irrelevant kilobytes. Other walls are due to lack of awareness of good practices, such as when an editor tries to cram every one of their cogent points into a single comprehensive response that is roughly the length of a short novel. Not all long posts are walls of text; some can be nuanced and thoughtful. Just remember: the longer it is, the less of it people will read. The chunk-o'text defense (COTD) is an alleged wikilawyering strategy whereby an editor accused of wrongdoing defends their actions with a giant chunk of text that contains so many diffs, assertions, examples, and allegations as to be virtually unanswerable. However, an equal-but-opposite questionable strategy is dismissal of legitimate evidence and valid rationales with a claim of "text-walling" or "TL;DR". Not every matter can be addressed with a

Figure 3-3. "Wall of text" example (source: Wikipedia, 2019)

When we compare this example with content that has formatting, hierarchy, and appropriate line lengths applied, the contrast is significant. Figure 3-4 is an improved version of the same content. Headings and subheadings have been added to provide hierarchy, whitespace has been used to break the content into discernible sections, line length has been reduced to improve readability, text links have been underlined, and key words have been highlighted to provide contrast with the surrounding text.



Wall of Text

A wall of text is an excessively long post to a noticeboard or talk page discussion, which can often be so long that some don't read it.

Types

Some walls of text are intentionally disruptive, such as when an editor attempts to overwhelm a discussion with a mass of irrelevant kilobytes. Other walls are due to lack of awareness of good practices, such as when an editor tries to cram every one of their cogent points into a single comprehensive response that is roughly the length of a short novel. Not all long posts are walls of text; some can be nuanced and thoughtful.

Just remember: the longer it is, the less of it people will read.

Figure 3-4. "Wall of text" improved with hierarchy, formatting, and appropriate line lengths (source: Wikipedia, 2019)

Now let's take a look at how chunking is applied in a broader context. Chunking can be used to help users understand underlying relationships by grouping content into distinctive modules, applying rules to separate content, and providing hierarchy (Figure 3-5). Especially in an information-dense experience, chunking can be leveraged to provide structure to the content. Not only is the result more visually pleasing, but it's also more scannable. Users who are skimming the latest headlines to determine which is worthy of their attention can quickly scan the page and make a decision.

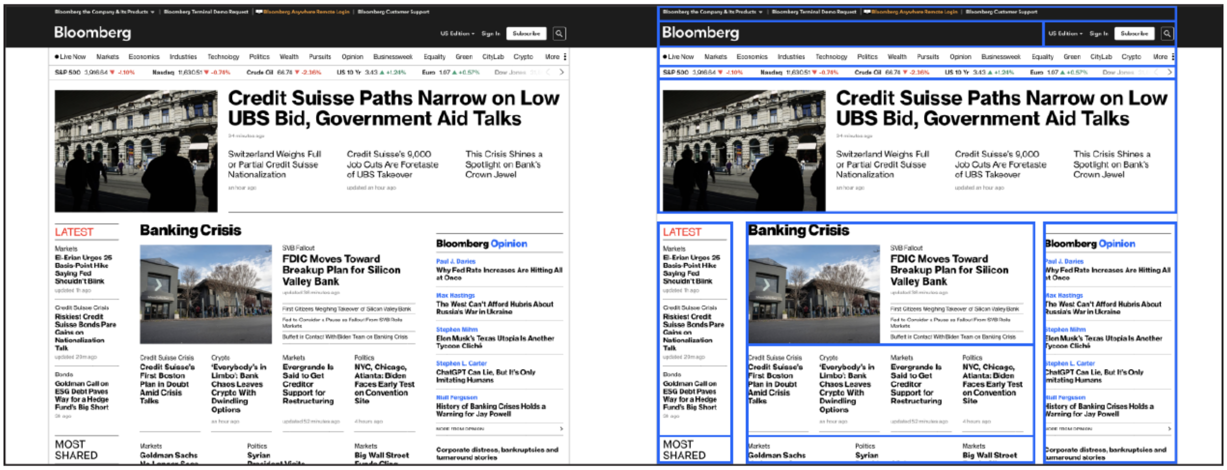


Figure 3-5. Example of chunking applied to dense information (source: Bloomberg, 2023)

While chunking is incredibly useful for bringing order to information-dense experiences, it can be found in many other places as well. Take, for example, ecommerce websites such as Nike.com (Figure 3-6), which uses chunking to group information related to each product. While individual elements might not share a background or surrounding border, they are visually chunked by their proximity to one another (product image, title, price, type of product, and finally total colors available). Additionally, Nike.com leverages chunking to group related filters in the lefthand sidebar.

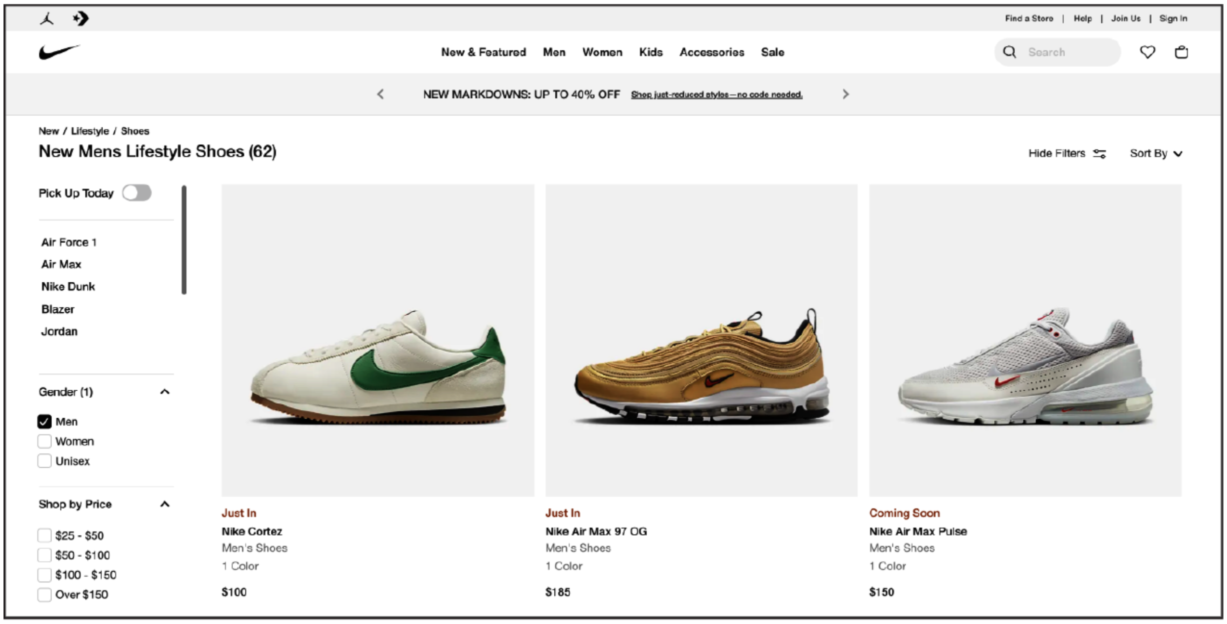


Figure 3-6. Chunking is commonly used to group products and filters on ecommerce websites (source: Nike.com, 2023)

Chunking can also be used to group related actions or functions together within the same space, thus creating a relationship among the grouped items and differentiating them from other groupings. This is especially true for toolbars in editing programs like Google Docs (Figure 3-7), which utilizes chunking to separate functionality within the toolbar into discernible groups.

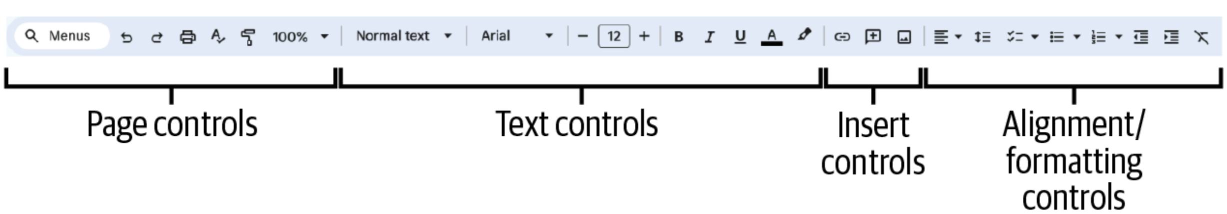


Figure 3-7. Google Docs utilizes chunking to separate functions into discernible groups (source: Google Docs, 2023)

These examples demonstrate how chunking can be used to visually organize any content for easier comprehension. It helps those who are consuming the content to understand the underlying relationships and information hierarchy. What chunking does not do is dictate a specific limit on the number of items that can be shown at a given time or within a group. Rather, it's simply a method for organizing content that makes it easier to quickly identify important information.

KEY CONSIDERATION

THE “MAGICAL” NUMBER SEVEN

Miller’s law is occasionally misunderstood to mean that there is a specific limit to the number of items that can be stored and processed in short-term memory at one time (7 ± 2), and that the number of related interface elements should therefore be limited to this range. A common example in regard to which this law is mistakenly cited is that of adjacent elements such as navigation links. Perhaps you’ve heard someone mention in the past that navigation links must be limited to seven, citing Miller’s law as the justification. In reality, design patterns such as navigation menus don’t require people to memorize them—the choices available to them via the navigation menu are visible at all times. In other words, there’s no usability gain provided by limiting these links to a specific number. As long as the menu is designed effectively, users will be able to quickly identify the relevant link—the only memorization necessary is what their actual goal is.

We’ll return to Nike.com and examine the primary navigation menu (Figure 3-8) to see an example. As you can see, the navigation links number well beyond seven, yet it is still easy to scan the list thanks to clear categorization and the use of whitespace and vertical dividers to separate sub-groupings.

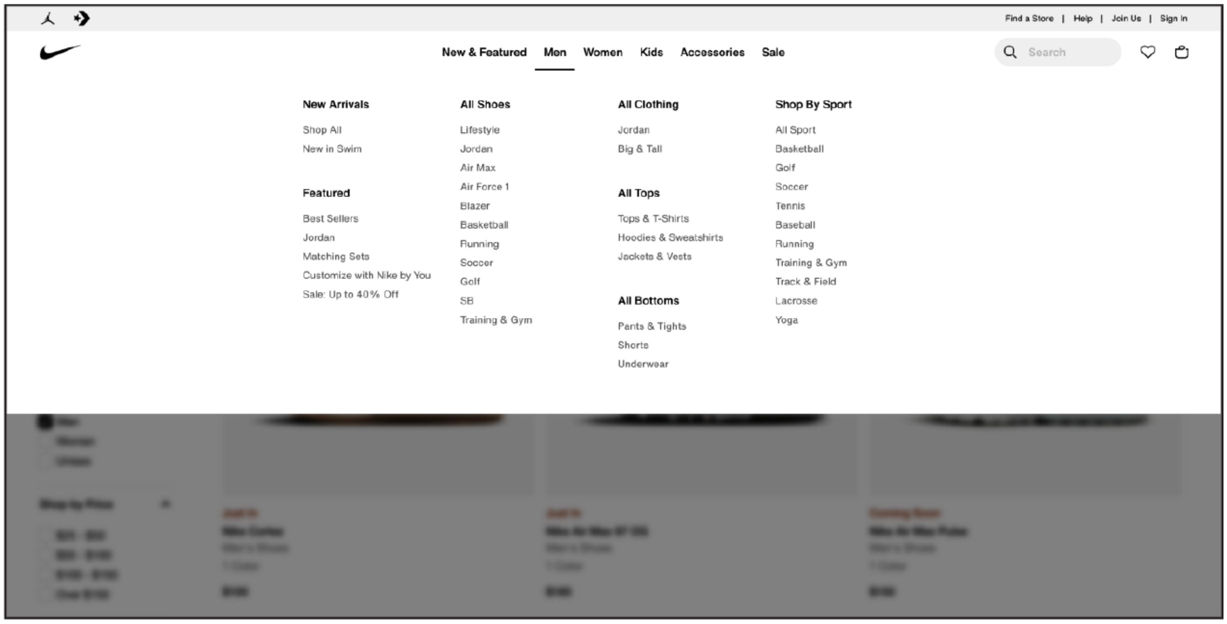


Figure 3-8. Despite not limiting menu items to seven, the navigation on Nike.com is easily comprehensible (source: Nike.com, 2023)

Miller's findings were centered around the limitations of short-term memory and how it can be optimized by organizing bits of information into meaningful chunks. The actual limit to the number of chunks that can be stored will vary per individual based on their knowledge of the information and the complexity of the information. There is research that suggests the average limit is closer to four items for short-term memory capacity,[3] and other prominent theories argue against measuring capacity in terms of a fixed number of elements altogether.[4]

Conclusion

The sheer volume of information around us is growing at an exponential rate—but we humans have a finite amount of mental resources available to process that information. The inevitable overload that can occur has a direct effect on our ability to complete tasks. Miller's law teaches us to use chunking to organize content into smaller clusters to help users process, understand, and memorize easily.

[1] George A. Miller, "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information," *Psychological Review* 63, no. 2 (1956): 81–97.

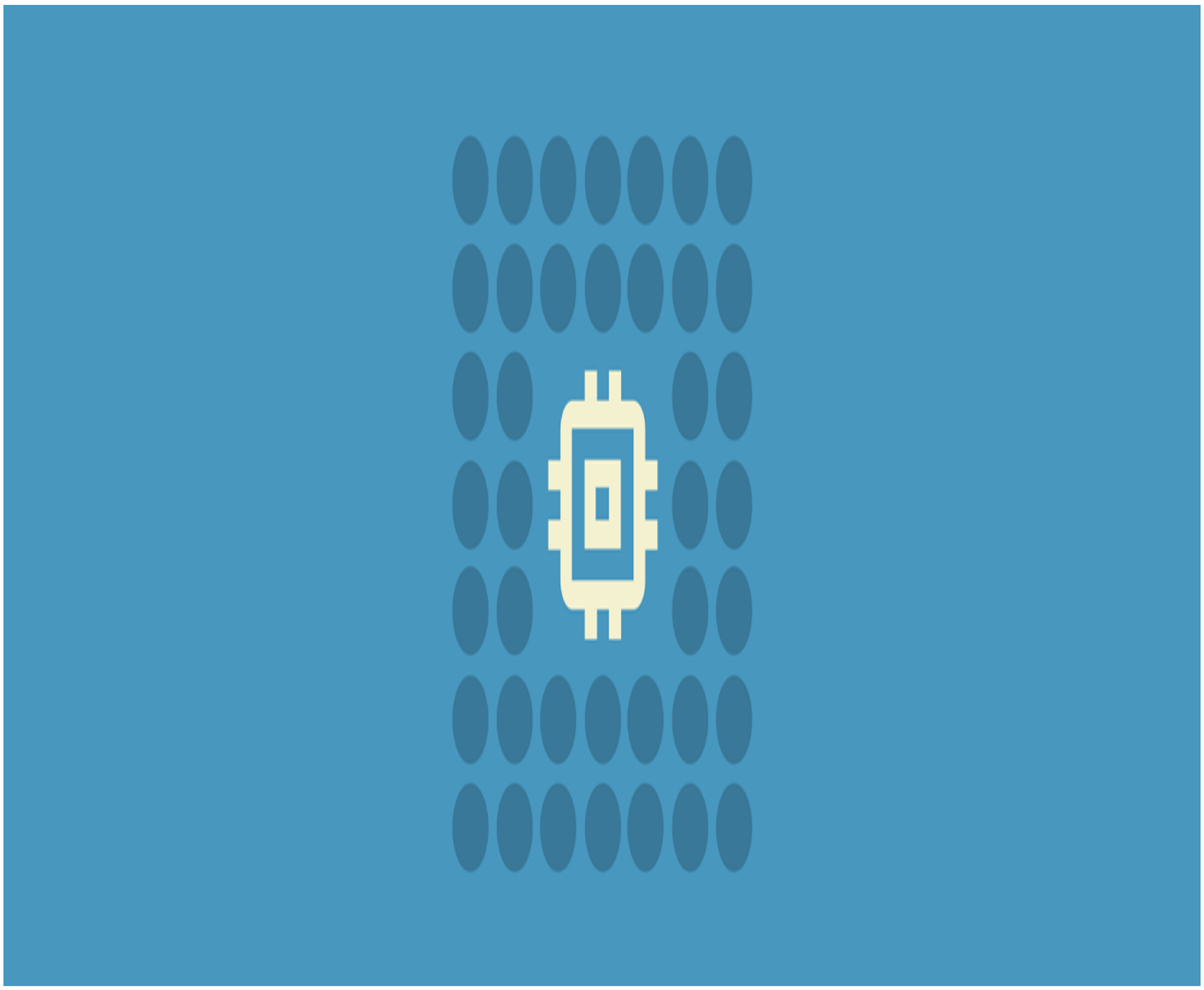
[2] John Sweller, "Cognitive Load During Problem Solving: Effects on Learning," *Cognitive Science* 12, no. 2 (1988): 257–85.

[3] Nelson Cowan, "The Magical Number 4 in Short-Term Memory: A Reconsideration of Mental Storage Capacity," *Behavioral and Brain Sciences* 24, no. 1 (2001): 87–114.

[4] Wei Ji Ma, Masud Husain, and Paul M. Bays, "Changing Concepts of Working Memory," *Nature Neuroscience* 17, no. 3 (2014): 347–56.

Chapter 4. Hick’s Law

> *The time it takes to make a decision increases with the number and complexity of choices available.*



KEY TAKEAWAYS

- Minimize choices when response times are critical to decrease decision time.
- Break complex tasks into smaller steps in order to decrease mental effort.
- Avoid overwhelming users by highlighting recommended options.
- Be careful not to simplify to the point of abstraction.

Overview

One of the primary functions we have as designers is to synthesize information and present it in a way that doesn't overwhelm the people who use the products and services we design. We do this because we understand, almost instinctively, that redundancy and excessiveness create confusion. This confusion is problematic when it comes to creating products and services that feel intuitive. Instead we should enable people to quickly and easily accomplish their goals. We risk causing confusion when we don't completely understand the goals and constraints of the people using the product or service.

Ultimately, our objective is to understand what the user seeks to accomplish so that we can reduce or eliminate anything that doesn't contribute to them successfully achieving their goal(s). We, in essence, strive to simplify complexity through efficiency and elegance.

What is neither efficient nor elegant is when an interface provides too many options. This is a clear indication that those who created the product or service do not entirely understand the needs of the user. Complexity extends beyond just the user interface; it can be applied to processes as well. The absence of a distinctive and clear call to action, unclear information architecture, unnecessary steps, too many choices or too much information—all of these can be obstacles to users seeking to perform a specific task.

This observation directly relates to Hick's law, which predicts that the time it takes to make a decision increases with the number and complexity of choices available. Not only is this principle fundamental to decision making, but it's also critical to how people perceive and process the user interfaces we create. We'll look at some examples of how this principle relates to design, but first let's look at its origins.

Origins

Hick's law was formulated in 1952 by psychologists William Edmund Hick and Ray Hyman, who were examining the relationship between the number of stimuli present and an individual's reaction time to any given stimulus. What they found was that increasing the number of choices available logarithmically increases decision time. In other words, people take longer to make a decision when given more options to choose from. It turns out there is an actual formula to represent this relationship: `RT = a + b log2 ( n )` (Figure 4-1). This formula calculates response time (RT) based on the number of stimuli present (*n*) and two arbitrary measurable constants that depend on the task (*a*, *b*).

Fortunately, we don't need to understand the math behind this formula to grasp what it means. The concept is straightforward when applied to design: the time it takes for users to interact with an interface directly correlates to the number of options available to interact with. This implies that complex or busy interfaces result in longer decision times for users, because the users must first process the options that are available to them and then choose which is most relevant in relation to their goal. When an interface is too busy, actions are unclear or difficult to identify, and critical information is hard to find, the mental effort required to find what we are looking for increases. This increase in mental effort is commonly referred to as *cognitive load*, which we covered in Chapter 3, "Miller's Law".

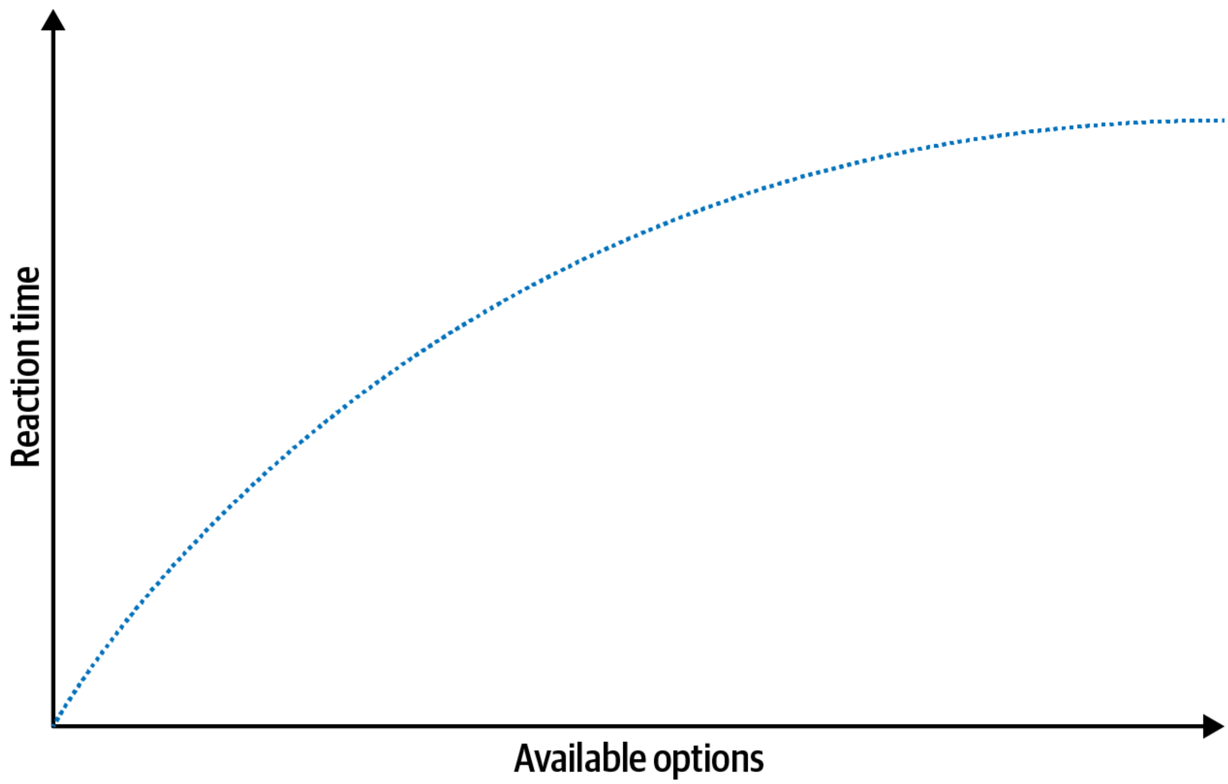


Figure 4-1. Diagram representing Hick's law

PSYCHOLOGY CONCEPTS

PARADOX OF CHOICE

Have you ever noticed it's easy to get indecisive and overwhelmed with the more choices you have? Take, for example, a restaurant menu with a plethora of food and beverage options. This menu will inherently require more mental energy to process and decide on an option in comparison to a menu that's focused around a dozen or so items. Despite the common assumption that the more choice we have the better, the opposite is often true: more choice leads to *choice overload*.[1]

This is the paradox of choice: the range of choices that is available today for virtually anything is far greater than in the past, but still, people are not happier.[2] The paradox was popularized by American psychologist Barry Schwartz and relates the ideas of psychologist Herbert A. Simon from the 1950s to the psychological stress that most consumers face today.

Schwartz was inspired by a study conducted by psychologists Sheena Iyengar and Mark Lepper in 2000 that challenged the implicit assumption that having more choices is necessarily more intrinsically motivating than having fewer.[3] In the experiment, shoppers at an upscale food market were presented with a display table showcasing 24 varieties of gourmet jam. Those who sampled the different spreads received a coupon offering a small discount on any jam purchase. On another day, shoppers encountered a similar table, but this time only six varieties of jam were on display. The larger display captured more attention compared to the smaller one. However, when it came time to make a purchase, individuals who saw the larger display were only one-tenth as likely to buy compared to those who saw the smaller display. In other words, shoppers were more likely to make a purchase when presented with a limited choice of gourmet jams compared to a larger selection.

Examples

Now that we have an understanding of Hick's law, let's take a look at some examples that demonstrate this principle. There are examples of Hick's law in action everywhere, but we'll start with a common one: remote controls.

As the number of features available in TVs increased over the decades, so did the options available on their corresponding remotes. Eventually, we ended up with remotes so complex that using them required either muscle memory from repeated use or a significant amount of mental processing. This led to the phenomenon known as "grandparent-friendly remotes." By taping off everything except for the essential buttons, grandkids were able to improve the usability of remotes for their loved ones, and they also did us all the favor of sharing the modified remotes online (Figure 4-2).

In contrast, today we have smart TV remotes: the streamlined cousins of the previous examples, with the controls simplified to only those that are absolutely necessary (Figure 4-3). The result is a remote that doesn't require a substantial amount of mental energy. The complexity is transferred to the TV interface itself, where information can be effectively organized and progressively disclosed within menus.

Figure 4-2. Modified TV remotes that simplify the "interface" (sources: Sam Weller via Twitter, 2015 [left]; Luke Hannon via Twitter, 2016 [right])

Figure 4-3. A smart TV remote, which simplifies the controls to only those absolutely necessary (source: Apple, 2023)

Now that we've looked at some examples of Hick's law at work in the physical world, let's shift our focus to the digital. As we've seen already, the number of choices available can have a direct impact on the time it takes to make a decision. We can ensure better user experiences by providing the right choices at the right time rather than presenting all the possible choices all the time. An excellent example of this can be found with Google Search, which provides the varying means of filtering results by type (all, images, videos, news, etc.) only after you've begun your search (Figure 4-4). This helps to keep people focused on the more meaningful task at hand, rather than being overwhelmed with decisions at the outset.

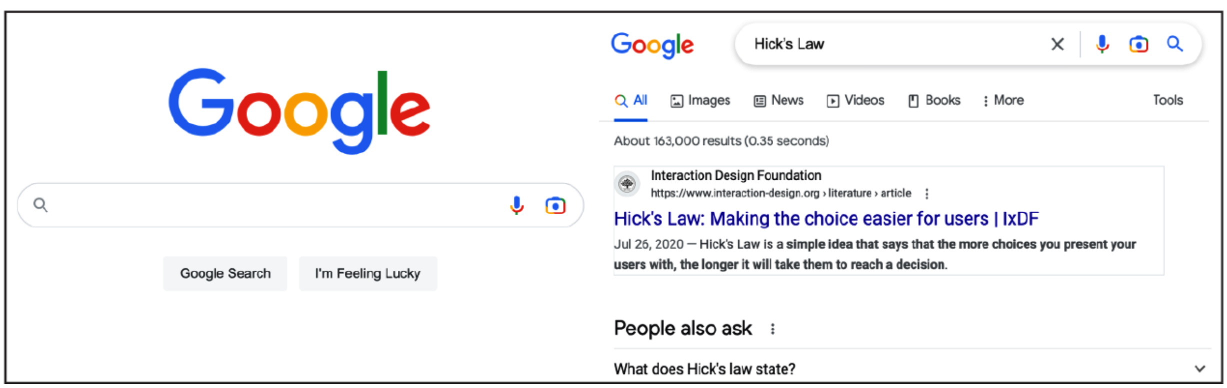


Figure 4-4. Google simplifies the initial task of searching (left) and provides the ability to filter results only after the search has begun (right) (source: Google, 2023)

Let's look at another example of Hick's law. Onboarding is a crucial but risky process for new users, and few applications nail it as well as Notion (Figure 4-5). Notion helps beginners learn the basics of its product by providing an easy-to-follow checklist for getting started. This is an effective way to onboard users because it mimics the way we actually learn: we often learn best by doing and building upon what we already know. By providing steps in a risk-free environment, we can enable new users to start interacting with an app without them feeling overwhelmed by an endless amount of possibilities for getting started.

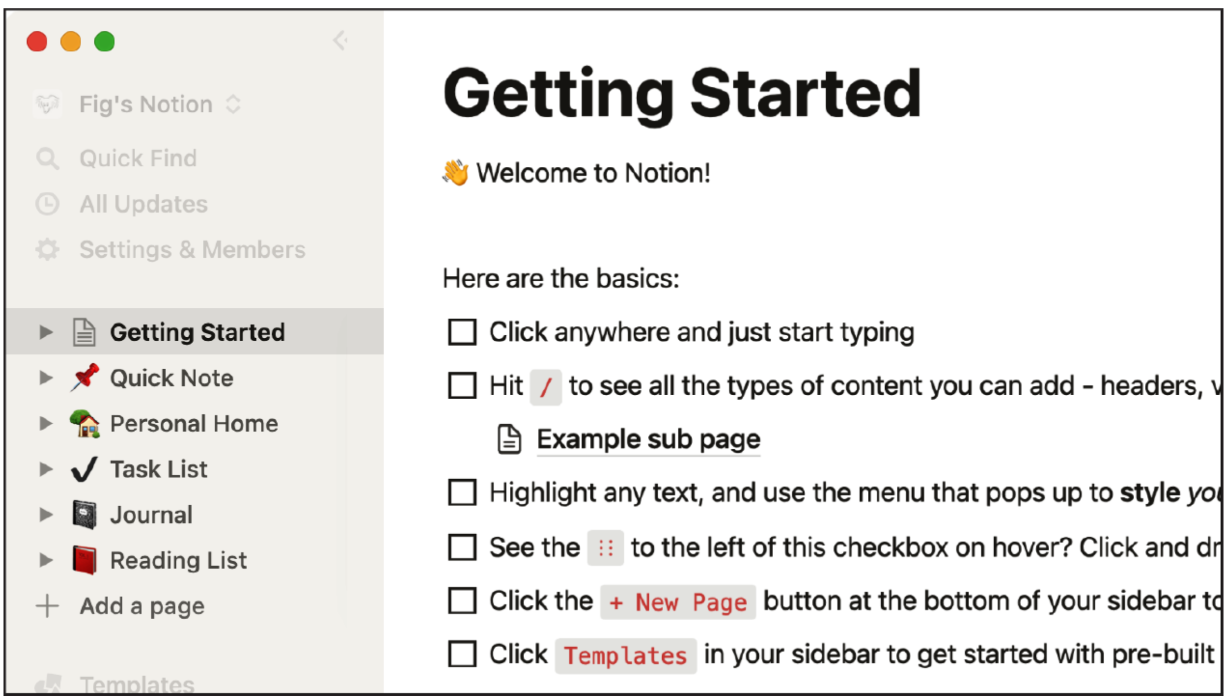


Figure 4-5. Screenshot from Notion's progressive onboarding experience (source: Notion, 2023)

Another common example of Hick's law in action can be found with streaming services and the choices we're presented when deciding on what to watch. Take, for example, Netflix, which found that its customers took an average of 18 minutes to find a show or movie. The reason for this was they were often paralyzed with indecision when it came to selecting a show or movie based on the quantity of options in front of them. To help remedy this, Netflix introduced various features such as "Trending Now" and "Popular on Netflix" (Figure 4-6) as ways to provide more weight to specific options through the *social proof* that others have enjoyed them.

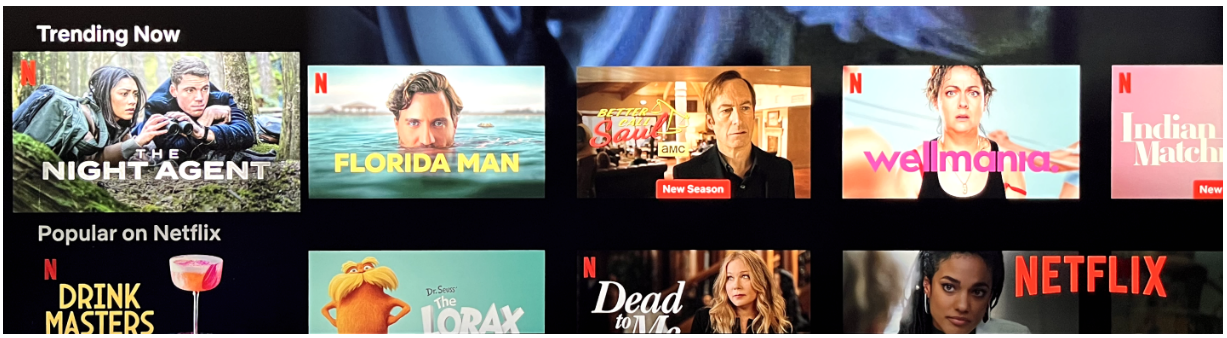


Figure 4-6. Netflix's "Trending Now" and "Popular on Netflix" sections provide more weight to specific options via social proof (source: Netflix, 2023)

TECHNIQUE

CARD SORTING

As we've seen in the previous examples, the number of choices can have a critical impact on the time it takes for people to make a decision. This is especially important when it comes to enabling users to find the information they need. Too many items can lead to more cognitive load for users, especially if the choices aren't clear. Conversely, with too few choices it becomes more difficult for users to identify which item is most likely to lead them to the information they're looking for. One particularly useful method for identifying users' expectations when it comes to information architecture is *card sorting*. This handy research method is great for figuring out how items should be organized according to people's mental models: simply have the participants organize topics within groups that make the most sense to them (Figure 4-7).

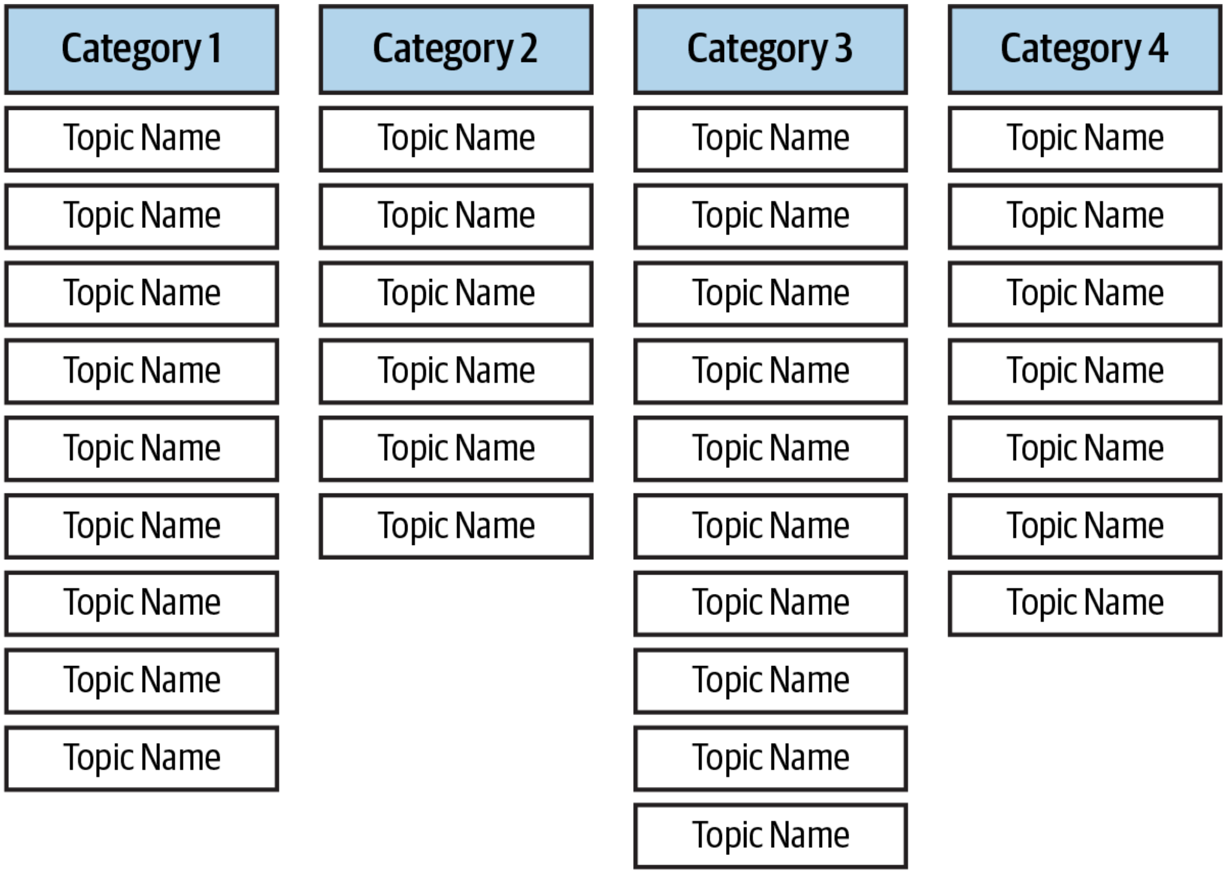


Figure 4-7. Card sorting

The steps required during this exercise are relatively straightforward. While there are a variety of approaches to card sorting (closed versus open, moderated versus unmoderated), they all follow the same general process. The following are the steps that make up a moderated open card sorting exercise,[4] which is the most common type:

1. *Identify topics*

   The first step is to identify the topics that the participants will be asked to organize. These topics should represent the main content within your information architecture, with each item written on an individual card (the exercise can also be conducted digitally). It’s recommended that you avoid labeling topics with the same words, which can bias participants and lead them to group these items together.[5]

2. Organize topics

The next step is to have the participants organize the topics, one at a time, into groupings that make sense to them. It’s common to have participants think out loud during this phase, which can provide valuable insight into their thought processes.

3. Name categories

Once the topics have been organized into groups, ask the participants to name each group they created based on the term they think best describes it. This step is particularly valuable because it reveals what each participant’s mental model is and will be helpful when determining what to eventually label categories within your information architecture.

4. Debrief participants (optional)

The optional but recommended final step during an open card sorting exercise is to ask the participants to explain their rationale for each of the groupings they created. This enables you to uncover why each participant made the decisions they did, identify any difficulties they experienced, and gather their thoughts on any topics that might have remained unsorted.

KEY CONSIDERATION

OVERSIMPLIFICATION

An important goal for designers is to eliminate unnecessary complexity for the users of the products and services they design—to become elegant simplifiers. After all, good user experiences are often those that feel easy and intuitive, and where obstructions that might deter people from achieving their goals have been removed. As we've seen, simplifying an interface or process helps to reduce the cognitive load for users and increases the likelihood that they'll complete their task and achieve their goal. But a balance must be struck when striving for simplicity, and it's important not to take simplification too far. When an interface has been simplified to the point of abstraction, it's no longer clear what actions are available, what the next steps are, or where to find specific information. In other words, the amount of visual information presented has been reduced to make the interface seem less complex, but this has led to a lack of sufficient cues to help guide people through a process or to the information they need. As a result, the amount of cognitive load required for users to achieve their goals has increased.

A common example of this is the use of iconography as a way to communicate critical information about possible actions (Figure 4-8). Using icons has a lot of advantages: they provide visual interest, they save space, they present excellent targets for taps or clicks, and they can provide quick recognition if they hold universal meaning. The challenge is that truly universal icons are rare, and icons often mean different things to different people. While relying on icons to convey information can help to simplify an interface, it can also make it harder to perform tasks or find information. This is especially true if the icons aren't immediately recognizable to users, who more often than not will have a wide spectrum of knowledge and experience.

Figure 4-8. Screenshot of the app bar from Facebook's iOS app (source: Facebook, 2023)

Another complicating factor is that similar icons may be used to represent different actions or information, sometimes in complete opposition, from one product or service to another. There is no icon standardization body that regulates what icons can be used where in websites or apps, which means that how icons are used is left to the discretion of the designers and their teams. We know that an icon can represent different things to different people, but what about when the same icon represents different actions? Since there is no standardization, the functionality attached to an icon can vary from one digital experience to another. Take, for example, the “heart” and “star” icons: they typically indicate the ability to favorite, like, bookmark, or rate an item, but they may sometimes simply indicate a featured item. Not only does the meaning and functionality of these two icons vary across different products and services, but they also often compete with each other. This obviously results in confusion and an increase in the cognitive load on users, because the icons’ meaning is hard to interpret precisely.

Adding contextual clues helps users to identify the options that are open to them and the relevance of the information available to the tasks they wish to perform. In the case of iconography, studies have shown that simply adding text labels to accompany icons will provide clarity and aid users with both discovery and recognition. This practice is even more critical when using icons for important elements such as navigation (Figure 4-9). The addition of text labels effectively reduces the abstraction of the icons alone by including additional information to help convey meaning and increase usability.

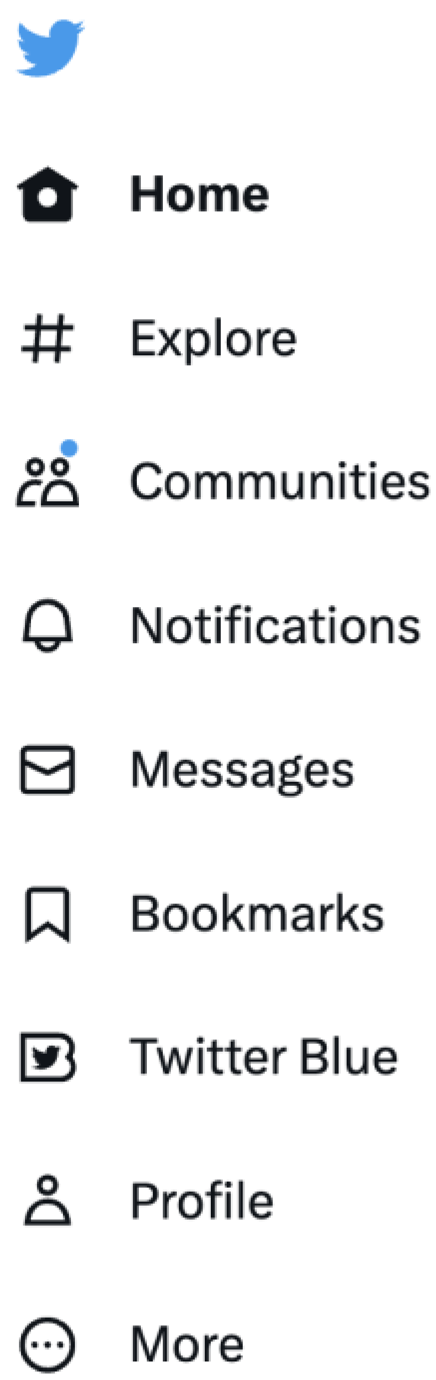


Figure 4-9. Text labels accompany icons in the navigation on the X (formerly Twitter) web app (source: X, 2023)

Conclusion

Hick's law is a key concept in user experience design because it's an underlying factor in everything we do. When an interface is too busy, actions are unclear or difficult to identify, and critical information is hard to find, a higher cognitive load is placed on users. Simplifying an interface or process helps to reduce the mental strain, but we must be sure to add contextual clues to help users identify the options available and determine the relevance of the information available to the tasks they wish to perform. It's important to remember that each user has a goal, whether it's to buy a product, understand something, or simply learn more about the content. I find the process of reduction, or eliminating any element that isn't helping the user achieve their goal, a critical part of the design process. The less they have to think about what they need to do to reach their goal, the more likely it is they will achieve it.

[1] "Why Do We Have a Harder Time Choosing When We Have More Options?," *The Decision Lab*, August 16, 2018, *https://oreil.ly/mmpYT*.

[2] Barry Schwartz, *The Paradox of Choice: Why More Is Less* (New York: HarperCollins, 2004).

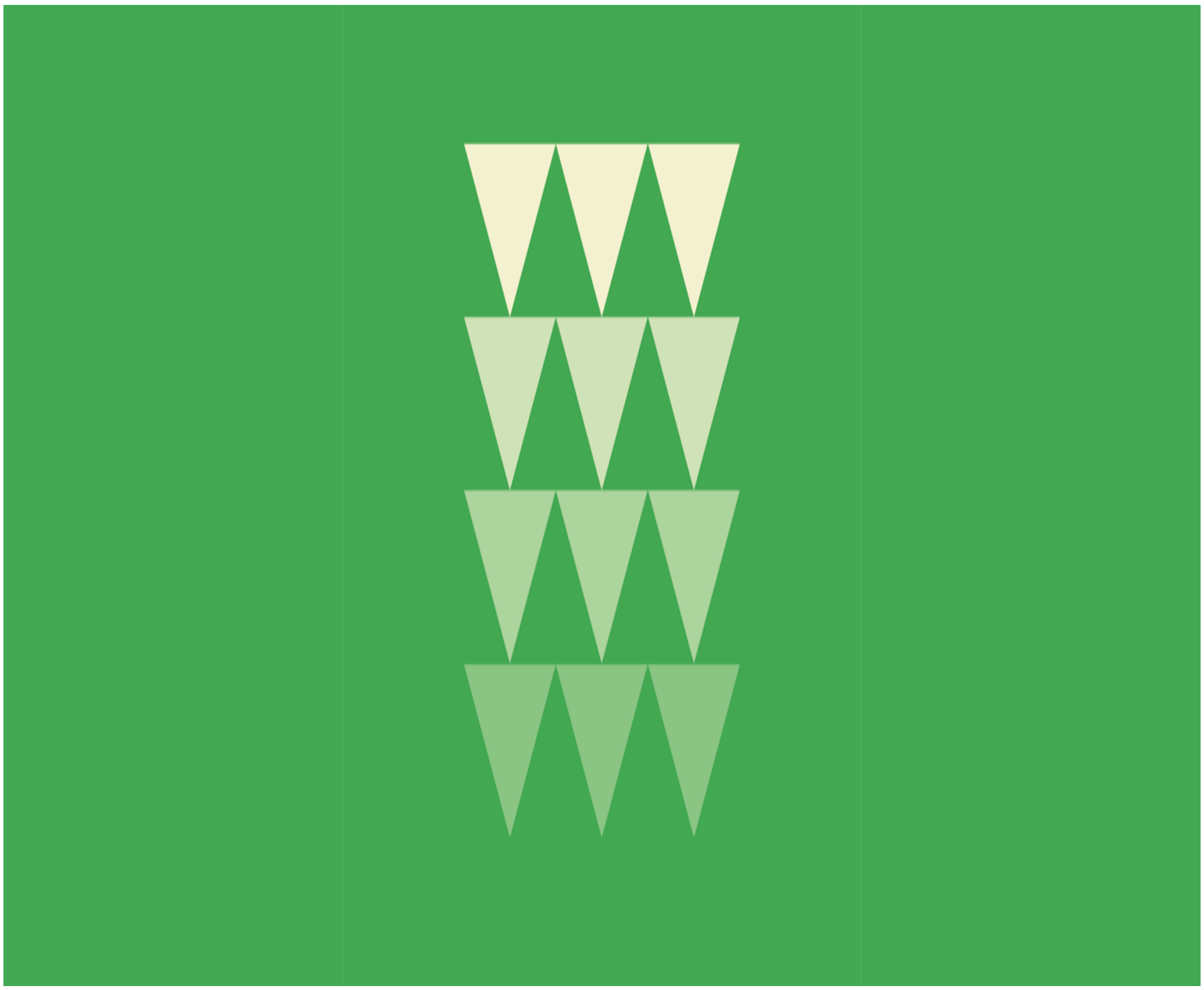
[3] Sheena S. Iyengar and Mark R. Lepper, “When Choice Is Demotivating: Can One Desire Too Much of a Good Thing?,” *Journal of Personality and Social Psychology* 79, no. 6 (2000): 995–1006.

[4] In a closed exercise, the groups are predefined by the researcher.

[5] Jakob Nielsen, “Card Sorting: Pushing Users Beyond Terminology Matches,” *Nielsen Norman Group*, August 23, 2009, *https://oreil.ly/bxhNN*.

Chapter 5. Postel's Law

> *Be conservative in what you do, be liberal in what you accept from others.*



KEY TAKEAWAYS

- Be empathetic to, flexible about, and tolerant of any of the various actions the user could take or any input they might provide.
- Anticipate virtually anything in terms of input, access, and capability while providing a reliable and accessible interface.
- The more we can anticipate and plan for in design, the more resilient the design will be.
- Accept variable input from users, translating that input to meet your requirements, defining boundaries for input, and providing clear feedback to each user.

Overview

Designing good user experiences means designing good *human* experiences. People don't behave like machines: we are sometimes inconsistent, frequently distracted, occasionally error-prone, and usually driven by emotion. We expect the products and services we interact with to intuitively understand us and be forgiving. We expect to feel in control at all times, and we're generally annoyed when asked to provide more information than is necessary. At the same time, the devices and software we use vary greatly in terms of feature support, capabilities, and form factors. To be capable of meeting users' expectations, the products and services designers build must be robust and adaptable. Postel's law, also known as the robustness principle, gives us a guiding principle for designing human-centric experiences that account for both scale and complexity.

The first half of Postel's law states that you should "*be conservative in what you do.*" In the context of design, this can be interpreted as stipulating that the output of our efforts, whether that's an interface or a comprehensive system, should be reliable and accessible. These are important characteristics of a digital product or service, because not only must the interface be easy to use, but it must be easy to use for the largest spectrum of users possible. This means that anyone, regardless of device size, feature support, input mechanism, assistive technology, or even connection speed, should be served something that works.

The second half of the principle states that you should "*be liberal in what you accept from others.*" In the context of design, this can be taken to mean the acceptance of input from users via any input mechanism and in a variety of possible formats. It applies to data entered into a form via mouse and keyboard (or perhaps keyboard only), assistive technology, touch and gesture input from mobile users, and even voice input in all its variations of language, dialect, and nomenclature. It applies to screens of any size and resolution, from a watch interface all the way up to a TV. It encompasses differences in network bandwidth, connection strength, and any other possible variation.

In this chapter, we'll take a close look at some examples of Postel's law in action and how designers can leverage this principle to design products and services that adapt to how people actually are.

Origins

Jon Postel was an American computer scientist who made significant contributions to the underlying protocols that would come to form the internet. One of these contributions was an early implementation of the Transmission Control Protocol (TCP), the foundation on which data is sent and received over a network. In this specification, Postel introduced what he called the *robustness principle*, which stated that "TCP implementations will follow a general principle of robustness: be conservative in what you do, be liberal in what you accept from others."[1] The idea was that programs that send data (either to other machines or to different programs on the same machine) should conform to specifications, while programs that receive data should be robust enough to accept and parse nonconformant input, as long as the meaning is clear.

Postel's principle was originally intended to be a guideline for network engineering, specifically in regard to the transfer of data across computer networks. The fault tolerance introduced by the robustness principle helped to ensure nodes on the early internet could communicate reliably, but its influence extends beyond just computer network engineering—software architecture has also been influenced by this principle. Take, for example, declarative languages such as HTML and CSS. Their loose error handling means that problems like authoring mistakes or lack of browser support for specific features are handled gracefully by the browser. If the browser doesn't understand something, it simply ignores it and moves on. This has lent an amazing amount of flexibility to these languages—flexibility that led to their dominance on the internet stage.

The philosophy outlined in Postel's law can also be applied to user experience design and how we deal with user input and system output. As I mentioned earlier, designing good user experiences means designing good human experiences. We are not always perfectly rational or attentive and can be easily distracted, confused, and irrational, especially when under stress. This means we can predict but must not assume things about where users are, how they work, and the technology they use. Since humans and computers communicate and process information in fundamentally different ways, it's the responsibility of design to bridge the communication gap. Let's take a look at some examples to see how this can be done.

Examples

Postel's law describes an approach to design that's more akin to the philosophy of human–computer interaction: we should anticipate virtually anything in terms of input, access, and capability while providing a reliable and accessible interface. There are countless examples that demonstrate this philosophical approach, but we'll begin with one that is ubiquitous in the digital world: input forms. Forms have long been a primary means for people to provide information to systems in the digital space. In essence, they are the medium through which humans and systems interact: a product or service requires information, and the user provides that information by way of form elements that are submitted for processing.

Using Postel's law as a guide in regard to forms, the first consideration is to be conservative in how much information you ask people to provide. The more fields you require users to fill out, the more cognitive energy and effort you're asking of them, which can lead to a deterioration in the quality of the decisions made (commonly referred to as *decision fatigue*[2]) and reduce the likelihood that they'll complete the form. By asking only for what's absolutely necessary and not requesting information you already have, such as an email address or a password, you can minimize the effort required to fill out a form.

Another consideration in regard to forms is their restrictiveness and what they require from users. Take, for example, the order of given name and family name, which can change depending on the cultural norms. It can be confusing to ask users within cultures accustomed to seeing family name first to fill out a form requiring their given name first, which is the norm in Western cultures. Strict formatting rules can also be an issue for addresses that don't conform to a standard country/region, state/territory/province, zip/postal code format. It's also important to consider formatting differences that could break form validation if it’s too restrictive, like including hyphenated names, names with spaces in them, or names with just one or two letters. Lastly, how we respond when there is an error on form inputs should be carefully considered; telling someone their name is “wrong” or “not accepted” can do a lot of damage to their experience and satisfaction with the product or service.

There’s also the consideration of how flexible the system is with respect to user input. Since humans and computers communicate in different ways, there’s sometimes a disconnect between the information that humans provide and the information that the computer expects. Postel’s law dictates that computers should be robust enough to accept varying types of human input and not only make sense of it but also process it into a computer-readable format. This can be done in a variety of ways, but perhaps most exciting are the ones that require the least amount of effort. Take, for example, Apple’s Face ID (Figure 5-1), a facial recognition system that enables Apple users to authenticate on their mobile devices without the need to provide a username or a password each time they attempt to unlock their devices.

Figure 5-1. Face ID lets you securely unlock your iPhone or iPad, authenticate purchases, sign in to apps, and more (source: Apple, 2023)

Next, let's look at an example that has become ubiquitous in the post-desktop era of computing: *responsive design*. Over the past few decades, as more and more devices gained the ability to connect to the web, the need to serve content that could adapt to any screen size increased. Ethan Marcotte introduced an approach in 2010 that he called "responsive web design," which relies on "fluid grids, flexible images, and media queries"[3] to create websites that allow content to respond in a fluid manner to different viewing contexts. It was a completely new approach to designing and building websites, at a time when the predominant strategy was to create separate websites for desktops and internet-capable mobile devices. Responsive web design pushed designers beyond creating device-specific experiences and toward an approach that embraced the fluid nature of the web. The growing capability of Cascading Style

Sheets (CSS) enabled designers to define how content could flexibly adapt to any viewing context, be it an internet-capable smartwatch, smartphone, gaming console, laptop, desktop computer, or TV (Figure 5-2). Today, responsive web design is the de facto standard when creating web experiences, and it embodies the philosophy of accepting a broad spectrum of input while providing output that is reliably adaptable and not quarantined to specific dimensions or devices.

Figure 5-2. Responsive web design embraces the fluid nature of the web

Progressive enhancement, which describes a strategy for web design focusing on content and a gradual layering of styling and interaction, can also be considered an example of Postel's law. First introduced by Steve Champeon and Nick Finck at SXSW in 2003 in a presentation titled “Inclusive Web Design for the Future”, this strategy emphasizes access to the basic content and functionality for all users, regardless of browser feature support, device features and capabilities, or internet connection speed. Additional style and interaction layers are progressively added as feature support and capabilities are detected, ensuring that people with newer browsers, more advanced devices, or faster connections receive a more enhanced experience without obscuring the core content. It’s an approach that stands in contrast to a previous strategy known as “graceful degradation,” which places emphasis on fault tolerance and focuses first on the more advanced software and hardware while providing a fallback for others.

Progressive enhancement’s strength centers around its ability to liberally accept any range of browser feature support, any level of device capability support, and any connection speed and to conservatively layer enhancements while preserving the core content, thus enabling universal access for everyone. Take, for example, a simple search box, which provides the ability for anyone to select it and enter a search query but is enhanced to support voice input for devices that support voice recognition (Figure 5-3). Everyone will get a default search box initially, and it will be usable by everyone, including those using assistive technology such as screen readers. If voice recognition support is detected, a layer of functional enhancement is added by allowing the user to select the microphone icon to invoke a voice assistant that will transcribe speech to text, thereby extending the input methods of the search box without taking away from its core functionality.

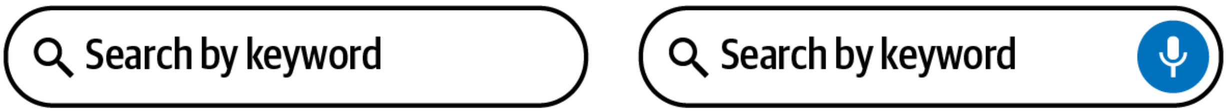


Figure 5-3. A progressively enhanced search component that provides a search box by default, and then voice support for devices that support voice recognition

Examples of Postel's law aren't limited to interfaces—they can also be found in our processes. Take, for example, design systems, which are collections of reusable components and patterns guided by standards that define how they are used. The goal of a design system is to enable these components and patterns to be assembled to build any number of applications and to provide a framework for ensuring the extensibility of designs. These tools have proven incredibly valuable, enabling companies to scale design in a consistent manner across the organization (Figure 5-4). To create an effective design system, organizations must be liberal in terms of what is accepted: everything from design, content, and code to strategy, opinions, and criticism may be provided by a diverse team of contributors. In contrast, the output of the design system is conservative: guidelines, components, patterns, and principles must all be clear and purposeful.

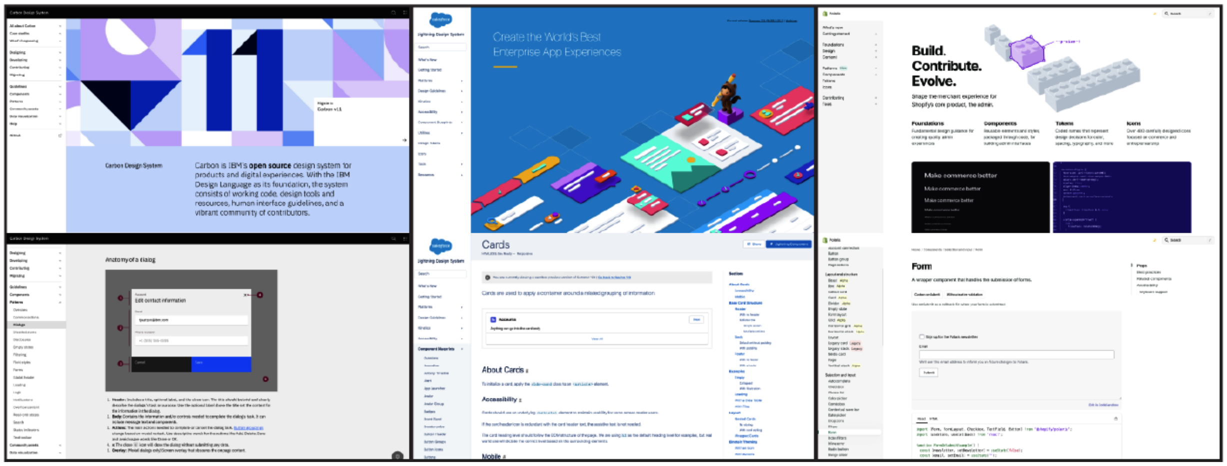


Figure 5-4. Design systems have enabled design to scale in a manageable and consistent manner within a number of well-known companies—pictured here, from left to right, are Carbon Design System by IBM, Lightning Design System by Salesforce, and Polaris by Shopify (source: IBM, Salesforce, Shopify, 2023)

TECHNIQUE

USER INTERVIEWS

Postel’s law is about bridging the communication gap between humans and computers by making technology more *human*. Designing good user experiences means designing good human experiences, and this requires us to understand our users. We can predict but must not assume things about where they are, how they work, and the technology they use. One incredibly effective method for uncovering this information about our users is through user interviews. A user interview is a quick and easy way to collect user data in a one-on-one session in which a researcher asks questions about a topic of interest, such as system use, behaviors, and habits, in order to gain insights about that topic. Such interviews can provide insights into what users think about a site, application, product, or process, including what content is memorable, what is important, and ideas for improvement. Interviews can be conducted before design, to enrich a contextual inquiry study, or at the end of a usability test to collect verbal responses related to observed behaviors.

Define the goal of the interview

What exactly are you or your stakeholders hoping to learn? Or what are you trying to understand better?

Ensure you collect valuable information for your design by making the goal concise and related to a specific aspect of the users' behavior or attitudes. For example, *learn more about our users* is too broad and ambiguous of a goal because it lacks the focus that will be valuable to improve specific aspects of the design. On the other hand, a goal such as *learn how doctors share patient medical history with fellow doctors, and where they feel there are challenges and opportunities* is more effective and likely to lead to more actionable insights.

Prepare your discussion guide

Be sure to prepare questions beforehand that focus around the goal of the interview. Don't be afraid to ask relevant follow-up questions based on the participant's responses. A natural, free-flowing conversation can lead to unexpected, fruitful insights. A general guide of themes to discuss can sometimes be more useful than a list of rigid questions.

Build rapport with the interviewee

An important yet sometimes overlooked step in conducting a user interview is making the interviewee feel comfortable. To build rapport with the interviewee, start by asking them about themselves, where they live, and if they've done anything like this before. Reassure them that there are no right or wrong answers, address questions they may have, and be sure to let them know that the interview is in no way a test of their knowledge or abilities. People are more likely to open up and provide valuable information once they are relaxed and trust the interviewer.

Avoid leading questions

Don't ask closed questions that are answerable with a "yes" or "no," or questions that are too vague to get specific and valuable responses. The goals is to elicit rich, unbiased answers from the interviewee. Open questions start with "what," "how," "when"—or "tell me about X." Additionally, be mindful of how you frame questions—how we ask a question can sometimes influence the response, which we want to avoid in order to get the most accurate data.

KEY CONSIDERATION

DESIGN RESILIENCY

The input that users provide to a system is variable and may span a wide spectrum. Therefore, to ensure a better user experience, we should design systems that are liberal in their acceptance of input. However, this also means there is an increased opportunity for things to go wrong, or to at least result in a less than ideal user experience. The more we can anticipate and plan for in design, the more resilient the design will be.

Take, for example, the topic of internationalization. The same text string can span different lengths, depending on the language. Many designers plan only for their native language, while not accounting for text expansion in other languages that could result in a considerable increase in length. English, a very compact language, contains words that can expand up to 300% when translated into a less compact language such as Italian (Figure 5-5). Text orientation can also vary per region of the world—from left-to-right in many Western countries to right-to-left or even vertical in others. By designing with these variations in mind, we can create more robust designs that can adapt to varying text string lengths and text orientations.

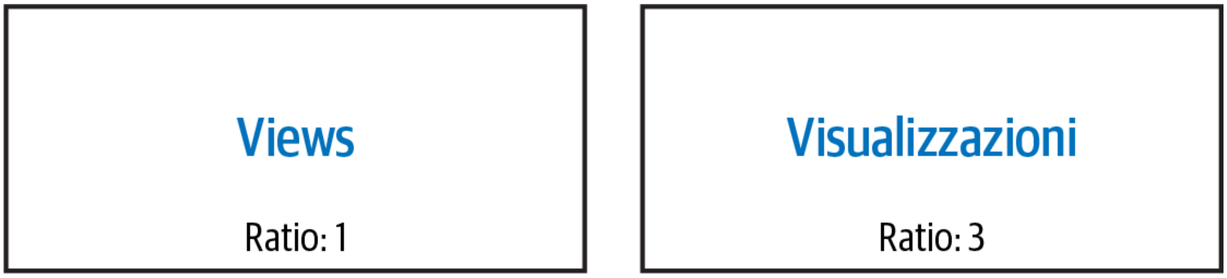


Figure 5-5. Text expansion from English (left) to Italian (right) (source: w3.org)

Another example is the default font size, which the user can customize both on mobile devices and in browsers. The purpose of this feature is to give the user control over the display, typically by increasing the size of all text throughout an application or website and thereby improving its accessibility. However, this can cause problems in designs that don't account for the possibility of the text size increasing—specifically, how it affects layout and the space available for text. Adaptable designs account for this feature and have a graceful response. Take, for example, Amazon, which does a great job of responding to font size customization in its website header navigation (Figure 5-6). The design accounts for the possibility of minimum font size customization by organizing the quick links below the search bar by importance and removing the links of lesser importance as the font size increases.

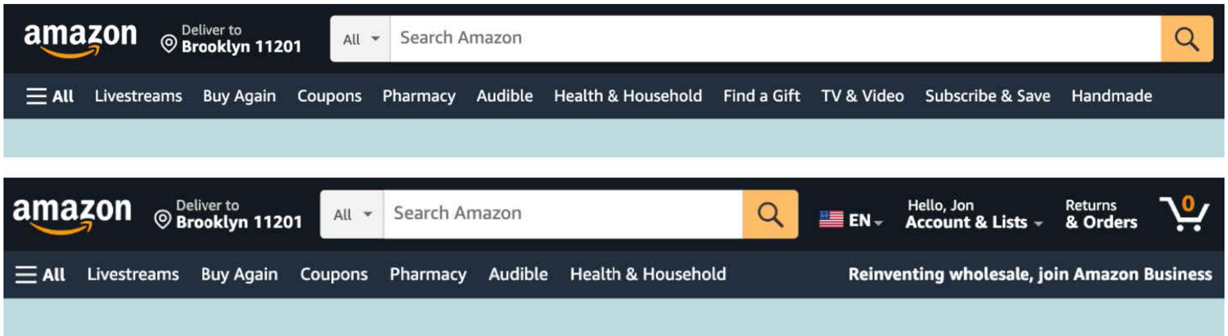


Figure 5-6. Amazon.com adapting to minimum font size customization (source: Amazon, 2023)

Conclusion

Postel's law can help us bridge the gap between human and machine. By designing systems that liberally accept variable human input and translate it into a structured, machine-friendly output, we transfer this burden away from users and therefore ensure a more *human* user experience. This allows us to build products and services that are robust and adaptable to fit the needs of growing scale and complexity. While it also means there is an increased opportunity for things to go wrong, we can anticipate and plan for this in design and thus ensure our work is more resilient.

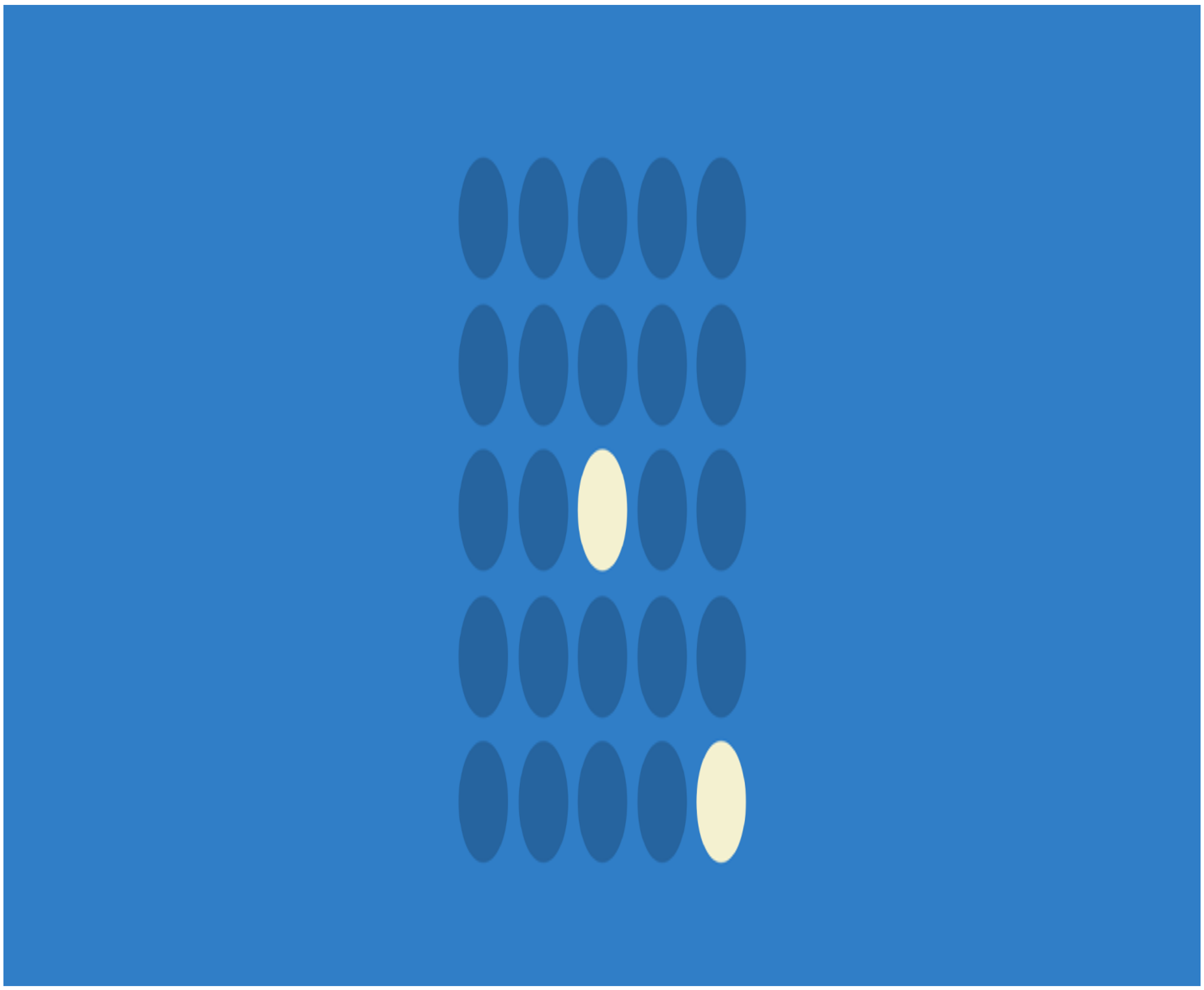
[1] Jon Postel, "RFC 793: Transmission Control Protocol," September 1981, https://oreil.ly/uxMIB.

[2] “Why Do We Make Worse Decisions at the End of the Day?,” *The Decision Lab*, August 15, 2019, *https://oreil.ly/0qEbe*.

[3] Ethan Marcotte, “Responsive Web Design,” *A List Apart*, May 25, 2010, *https://oreil.ly/RYGX0*.

Chapter 6. Peak–End Rule

People judge an experience largely based on how they felt at its peak and at its end, rather than on the total sum or average of every moment of the experience.



KEY TAKEAWAYS

- Pay close attention to the most intense points and the final moments (the "end") of the user journey.
- Identify the moments when your product is most helpful, valuable, or entertaining and design to delight the end user.
- Remember that people recall negative experiences more vividly than positive ones.

Overview

An interesting thing happens when we recollect a past event. Instead of considering the entire duration of the experience, we tend to focus on an emotional peak and on the end, regardless of whether those moments were positive or negative. In other words, we remember each of our life experiences as a series of representative snapshots rather than a comprehensive timeline of events. Our feelings during the most emotionally intense moments and at the end are averaged in our minds and heavily influence how we recall the overall experience to determine whether we'd be willing to do it again or recommend it to others. This observation, known as the peak–end rule, strongly suggests we should pay close attention to these critical moments to ensure users evaluate an overall experience positively.

Origins

Evidence for the peak–end rule was first explored in the 1993 paper “When More Pain Is Preferred to Less: Adding a Better End” by Daniel Kahneman et al.[1] They conducted an experiment in which participants were subjected to two different versions of a single unpleasant experience. The first trial involved participants submerging a hand in 14°C water (roughly 57°F) for 60 seconds. The second trial involved participants submerging the other hand in 14°C water for 60 seconds and then keeping it submerged for an additional 30 seconds as the water was warmed to 15°C. When given the choice of which experience they would repeat, participants were more willing to repeat the second trial, despite it being a longer exposure to the uncomfortable water temperatures. The conclusion by the authors was that the participants chose the longer trial simply because they preferred the memory of it in comparison to the first trial.

Subsequent studies would corroborate this conclusion, beginning with a 1996 study by Kahneman and Redelmeier[2] that found that colonoscopy or lithotripsy patients consistently evaluated the discomfort of their experience based on the intensity of pain at the worst and final moments, regardless of length or variation in intensity of pain within the procedure. A later study by some of the same researchers[3] expanded on this by randomly dividing patients into two groups: one that underwent a typical colonoscopy, and another that underwent the same procedure in addition to having the tip of the scope left in for three extra minutes without inflation or suction. When asked afterward which they preferred, patients who underwent the longer procedure experienced the final moments as less painful, rated their overall experience as less unpleasant, and ranked the procedure as less aversive in comparison to the other participants. Additionally, those that underwent the longer procedure were more likely to return for subsequent procedures—a result of these participants judging the experience positively because of the less painful end.

PSYCHOLOGY CONCEPT

COGNITIVE BIASES

To understand the peak–end rule, it is helpful to have an understanding of *cognitive biases*. The topic warrants an entire book of its own, but here I'll just give a brief introduction in the context of the peak–end rule.

Cognitive biases are systematic errors of thinking or rationality in judgment that influence our perception of the world and our decision-making ability. First introduced by Amos Tversky and Daniel Kahneman in 1972,[4] these mental shortcuts increase our efficiency by enabling us to make quick decisions without the need to thoroughly analyze a situation. Instead of constantly becoming paralyzed by the process of mental examination every time we must make a decision, we can rely on these unconscious automatic responses to help expedite things, engaging in heavier mental processing only when necessary. However, cognitive biases can also distort our thinking and perception, ultimately leading to inaccurate judgment and poor decisions.

Perhaps you've tried to have a logical discussion about a polarizing hot-button issue with someone else, only to discover it was incredibly difficult. The underlying reason for this can quite often be attributed to the fact that we attempt to preserve our existing beliefs by paying attention to information that confirms those beliefs and discounting information that challenges them. This is known as *confirmation bias*: a bias of belief in which people tend to seek out, interpret, and recall information in a way that confirms their preconceived notions and ideas.[5] This is but one of many common biases humans are susceptible to on a daily basis.

The peak–end rule, also a cognitive bias, is known as a *memory bias* because it impairs the recall of a memory. We remember intensely emotional events more than less emotional events, and this has an effect on how we perceive an experience: we recall not the sum of how we felt throughout the experience but the average of how we felt during its peak emotional moments and at its end.

The peak–end rule is related to another cognitive bias known as the recency effect, which states that items near the end of a sequence are the easiest to recall.

Examples

Let’s take a look at a few examples, beginning with a company that understands the power of personalization to create a memorable user experience. The end of the year is a good time to reflect back on the memories, challenges, and accomplishments of the prior 365 days. It’s in many ways an end to one version of ourselves and the beginning of a new version. Spotify recognizes this reflective moment and uses it to offer its users the opportunity to look back on their last 365 days of music and audio listening with Spotify Wrapped. The feature shows stats like the user’s most liked artists, songs played the most, listening statistics, and interesting features such as an “audio aura” that changes colors, a quiz you can interact with, soundtracks for movies personalized to you, rankings of listeners around the world, and more (Figure 6-1). Spotify utilizes the power of personalization to make experiences feel special and connected to the user by enabling them to introspect upon what they know about themselves through music, learn more about the artists and podcasts they’ve enjoyed, and subscribe to a larger musical community through sharing. It’s a moment throughout the Spotify user experience journey that is bound to create a lasting positive impression.

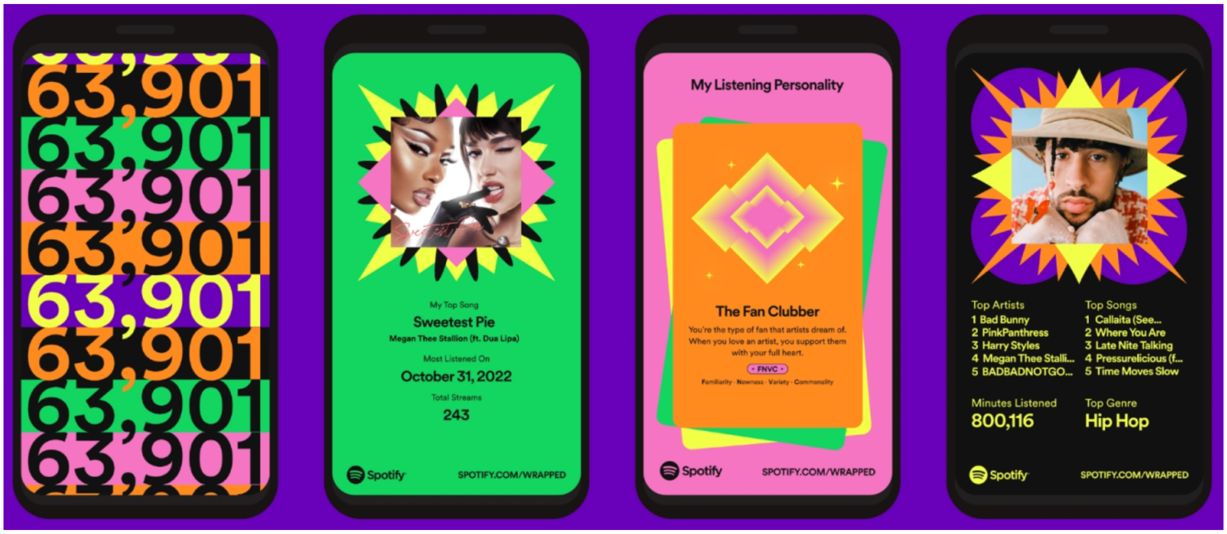


Figure 6-1. Spotify Wrapped 2022 (source: Spotify, 2022)

Positive events aren't the only ones that have an impact on how people feel about a product or service. Negative events also provide emotional peaks and can contribute to a user's lasting impression of an experience. Take, for example, wait times, which can have a profound effect on how people perceive a product or service. Ride-sharing company Uber realized that waiting was an unavoidable part of its Express POOL business model and sought to reduce this pain point by focusing on three concepts related to wait time: idleness aversion, operational transparency, and the goal gradient effect, concepts that have since made their way into all Uber services (Figure 6-2).[6] Uber customers are presented with an animation that helps to keep them not only informed but also entertained (idleness aversion). The app provides an estimated time of arrival and information on how arrival times are calculated (operational transparency). It clearly explains each step of the process so customers feel that they are continuously making progress toward their goal of getting a ride (goal gradient effect). By focusing on people's perceptions of time and waiting, Uber was able to reduce its post-request cancellation rate and avoid what could easily become a negative emotional peak while using its service.

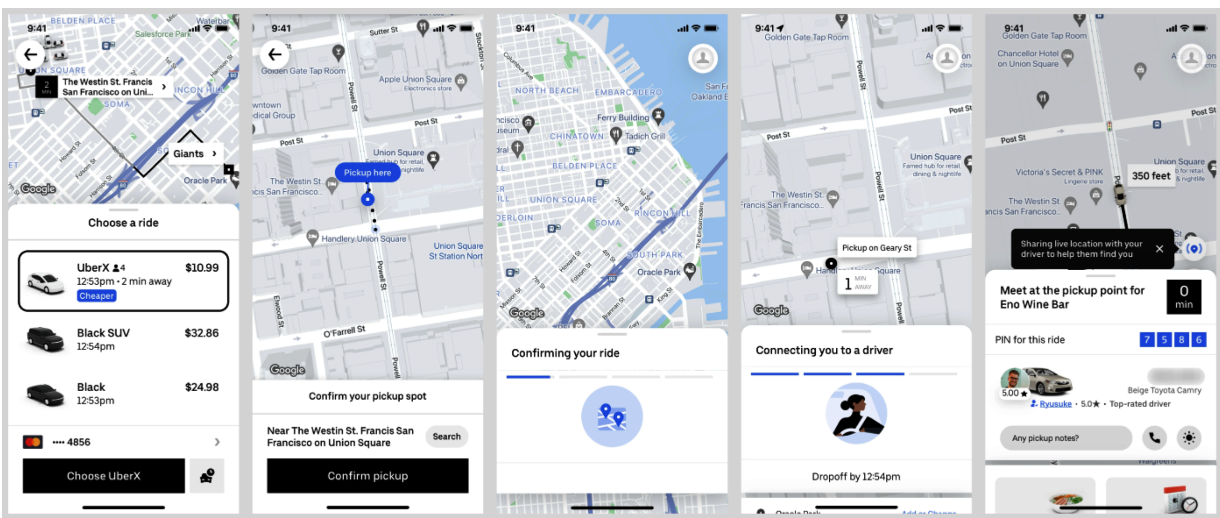


Figure 6-2. Uber app (source: Uber, 2023)

Another company that demonstrates proficiency in understanding how peak moments impact user experience is Duolingo. Its platform provides a fun and effective way to learn a language that is enjoyable and easy to use, while also encouraging users to continue learning. One important way it makes the process of learning a new language engaging is through gamified features such as levels and streaks, which celebrate learning milestones (Figure 6-3). These celebratory moments represent the accumulation of all the work that goes into learning a new language. Duolingo understands the importance of these moments and goes beyond presenting a simple progress indicator. By infusing a touch of brand character through illustration, subtle animation, and humor, the platform reinforces achievement and makes the experience more engaging.

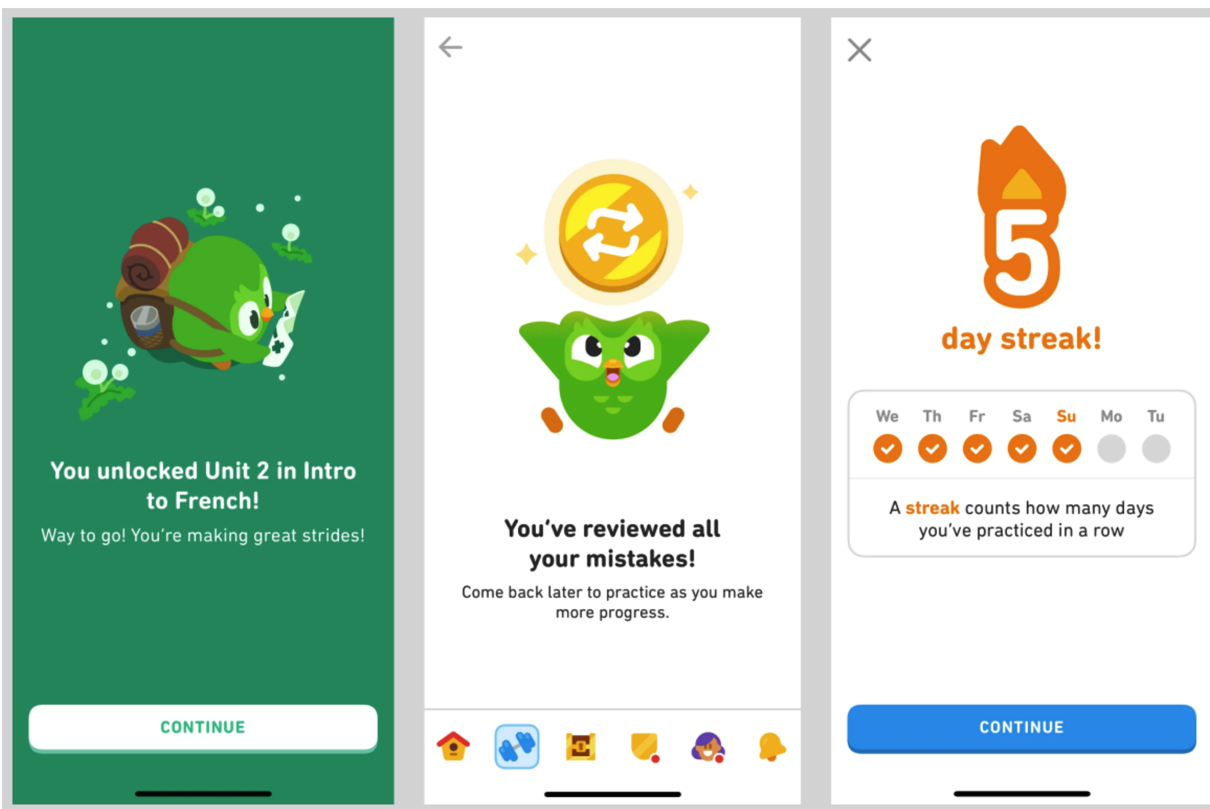


Figure 6-3. Duolingo gamified features (source: Duolingo, 2023)

Duolingo's artful capitalization on key moments doesn't end there. With Legendary Level challenges, users strive to complete timed challenges that make daily language learning more interesting. If a Legendary Level is successfully completed, the user is rewarded a new theme in the interface (Figure 6-4). These details reinforce the feeling of accomplishment and enhance the experience, creating positive mental snapshots for people that use this service.

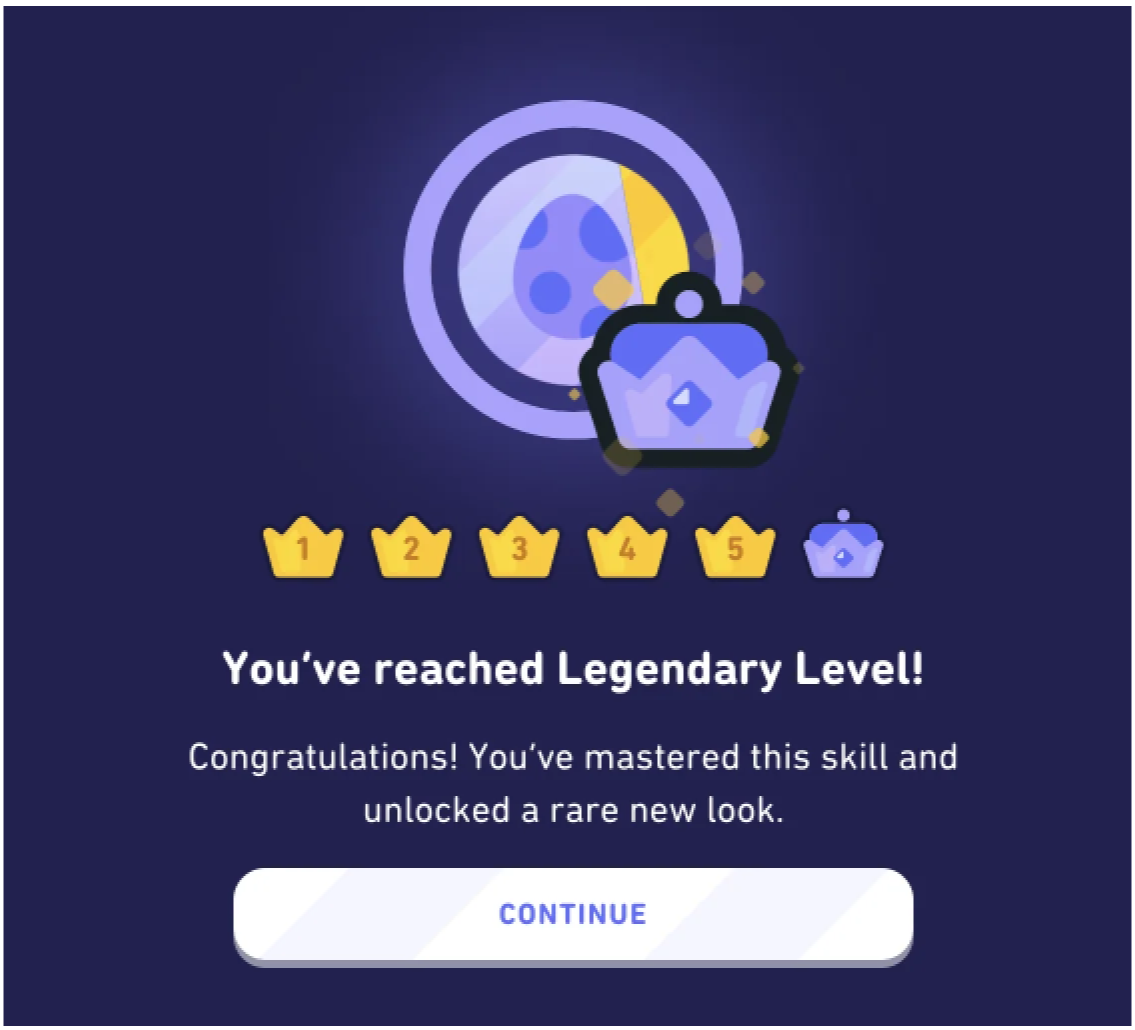


Figure 6-4. Legendary Level unlock screen (source: Duolingo, 2023)

TECHNIQUE

JOURNEY MAPPING

One handy tool for identifying the emotional peaks of end users throughout an experience is journey mapping. This qualitative exercise is invaluable for visualizing how people use a product or service through the narrative of accomplishing a specific task or goal. Journey mapping results in the creation of a design artifact (Figure 6-5) that not only helps designers and project stakeholders align to a common mental model but also creates a deeper shared understanding of the customer experience and aids in identifying the challenges and opportunities present within an experience.

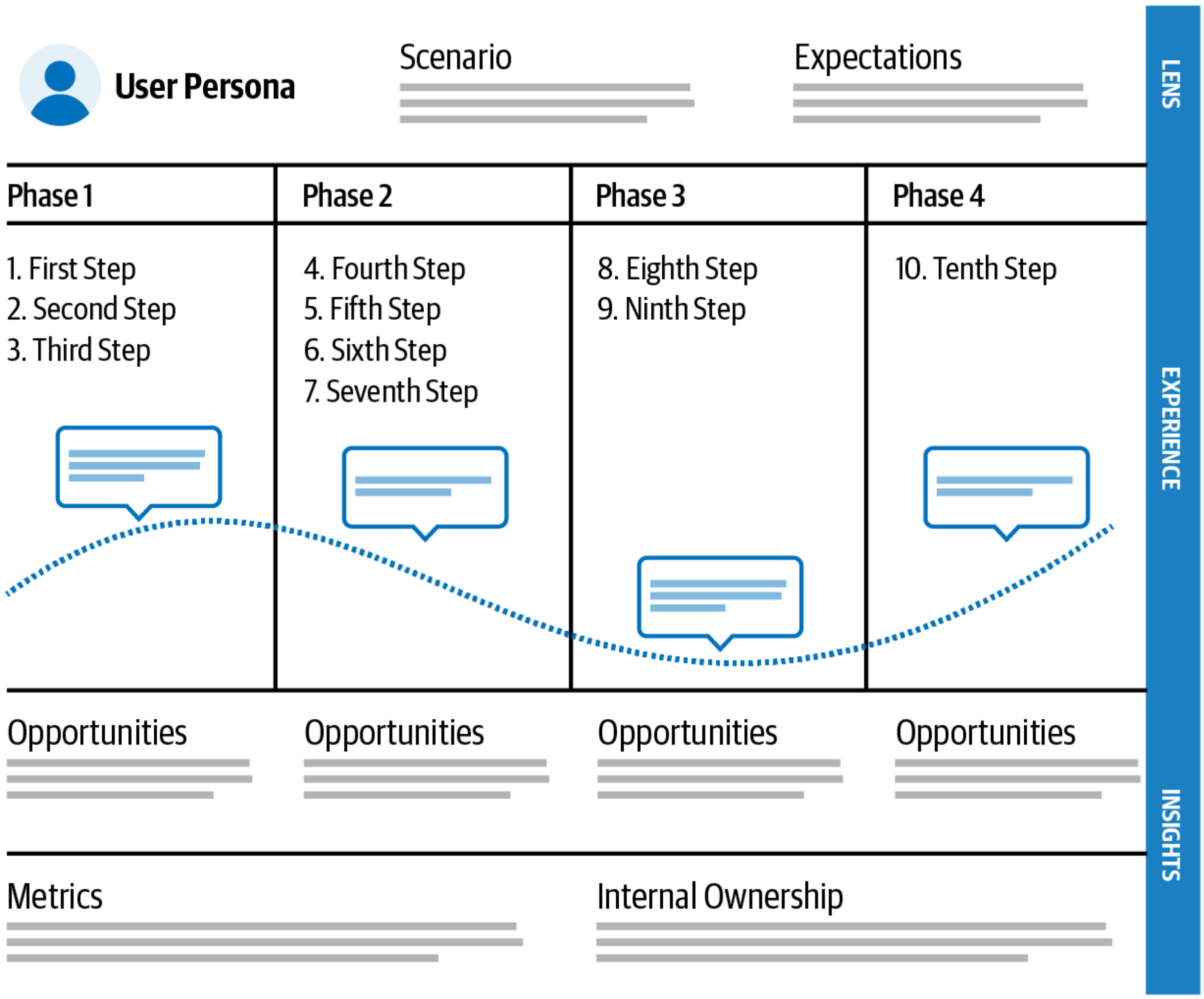


Figure 6-5. Example journey map

Like all design exercises, journey maps can and should be tailored to the purposes and goals of the project and be grounded in research that's been conducted with real users. That being said, they'll usually contain some key information:

Lens

The lens of a journey map establishes the perspective of the person the experience represents. It usually will contain the persona of the end user, which should be predefined based on research on the target audience of the product or service (see Chapter 1, “Jakob’s Law”). The lens should capture the specific scenario that the journey map is focused on. This scenario may be real, or it can be anticipated in the case of a product or service that hasn’t been launched yet. Finally, the lens usually describes the expectations of the persona in that scenario. For example, Jane (persona) is using a ride-share service app to order a ride (scenario) that she expects to arrive at her exact location in 10 minutes or less (expectation).

Experience

The next part of a journey map is the experience section, which illustrates the actions, mindset, and emotions of the end user mapped across a timeline. Starting from the top, the experience is first organized into high-level phases. Next are the actions, which define the steps that the end user must take within each phase to accomplish their task or goal. Following the actions is information pertaining to the mindset of the end user during the experience. This can vary based on what insights the journey map is aiming to uncover; it’s essentially a contextual layer of information that provides a deeper view into what the customer is thinking during each phase. Typical information captured within this layer includes general thoughts, pain points, questions, or motivations that originate from research and user interviews. Finally, there’s the emotional layer, which is usually represented as a continuous line mapped across the entire experience and which captures the emotional state of the persona during the experience. This layer is especially significant with regard to the peak–end rule, because it captures the emotional peaks of the customer.

Insights

The last part of a journey map is the insights section, which identifies the important takeaways that surface within the experience. This section usually contains a list of possible opportunities to improve the overall experience. It also typically contains a list of metrics associated with improving the experience, and details on the internal ownership of these metrics. Going back to our ride-share example, providing real-time information on the location of the vehicle after the ride is ordered can help reduce the pain point of waiting (opportunity). That feature will need to be designed and developed by the product team (internal ownership) and can be monitored according to post-ride ratings (metric).

KEY CONSIDERATION

NEGATIVITY BIAS

We have a tendency as humans not only to register negative events more readily but also to dwell on these events. This bias toward the negative leads you to pay much more attention to the bad things that happen, making them seem much more important than they really are. It is inevitable that at some point in the lifespan of a product or service something will go wrong. There might be a server failure that has a ripple effect and leads to service outages, a bug that opens up a security vulnerability, or a design decision that fails to consider all customers and leads to some unintended consequences. All of these types of situations can have an emotional effect on the people that use your product and may ultimately inform their overall impression of the experience.

We must mitigate negative peaks whenever possible and thus avoid the negativity bias associated with them. An incredibly effective way to do this is to provide guidance during the user journey that prevents users from ending up facing an error or confusing state to begin with. One place in particular that can lead to a negative experience is account creation, specifically the requirements for passwords to ensure they are secure. Rigid password rules can quickly lead to frustration just as people are excited enough about a product or service to create an account and give it a try. Mailchimp avoids this potential pain point by providing real-time validation to ensure passwords are secure while also making the rules easy to follow (Figure 6-6).

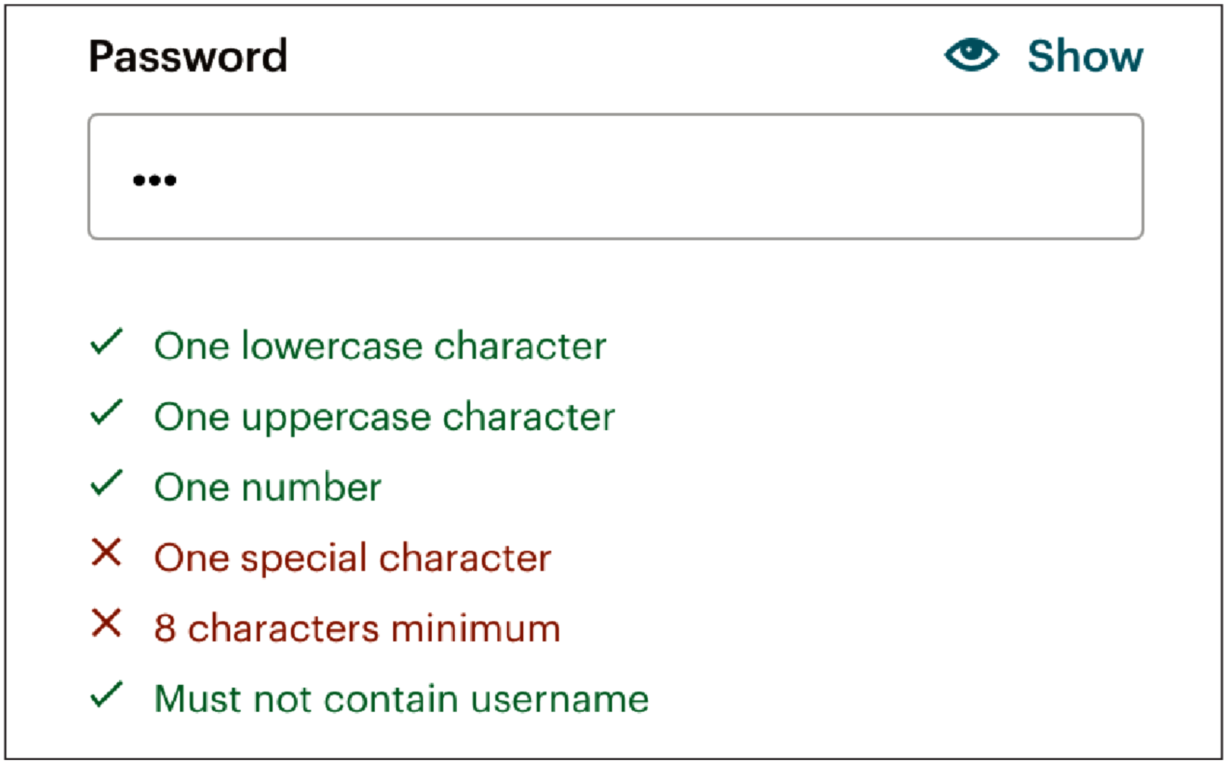


Figure 6-6. Real-time password validation (source: Mailchimp, 2023)

Setbacks can also be opportunities, however, if the right fallbacks are in place. Take, for example, the all-too-common 404 error page. When a web page can't be found, users may become frustrated, creating a negative impression. But some companies use this as an opportunity to create a rapport with their customers and enforce their brand personality by leveraging some good old-fashioned humor (Figure 6-7). It's important to note that humor can only go so far—the last thing you want to do is make a negative experience even worse. We must be mindful of context and the appropriateness of how we communicate with our users to choose the right approach.

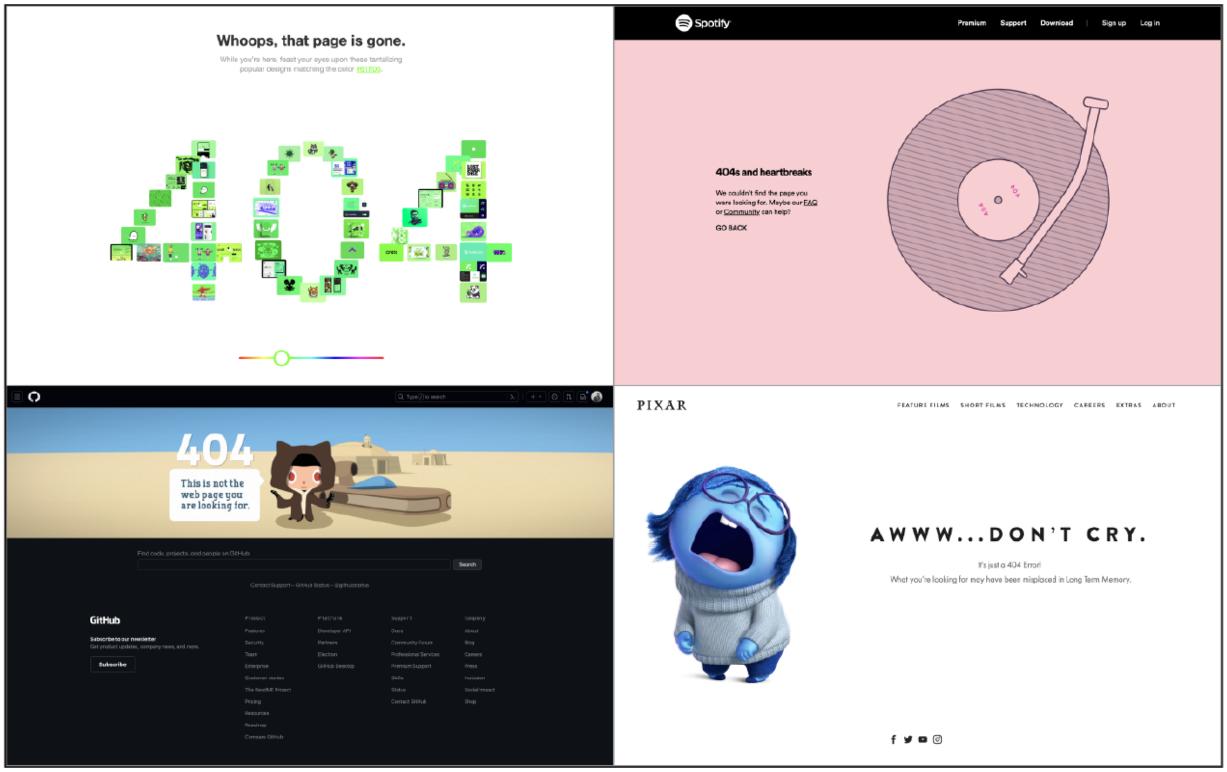


Figure 6-7. Various 404 pages that use humor and brand personality (sources [clockwise from top left]: Dribbble, Spotify, Pixar, and GitHub, 2023)

Conclusion

Our memories are rarely a perfectly accurate record of events. How users recall an experience will determine how likely they are to use a product or service again or recommend it to others. Since we judge past experiences based not on how we felt throughout the whole duration of the event but on the average of how we felt at the peak emotional moments and at the end, it is vital that these moments make a lasting good impression. By paying close attention to these key moments of an experience, we can ensure users recollect the experience as a whole positively.

[1] Daniel Kahneman, Barbara L. Fredrickson, Charles A. Schreiber, and Donald A. Redelmeier, “When More Pain Is Preferred to Less: Adding a Better End,” *Psychological Science* 4, no. 6 (1993): 401–5.

[2] Donald A. Redelmeier and Daniel Kahneman, “Patients’ Memories of Painful Medical Treatments: Real-Time and Retrospective Evaluations of Two Minimally Invasive Procedures,” *Pain* 66, no. 1 (1996): 3–8.

[3] Donald A. Redelmeier, Joel Katz, and Daniel Kahneman, “Memories of Colonoscopy: A Randomized Trial,” *Pain* 104, no. 1–2 (2003): 187–94.

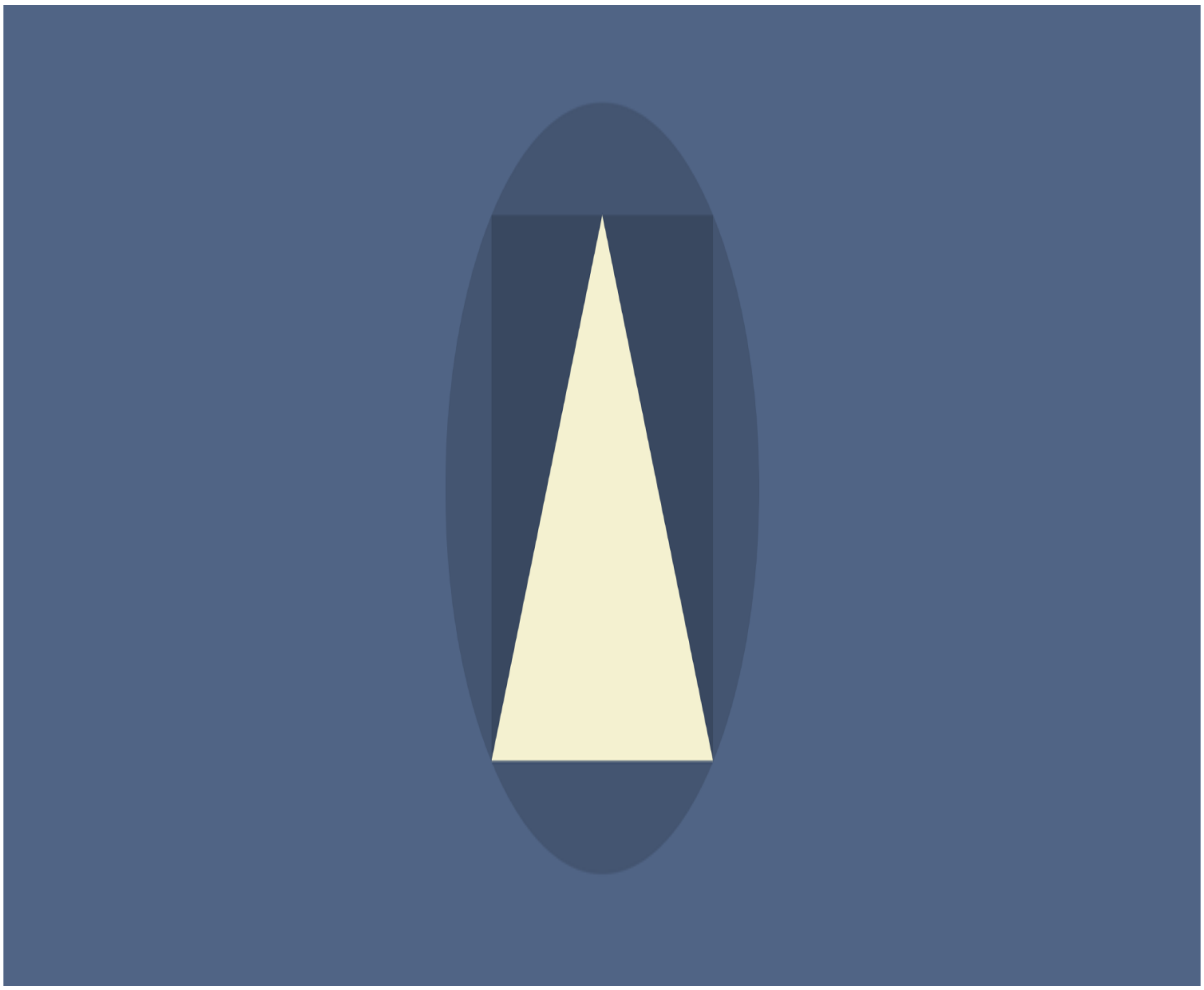
[4] Daniel Kahneman and Amos Tversky, “Subjective Probability: A Judgment of Representativeness,” *Cognitive Psychology* 3, no. 3 (1972): 430–54.

[5] Scott Plous, *The Psychology of Judgment and Decision Making* (New York: McGraw-Hill, 1993).

[6] Candice Hogan, “How Uber Leverages Applied Behavioral Science at Scale,” *Uber Engineering* (blog), January 28, 2019, *https://oreil.ly/n1csD*.

Chapter 7. Aesthetic–Usability Effect

> *Users often perceive aesthetically pleasing design as design that's more usable.*



KEY TAKEAWAYS

- Aesthetically pleasing design creates a positive response in people's brains and leads them to believe the design actually works better.
- People are more tolerant of minor usability issues when the design of a product or service is aesthetically pleasing.
- Visually pleasing design can mask usability problems and prevent issues from being discovered during usability testing.

Overview

As designers, we understand that our work is about more than just how something looks; it's also about how it works. That's not to say good design can't also be attractive design. In fact, an aesthetically pleasing design can influence usability. Not only does it create a positive emotional response, but it also enhances our cognitive abilities, increases the perception of usability, and extends credibility. In other words, an aesthetically pleasing design creates a positive response in people's brains and leads them to believe the design actually works better[1]—a phenomenon known as the aesthetic–usability effect. We use automatic cognitive processing to determine at a visceral level if something is beautiful very quickly upon first seeing it, and this extends to digital interfaces as well. First impressions do matter.

In this chapter, we'll explore the origins of this principle, learn more about how our brains interpret information based on aesthetic attractiveness, and take a look at a few examples that make use of this effect.

Origins

The origins of the aesthetic–usability effect can be traced back to a study conducted in 1995 by researchers Masaaki Kurosu and Kaori Kashimura from the Hitachi Design Center.[2] Prior to this, the relationship between aesthetics and digital interfaces had been largely unexplored. The study, which began as an attempt to investigate the relationship between inherent usability and something the researchers called "apparent usability," demonstrated the correlation between people's perceptions of ease of use and visual attractiveness.

Kurosu and Kashimura tested 26 layout patterns of ATM interfaces (Figure 7-1) with 252 participants and asked each of them to rate each design according to both functionality and aesthetics.

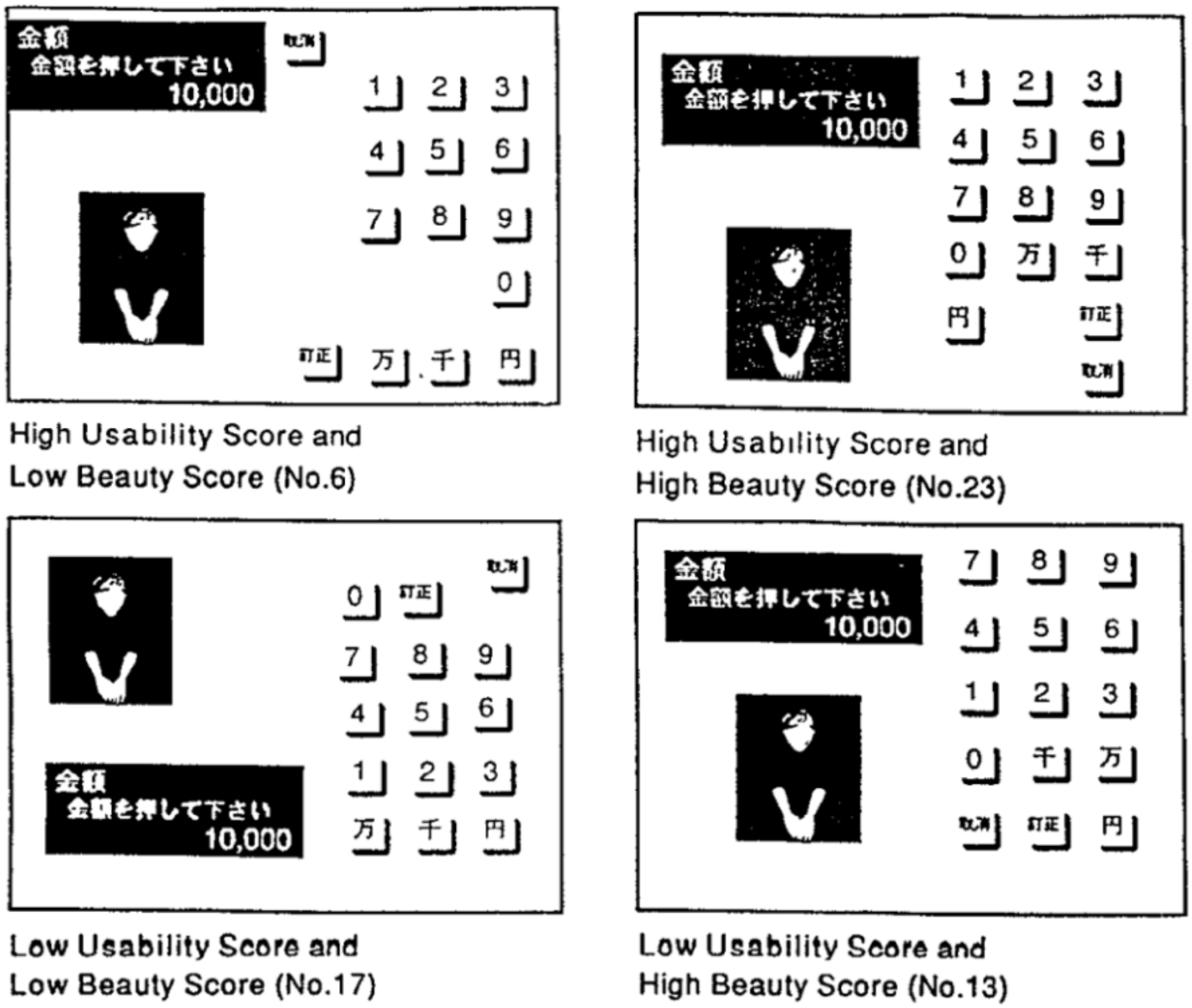


Figure 7-1. Sample layout patterns (source: Kurosu and Kashimura, 1995)

The participants used a 10-point rating scale to evaluate the usability and visual attractiveness of each design. The results showed that their perception of usability was strongly influenced by their perception of the attractiveness of the interface (Figure 7-2). In other words, apparent usability is less correlated with inherent ease of use than with apparent beauty.

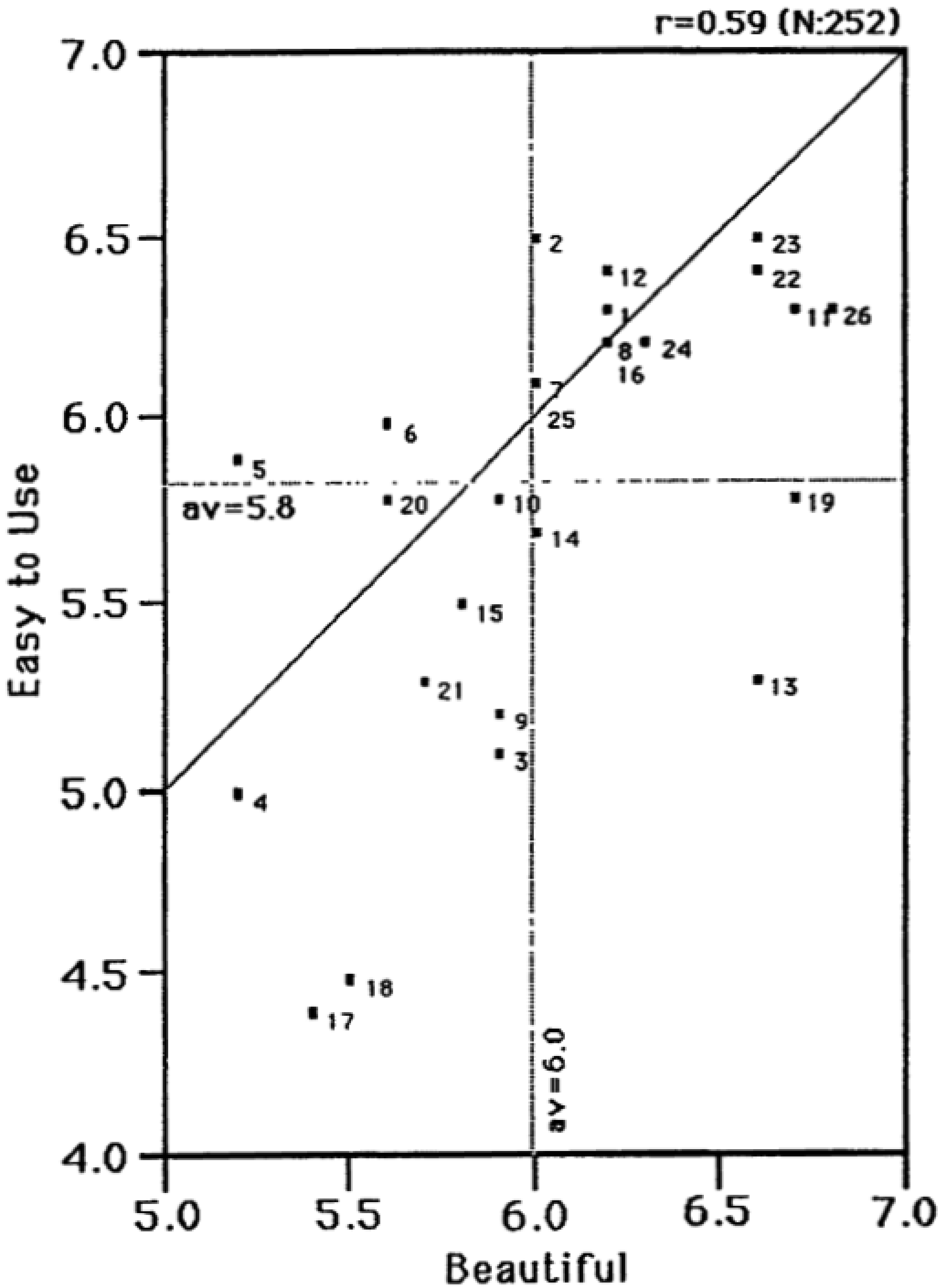


Figure 7-2. Correlation of usability with beauty (source: Kurosu and Kashimura, 1995)

Subsequent research, such as the 2000 study "What Is Beautiful Is Usable" by Noam Tractinsky et al., corroborates Kurosu and

Kashimura’s findings and further confirms that the aesthetics of the interface of a system affect users’ perceptions of the usability of the system.[3] The correlations between perceived attractiveness and other qualities (including trust and credibility) have also been explored, as have the effects of aesthetics on usability testing (see the Key Consideration “Effect on Usability Tests” later in this chapter).

PSYCHOLOGY CONCEPT

AUTOMATIC COGNITIVE PROCESSING

Contrary to what we've been taught not to do, people do in fact judge books by their covers. This isn't actually a bad thing, though—in fact, it's necessary. Automatic cognitive processing is helpful because it enables us to react quickly. Carefully processing every object around us would be slow, inefficient, and in some circumstances dangerous, so we begin to mentally process information and form an opinion based on past experiences before directing our conscious attention toward what we're perceiving. This automatic and involuntary mode of thinking stands in contrast to the slower and more deliberate mode of thinking that follows, and it's exactly what psychologist and economist Daniel Kahneman explores in his 2013 book *Thinking, Fast and Slow* (Farrar, Straus and Giroux). This psychodrama with two characters, System 1 and System 2, details the relationship between the two forms of cognitive processing and how they influence our decision making.

System 1 operates impulsively and involves little or no psychological effort. It is quick, and there is no sense of voluntary control. This mode of thinking is among the innate abilities we share with other animals, and it enables us to recognize objects, identify danger, direct our attention, avoid loss, and quickly react based on experience or prolonged practice. System 1 is the system that runs automatically and generates information (intuitions, feelings, intentions, or impressions) for System 2.

System 2 operates more slowly and requires mental effort. It is the system called upon when System 1 runs into difficulty, and it provides support in the form of more detailed and specific processing, with the goal of solving the problem at hand. This is the system of thinking that we use for complex problem solving that requires attention. Focus, research, searching memory, mathematical operations (beyond simple arithmetic), and situational awareness are all things that involve this mode of thinking.

The interaction of these two systems centers around minimizing effort and optimizing performance. System 1 handles most of what we think and do, and System 2 takes over when necessary. The implications of this when it comes to digital products and experiences are monumental. We rely on System 1 to quickly identify information relevant to our tasks and to ignore information that isn't instantly perceived to be relevant. We rapidly scan the available information in search of what will help us achieve our goal, and anything that isn't a match is passed over. When it comes to the aesthetic–usability effect, System 1 thinking is incredibly important because this is where we form first impressions. In fact, studies have shown that people form an opinion about a website within 50 milliseconds of seeing it, and that visual appeal is a primary determining factor.[4] Interestingly, the opinion formed during this brief period—the visceral response—rarely changes as users spend more time on the site. While our first impressions are not always foolproof, they usually are relatively accurate and help us to make quick decisions.

Examples

We'll start our examples of the aesthetic–usability effect by looking closely at two companies that have put aesthetics at the center of what they do. First is Braun, the German electronics company, which has made an indelible mark in the world of design and exemplifies how aesthetically pleasing products can create a lasting impression. Under the design direction of Dieter Rams, and guided by the Bauhaus philosophy of *form follows function*, the company has influenced generations of designers with its products' balance of functional minimalism and aesthetic beauty. Rams's "less but better" approach, which emphasizes form following function, has directly resulted in some of the most well-designed products ever produced.

Take, for example, the Braun SK4 record player (Figure 7-3), nicknamed “Snow White’s Coffin” due to its white metal casing and transparent lid. Constructed of powder-coated sheet metal with elmwood side panels, it stood in drastic contrast to the lavishly ornamented all-wood products more typically available to consumers at the time of its production in 1956. The SK4 was one of Braun’s first products to pioneer the company’s new contemporary industrial design language in which every detail had a functional purpose, including the plexiglass cover that resolved the rattling at higher volumes observed with metal covers. Products like this one mark a pivotal point in design history, when electronic devices went from being disguised as furniture to being presented as standalone entities that were beautiful *and* functional.

Figure 7-3. Braun SK4 record player, designed by Hans Gugelot and Dieter Rams (source: Museum of Modern Art)

Now let's take a look at an example of a brand that in many ways continues Braun's legacy of functional minimalism balanced by refined aesthetics: Apple. The influence of Braun's design philosophy on Apple's products is quite apparent. Devices such as the iPod, iPhone, and iMac echo the beautifully minimal aesthetic of Braun's product lines while focusing on ease of use (Figure 7-4).

Figure 7-4. Apple iPod (top left), Apple iPhone (top middle), Apple iMac (top right), Braun T3 pocket radio (bottom left), Braun ET44 calculator (bottom middle), and Braun LE1 loudspeaker (bottom right)

Apple's attention to aesthetics extends beyond industrial design—the brand is well known for creating interfaces that are both elegant and easy to use (Figure 7-5). In fact, its reputation in this regard has become a competitive advantage and helped to usher in a new era in which good design is fundamental to successful businesses. The attention to detail in everything the company creates has directly contributed to Apple becoming one of the most beloved brands in the world. That's not to say that its products' interfaces don't have any usability issues, but people are much more likely to overlook these issues due to the pleasing aesthetic that’s at the core of the design—the aesthetic–usability effect at work.

Figure 7-5. Screenshot of various Apple interface designs (source: Apple, 2023)

TECHNIQUE

USABILITY TESTING

A simple truth that designers (or anyone else working within a design team) must embrace in order to create more effective products and experiences is the fact that we *are not the user*. We're much too close to what we build to objectively see it and understand how users will interact with it. The best user interfaces are those that have been shaped by observations of real users and their interactions with them. So how can designers shape their work to be more effective? An incredibly effective way is with usability testing. The goal of this observational method is to uncover problems in a design, discover existing opportunities, and learn more about the behaviors and preferences of users by asking participants to engage in realistic activities. It is one of the most effective techniques for understanding how well a design will perform once it is in the hands of real users. Designers can use this method to improve their work through subsequent iterations based on the findings from representative users.

Planning the test

The first thing to do when conducting a usability test is to plan it. This includes defining the objectives, writing a test script, and finding people to take part. Begin by establishing the goals of your test and what you are trying to learn. Is the goal to ensure how well users understand a specific feature or workflow? Document your objectives and anything else that will help frame the outcome of the test. Next, write a test script based around tasks that you'd like to see users perform. You can think of these as prompts that initiate your test participants to perform specific tasks that you can observe and learn from. Finally, target and recruit representative users of the product or service you're building. Don't rely solely on usability data from your own team or company unless what you're designing is intended exclusively for them.

Conducting the test

Ask participants to perform realistic tasks using a prototype or an actual product. The tasks can be very specific or open-ended, depending on the goals of the test. It's important to remain neutral, help participants understand that they are helping you test the design and that you are not testing them, and avoid priming participants with specific text found in the design.

While you are running the test, make sure to listen intently and avoid biasing the participants. It's also common to ask participants to think out loud, which helps you to better understand their behaviors, goals, thoughts, and motivations. Be sure to measure both the speed and ease with which participants perform tasks in addition to what they say about it—how well participants perform doesn't always match their subjective rating of a task.

Finally, it is important to remember that the mere act of being observed can potentially influence participants to behave in ways that they believe are expected of them, a phenomenon known as observer bias.[5] We can mitigate its effects by emphasizing that the study is meant to test the design and not their abilities or knowledge, and that their honest feedback will be used to improve the design and will not be shared outside of the study.

Synthesizing the data

Once you've conducted the test and captured data, it's time to synthesize it into insights that can be turned into actionable next steps. Synthesis is best done as a group activity: include everyone who participated directly in the interview process. It's even better if you can involve the entire core project team; doing so will increase the team's understanding, investment, and empathy toward users from the beginning. Involving more people in the synthesis also helps to ensure more perspectives when interpreting the data and can be critical in avoiding the biases that come with a singular point of view.

Next, establish a structure for your synthesis, beginning with a summary of the goals and how the study was conducted. Make sure to document team members that helped during the study along with their roles, the details of those who participated, and how the data was gathered. Pull out quotes and observations captured during the study that indicate the participants’ goals, priorities, actions, motivations, pain points, habits, interactions, tools, or context (environment or other influencing factors). Quotes and observations should then be grouped by themes or patterns, which will in turn inform insights and their implications for the design. Make sure to look back at the problem you started with and see if the patterns you saw while doing the test help answer the questions you asked. It’s important to remember to avoid solutions during this step—the focus is on the insights you can surface in order to understand the context and needs of the user. Additionally, avoid identifying larger patterns before having gone through all the data and differentiating observations from their potential meaning.

The last step is to document the synthesis in a shareable format. Succinctness is the most effective quality to strive for, but be sure to include the research goals, methods, insights, and recommendations. Reinforce insights with specific examples from the research. Remember that research oftentimes will indicate what you should learn more about. This is a totally valid outcome, and you can use those insights as the starting point for additional research.

KEY CONSIDERATION

EFFECT ON USABILITY TESTS

The positive benefits of aesthetically pleasing design come with a significant caveat. Since people tend to believe that beautiful experiences also work better, they can be more forgiving when it comes to usability issues. Psychologists Andreas Sonderegger and Jürgen Sauer observed exactly how aesthetics affect usability tests.[6] Using a computer simulation of a mobile phone, 60 adolescents were asked to complete a number of common tasks. Two separate simulations were used that were functionally identical but differentiated by their visual attractiveness—one was visually appealing (for the time), and the other was notably unattractive (Figure 7-6).

Figure 7-6. The two prototypes employed in the experiment (source: Sonderegger and Sauer, 2010)

Sonderegger and Sauer found that not only did participants rate usability higher for the more attractive phone (the model on the left), but the visual appearance of the phone “had a positive effect on performance, leading to reduced task completion times for the attractive model.” What this study implies is that perceived aesthetic quality has the potential to mask usability issues to an extent. This effect applies even when the device isn’t actually easier to use, and it could be problematic when it comes to usability tests, where identifying issues is critical.

Keeping in mind the potential of aesthetics to influence perceived usability, it is important that we mitigate this influence by listening to what users say when evaluating the usability of an experience and, more importantly, watching what they do. Asking questions that lead participants to look beyond aesthetics can help to uncover usability issues and counter the effects that visual attractiveness can have on usability test results.

Conclusion

Aesthetically pleasing design can influence usability by creating a positive emotional response, which in turn enhances people's cognitive abilities. When this happens, users tend to believe the design actually works better and are more likely to overlook minor usability issues. While this might seem like a good thing, it can actually mask usability problems and prevent issues from being discovered during usability testing.

[1] F. Gregory Ashby, Alice M. Isen, and And U. Turken, "A Neuropsychological Theory of Positive Affect and Its Influence on Cognition," *Psychological Review* 106, no. 3 (1999): 529–50.

[2] Masaaki Kurosu and Kaori Kashimura, “Apparent Usability vs. Inherent Usability: Experimental Analysis on the Determinants of the Apparent Usability,” in *CHI ’95: Conference Companion on Human Factors in Computing Systems* (New York: Association for Computing Machinery, 1995), 292–93.

[3] Noam Tractinsky, Adi S. Katz, and Dror Ikar, “What Is Beautiful Is Usable,” *Interacting with Computers* 13, no. 2 (2000): 127–45.

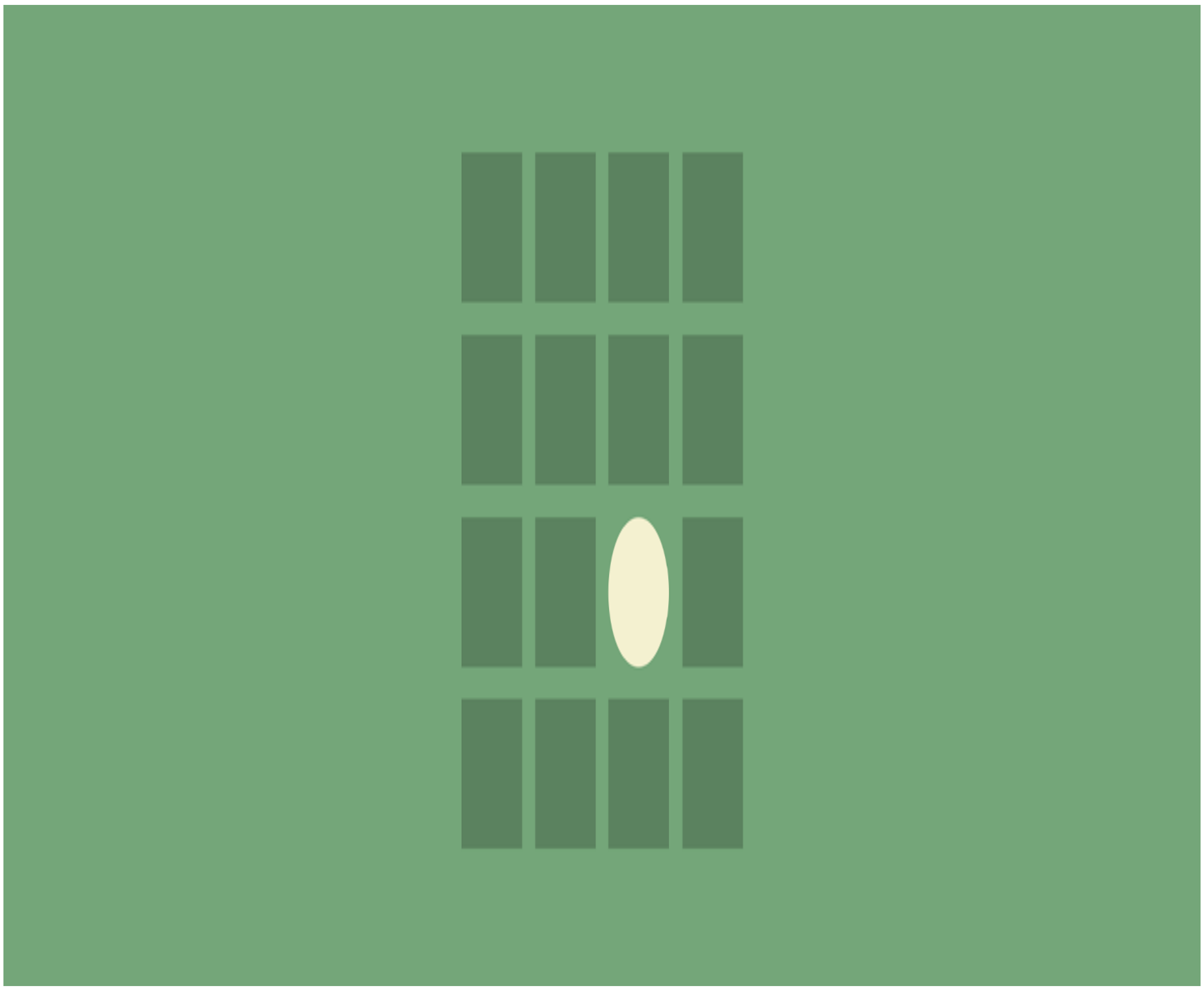
[4] Gitte Lindgaard, Gary Fernandes, Cathy Dudek, and Judith M. Brown, “Attention Web Designers: You Have 50 Milliseconds to Make a Good First Impression!,” *Behaviour and Information Technology* 25, no. 2 (2006): 115–26.

[5] Mayya Azarova, “The Hawthorne Effect or Observer Bias in User Research,” *Nielsen Norman Group*, May 21, 2023, [*https://oreil.ly/-UY6W*](https://oreil.ly/-UY6W).

[6] Andreas Sonderegger and Jürgen Sauer, “The Influence of Design Aesthetics in Usability Testing: Effects on User Performance and Perceived Usability,” *Applied Ergonomics* 41, no. 3 (2010): 403–10.

Chapter 8. Von Restorff Effect

> *When multiple similar objects are present, the one that differs from the rest is most likely to be remembered.*



KEY TAKEAWAYS

- Make important information or key actions visually distinctive.
- Use restraint when placing emphasis on visual elements to avoid them competing with one another and to ensure salient items don't get mistakenly identified as ads.
- Don't exclude users with a color vision deficiency or low vision by relying exclusively on color to communicate contrast.
- Carefully consider users with motion sensitivity when employing motion to communicate contrast.

Overview

Millions of years of evolution have given humans an incredibly sophisticated system of vision and cognitive processing. We can identify objects in fractions of a second, we possess superior pattern processing capabilities in comparison to other living things, and we have an innate ability to spot small differences in objects.[1] These traits have proven valuable for the survival of our species, and they remain with us to this day, affecting how we perceive and process the world around us. Our focus is not only dictated by the goals we seek to accomplish but also directed by these instinctual abilities.

They also affect how we encode information in memory, and therefore our ability to recall items and events at a later point—recognition is prioritized over recall. When it comes to digital interfaces, an interesting consideration is the tendency of contrasting elements to draw our attention faster. A primary challenge we have as designers is managing what users will focus on in an interface, while supporting them in achieving their goals. On the one hand, visual emphasis can be used to guide users toward a goal by capturing their attention. On the other hand, too many points of visual emphasis will compete with one another and make it harder for people to find the information they need. Color, shape, size, position, and motion are all factors that come into play in directing the attention of users, and we must carefully consider each of these when building interfaces.

Origins

The von Restorff effect is named after German psychiatrist and pediatrician Hedwig von Restorff, who found in a 1933 study employing the isolation paradigm that participants presented with a list of categorically similar items best remembered ones that were distinctly different.[2] In other words, memory is improved for items of a set that are visually or conceptually isolated from the other items. While von Restorff wasn't the first to investigate the effects of this paradigm on memory, it became closely associated with her and the study of distinctiveness. Her initial findings would later be corroborated by research, such as that by Shelley Taylor and Susan Fiske (1978), suggesting that people are drawn to salient, novel, surprising, or distinctive stimuli.[3]

PSYCHOLOGY CONCEPT

SELECTIVE ATTENTION

Simply put, humans live in a world of distraction. Every day, at any given moment, we are subjected to a plethora of sensory information. While driving, at work, when attending a social event or simply shopping online, most people have a multitude of signals competing for their attention.

Objects within our field of view might be visible, but we don't always *see* them. The reason for this is because attention plays a fundamental role in how we perceive the world around us. In order to maintain focus on information that is important or relevant to the task at hand, we often filter out information that isn't relevant. In other words, our ability to focus on the things around us is limited in terms of capacity and duration, so we focus on relevant information to the detriment of nonrelevant information. It's a survival instinct known in cognitive psychology as *selective attention*,[4] and it's critical not only to how we humans perceive the world around us but also to how we process sensory information in critical moments that could mean the difference between life and death.

As we saw in Chapter 3's discussion of Miller's law and the capacity of short-term memory, attention is also a limited resource. Though there are different ways of conceptualizing memory and attention, there is broad agreement in the psychological community that working memory is closely related to attention.[5] The implications of this with regard to digital products and services is significant, since the interfaces people interact with must guide their attention, prevent them from being overwhelmed or distracted, and help them in finding the relevant information or action.

One example of selective attention that is common in digital interfaces is the user behavior known as *banner blindness*. Banner blindness describes the tendency for people to ignore elements that they perceive to be advertisements, and it is a strong and robust phenomenon that's been documented across three decades.[6] When you consider banner blindness in the context of our limited capacity for attention, it makes sense that we'd ignore anything that we don't typically find helpful (e.g., digital ads). Instead, people are more likely to search for items that help them achieve their goals—especially design patterns such as navigation, search bars, headlines, links, and buttons (as Jakob's law dictates, they will also instinctively look for these items in common locations). Even legitimate content elements may be ignored if they remotely resemble ads or are placed in close proximity to them. Therefore, it's good to be aware that, when visually differentiating content, we might inadvertently lead to it being mistaken for an ad.

Related to banner blindness is *change blindness*, which describes the tendency for people to fail to notice significant changes when they lack strong enough visual cues, or when their attention is focused elsewhere.[7] Since our attention is a limited resource, we often ignore information we deem irrelevant in order to complete tasks efficiently. Because our attention is focused on what appears to be most salient, we may overlook even major differences introduced elsewhere. If it’s important that the user be aware of certain changes to the interface of a product or service, we should take care to ensure that their attention is drawn to the elements in question.

Examples

As you can imagine, examples of the von Restorff effect can be found in every digital product and service, some of which make use of it more effectively than others. The need to make specific elements or content visually distinct is fundamental in design. When this technique is used sparingly and strategically, the contrast that it affords not only helps draw attention but also directs people to the most valuable information.

A common example of this visual phenomenon can be found in the design of interactive elements such as buttons, text links, and the like. The visual differentiation of these elements can help draw people's attention and inform them of the actions available to them, guiding users in completing tasks and preventing them from taking actions they didn't intend to. To demonstrate, take a look at the example in Figure 8-1, which depicts two versions of a confirmation modal: one with buttons that are visually indistinct from one another, and another with emphasis placed on the most important button. The lack of visual contrast in the modal on the left could easily lead to people accidentally selecting the wrong action. By placing a visual emphasis on the destructive action, the version on the right not only will help guide users who want to delete their accounts to the correct option but also will help those who don't intend to delete their accounts avoid accidentally selecting this option. For extra safety, there is also a warning icon included in the header of the modal on the right to help draw attention and communicate the importance of the content within the modal.

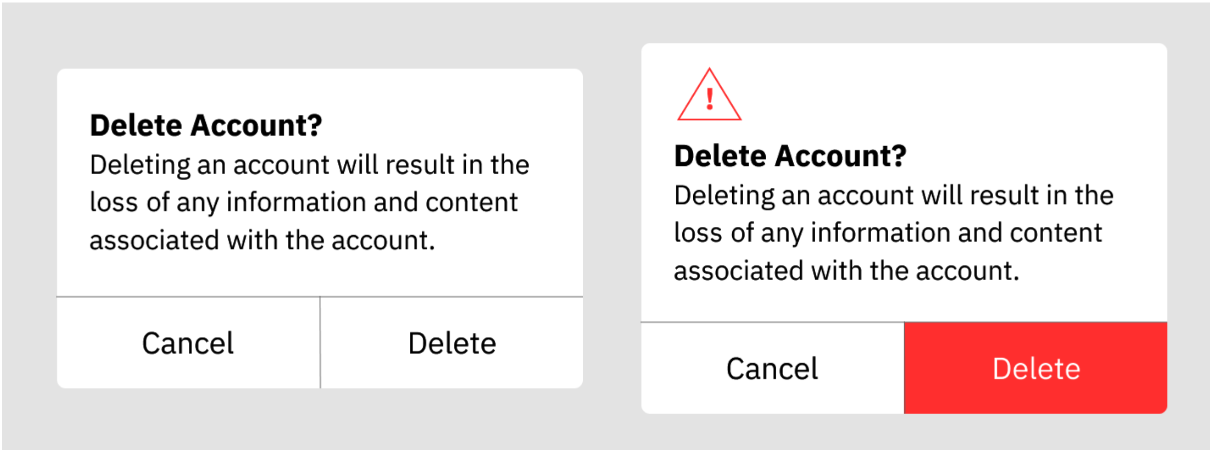


Figure 8-1. Example of how contrast can be used to draw attention to important actions and help users avoid accidentally selecting the wrong option

Let's take the button example a step further and look at an interface that moves beyond the simple use of color to create contrast. The floating action button (FAB), a design pattern introduced by Google's Material Design (Figure 8-2), "performs the primary, or most common, action on a screen." By providing guidelines around the design of this element, its placement on the screen, and what actions it should perform, Google ensures its consistency across various products and services. As a result, it has become a familiar pattern that people recognize and that therefore helps to guide their experience (so this is also an example of Jakob's law in action).

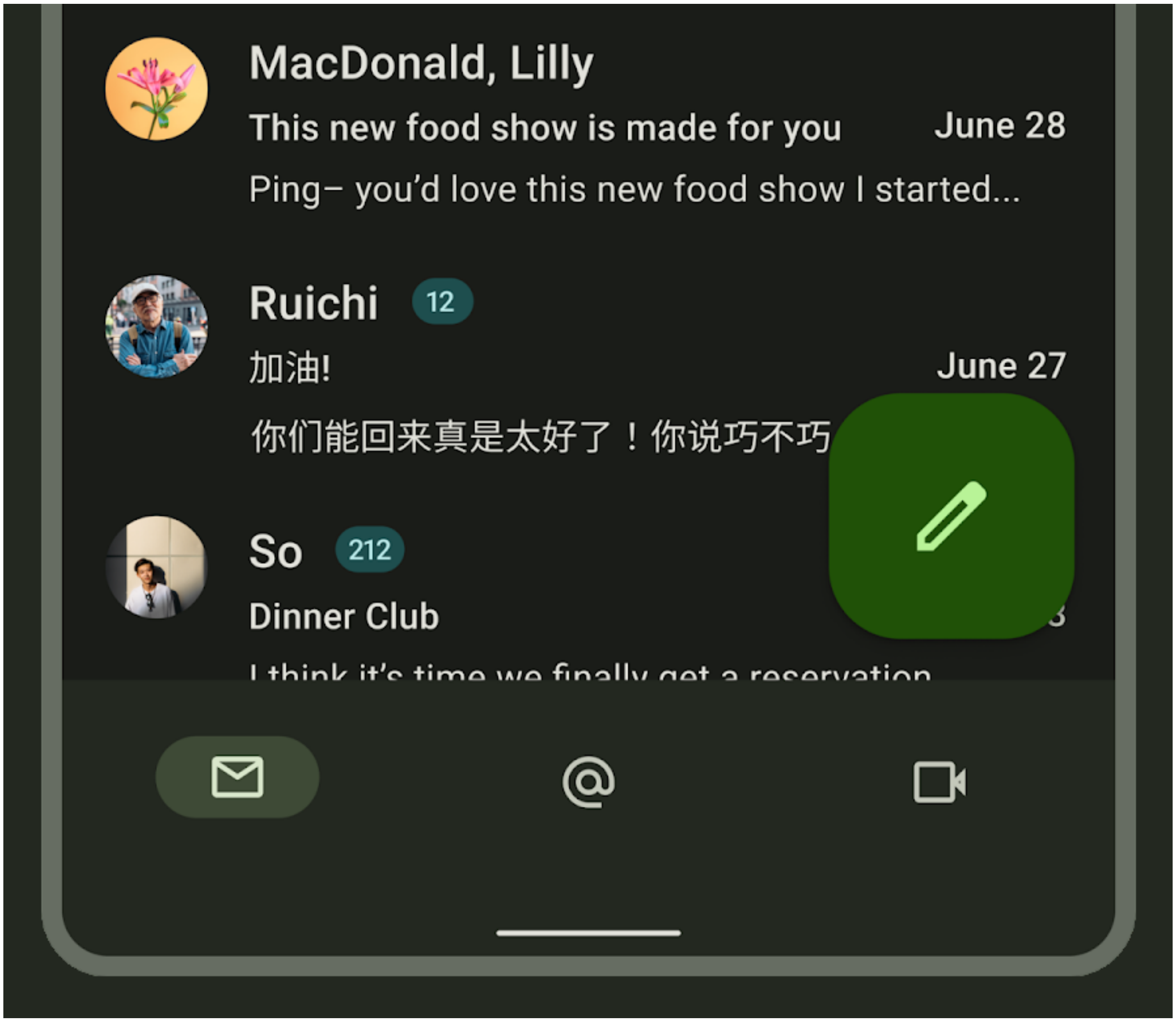


Figure 8-2. Examples of the floating action button from Material Design (source: Google's Material Design, 2023)

Another common example of the von Restorff effect can be found in pricing tables. Subscription plans are available for most of the services we use, and often companies will emphasize one option over the others. To achieve this emphasis, designers frequently differentiate the option they want to call out by adding visual cues. Take, for example, Notion, which places emphasis on the "Plus" option

(Figure 8-3) through the use of color (the darker color is applied to the “Get started” button), shape (the card appears slightly larger due to the “Most popular” element at the top), and position (placing the card close to the center of the display).

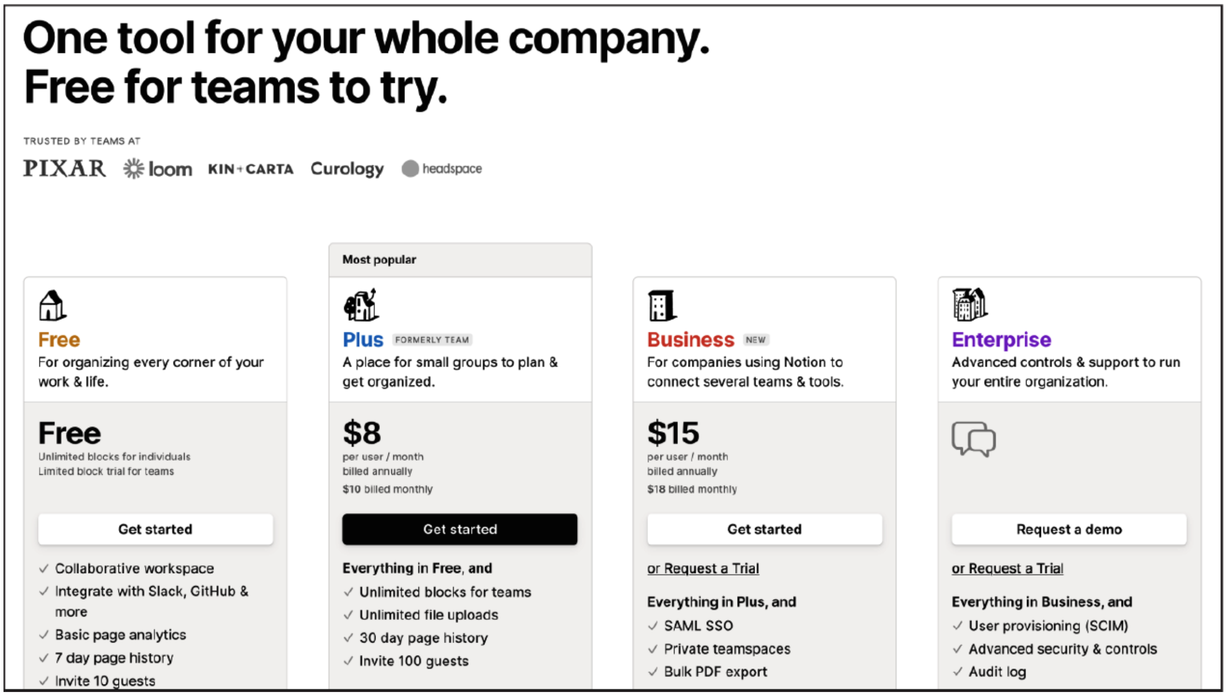


Figure 8-3. An example of the von Restorff effect in a pricing table (source: Notion, 2023)

The von Restorff effect can also be seen in design elements intended to grab our attention. Take notifications, for example (Figure 8-4), which are meant to inform users when something requires them to take action. These ubiquitous elements can be found in almost every app or service and are designed to grab our attention, for better or worse.

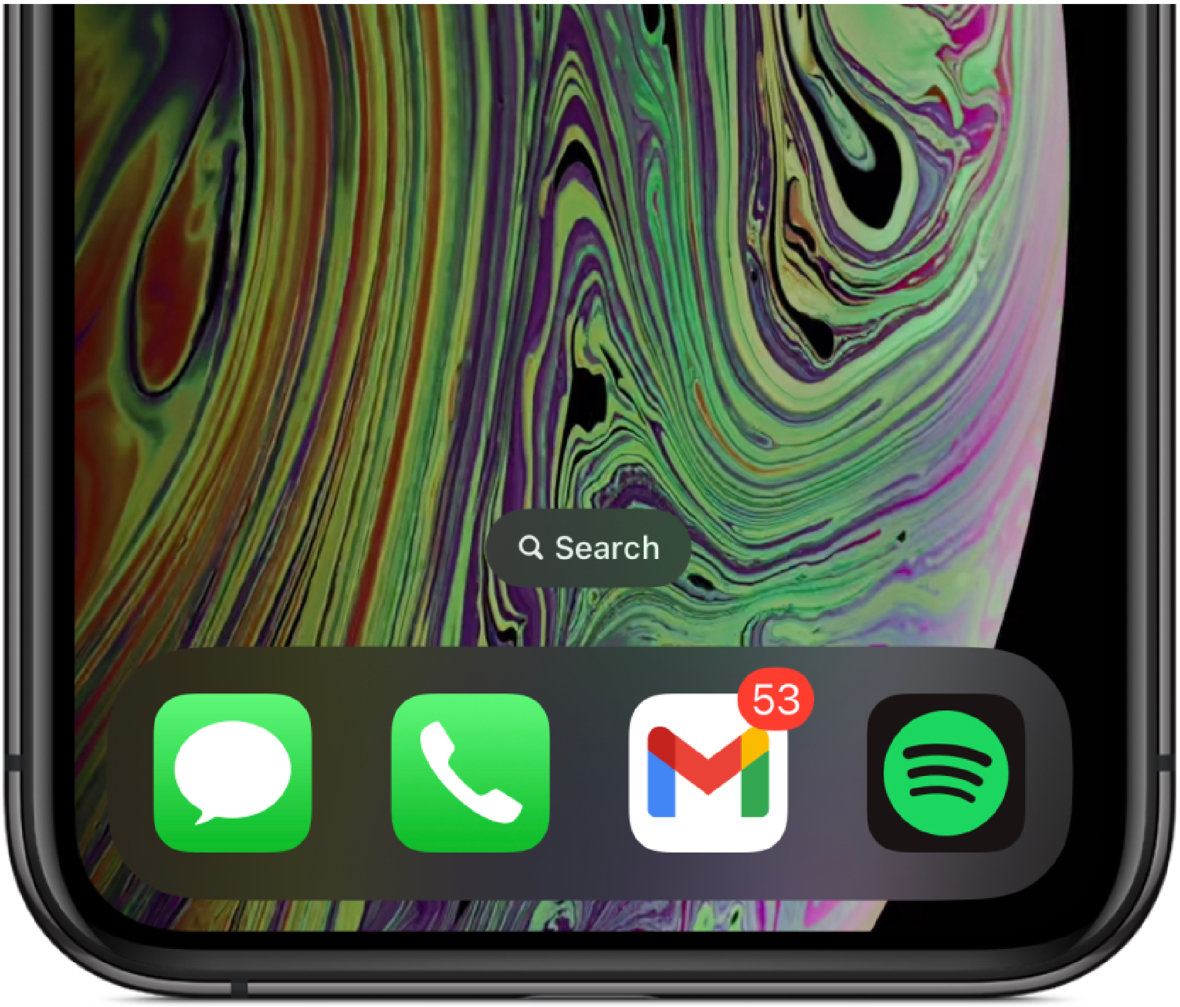


Figure 8-4. Employing the von Restorff effect to call attention to notifications (source: iOS, 2023)

We can extend the thinking behind the von Restorff effect and apply it to design going beyond singular elements as well. Take, for example, news websites, which commonly place emphasis on featured content in order to make it stand out against lots of other headlines, images, and ads (Figure 8-5). The consistent pattern you'll notice on these websites is the use of scale to create contrast between the featured content and adjacent content. The reader's attention is drawn to the information that breaks out of the implied columns of content.

As these examples illustrate, visual contrast can be created in many ways. Color is a common way to differentiate elements, but it is by no means the only way to create contrast. Scale, shape, negative space, and motion are additional properties that can make specific elements or content stand out in comparison to adjacent information.

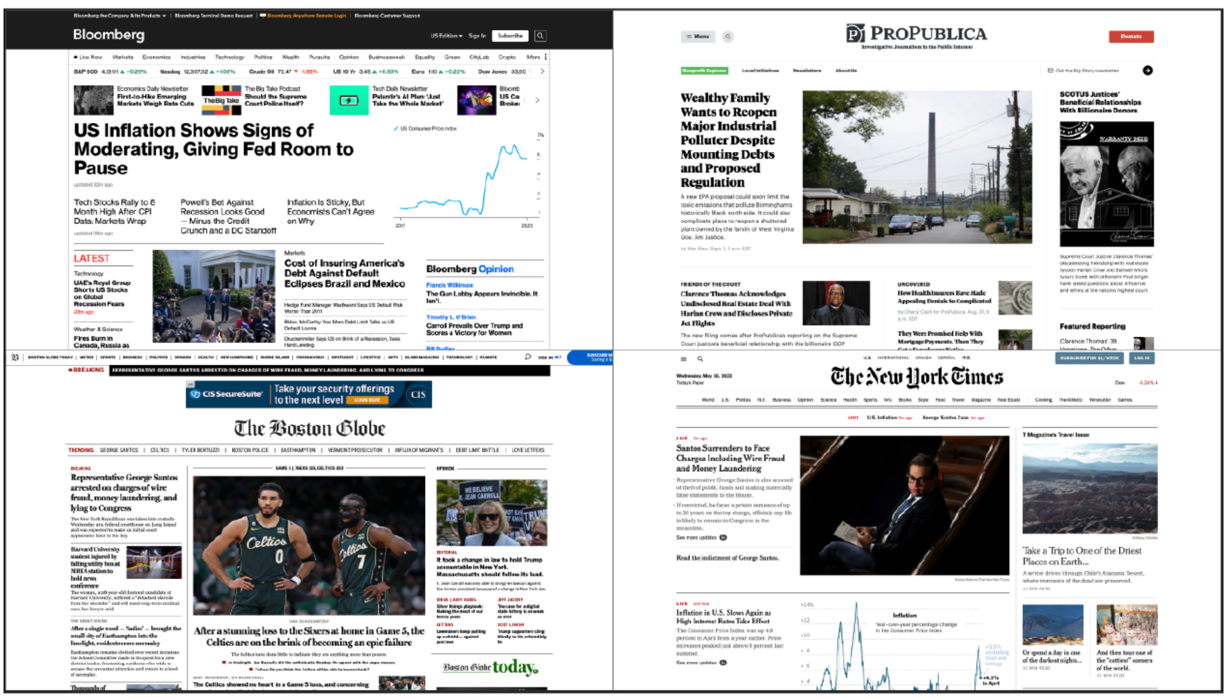


Figure 8-5. News websites often use scale to emphasize featured headlines (sources [clockwise from top left]: Bloomberg, ProPublica, the New York Times, and the Boston Globe, 2023)

KEY CONSIDERATION

ACCESSIBILITY

The topic of accessibility warrants an entire book on its own, but I'll highlight some key visual aspects when it comes to making information, activities, and environments usable for as many people as possible. It's crucial to have an awareness of which visual properties you are using to create contrast and how they affect different people:

Color Contrast

Take, for example, people with color vision deficiency, who are unable to distinguish certain shades of color (or, in some cases, see any color). Vision impairments such as cataracts can also affect how people perceive detail and difference, causing them to miss subtle differentiations between elements. It's important that we ensure sufficient color contrast exists between foreground and background elements to help those who have trouble seeing specific colors or have an impairment that results in low vision.

Color contrast is particularly important with text—a higher contrast ratio between text and background makes it easier for people with low vision to read while also improving the reading experience for people with normal vision. According to the Web Content Accessibility

Guidelines (WCAG), the color contrast ratio between text and its background should be at least 4.5:1. For larger text (at least 18 pt) or bold text (at least 14 pt), the ratio is a bit more lenient at 3:1.[8]

Visual Cues

Relying solely on color to communicate visual contrast, signify interactive elements, or indicate visual feedback is problematic for individuals with color blindness or low vision. It’s important to use additional visual cues such as strokes, patterns, and shape to differentiate elements and make interactive elements easily identifiable. Take, for example, focus indicators, which are usually identifiable via the thick-weight line around the in-focus element. These visual indicators help those who navigate using a keyboard and are commonly applied to links, form fields, widgets, buttons, and menu items to ensure a clear indication of focus.

Moderation

Finally, it’s important to consider when and how often contrast should be created—it should be used with intention and not be overused. The only thing worse than no contrast is way too much of it, which not only can dilute the power of the elements or content that you intended to stand out but can also visually overwhelm people. It’s wise to use restraint when placing emphasis on visual elements to ensure they don’t compete with each other.

The importance of moderation is even clearer when we take into account factors such as banner blindness and change blindness. If the visual emphasis on content causes the content to be mistakenly identified as an advertisement, then it’s likely to be ignored. Additionally, if too many items are emphasized, people are less likely to notice important information or changes that occur: they may either be distracted or automatically tune out the “noise.”

Contrast is also sometimes provided through the use of motion, but it’s important to consider how this might affect users with a vestibular disorder, or with any disease, damage, or injury to the system connected to the inner ear and brain that processes the sensory information involved with controlling balance and eye movements. Take, for example, those with benign paroxysmal positional vertigo (BPPV) or labyrinthitis, in whom motion can trigger dizziness, nausea, headaches, or worse. In addition, motion can affect those with epilepsy and migraine sensitivities. We must carefully consider when and how we use motion in our designs to ensure users with motion sensitivity aren’t negatively affected.

EYE TRACKING

Eye tracking is a research technique used in user experience design to measure and analyze where users look and how they interact with digital interfaces or physical objects. By using specialized hardware and software, eye-tracking studies can provide valuable insights into user behavior, preferences, and cognitive processes. These insights include where users look, how they navigate, what they ignore, and their emotional responses. Eye tracking provides objective data that is less prone to biases and errors, captures rich insights about user behavior, helps improve usability, and is cost-effective due to its compatibility with remote and scalable studies.

Common types of eye-tracking studies include heat map, gaze plot, fixation duration, attentional bias, and comparative studies. The type of study chosen depends on the research question and goals of the study, as well as the characteristics of the interface or object being studied. The following steps are typically involved in conducting an eye-tracking study:

1. *Define the research question*

   Identify the research question or hypothesis that the study aims to answer.

2. Select the participants

Choose a sample of participants that is representative of the target user group.

3. Set up the equipment

Set up the eye-tracking hardware and software, and calibrate the system for each participant.

4. Develop the stimuli

Create stimuli, such as digital interfaces, websites, or physical objects, that participants will interact with during the study.

5. Conduct the study

Participants interact with the stimuli while their eye movements are recorded.

6. Analyze the data

Analyze the eye-tracking data to answer the research question or hypothesis.

7. Interpret the results

Interpret the results and draw conclusions about user behavior, preferences, and cognitive processes.

Eye tracking is a powerful tool for understanding user behavior, but it has limitations, such as limited context, interference, limited sample size, limited stimuli, cultural differences, and technical limitations. It is recommended that eye tracking be used in conjunction with other research methods to gain a complete understanding of user behavior. Additionally, its limitations and potential sources of bias should be carefully considered and minimized.

Conclusion

The von Restorff effect is a powerful guideline for how to use contrast to direct people's attention to the most relevant content. It can help to inform our design decisions when we want to place emphasis on critical or important actions or information, and help to ensure that users of our products and services can quickly identify what they need to achieve their goals. Contrast can also become problematic when not used with restraint. When designers differentiate elements visually, the effect is to draw the user's attention. If too many elements are visually competing with each other, their power is diluted and they no longer stand out among the other elements. Additionally, we must be aware of how visual properties we use to create contrast are perceived by those with vision deficiencies and how those properties might affect people with motion sensitivities.

Mark P. Mattson, “Superior Pattern Processing Is the Essence of the Evolved Human Brain,” *Frontiers in Neuroscience* 8, no. 8 (2014): 265.

Hedwig von Restorff, “Über die Wirkung von Bereichsbildungen im Spurenfeld,” *Psychologische Forschung* 18 (1933): 299–342.

Shelley E. Taylor and Susan T. Fiske, “Salience, Attention, and Attribution: Top of the Head Phenomena,” in *Advances in Experimental Social Psychology*, vol. 11, ed. Leonard Berkowitz (New York: Academic Press, 1978), 249–88.

Jakob Nielsen, “Tunnel Vision and Selective Attention,” Nielsen Norman Group, August 26, 2012, *https://oreil.ly/8OHG-*.

Klaus Oberauer, “Working Memory and Attention—A Conceptual Analysis and Review,” *Journal of Cognition* 2, no. 1 (2019): 36.

Kara Pernice, “Banner Blindness Revisited: Users Dodge Ads on Mobile and Desktop,” Nielsen Norman Group, April 22, 2018, *https://oreil.ly/d1wTo*.

Raluca Budiu, “Change Blindness in UX: Definition,” Nielsen Norman Group, September 23, 2018, *https://oreil.ly/UAtMz*.

“Understanding Success Criterion 1.4.3,” World Wide Web Consortium, September 2023. *https://oreil.ly/GfD4i*.

Chapter 9. Tesler’s Law

> *Tesler’s law, also known as the law of conservation of complexity, states that for any system there is a certain amount of complexity that cannot be reduced.*

KEY TAKEAWAYS

- All processes have a core of complexity that cannot be designed away and therefore must be assumed by either the system or the user.
- Ensure as much as possible of the burden is lifted from users by dealing with inherent complexity during design and development.
- Take care not to simplify interfaces to the point of abstraction.

Overview

Who should bear the burden of complexity within an application or a process—the user, or the designers and developers? This is a fundamental question when considering the design of user interfaces and, more broadly, how humans interact with technology. A key objective for designers is to reduce complexity for the people who use the products and services we help to build, yet there is some inherent complexity in every process. Inevitably, we reach a point at which complexity cannot be reduced any further but can only be transferred from one place to another. At this point, it finds its way either into the user interface or into the processes and workflows of designers and developers.

Origins

The origins of Tesler's law can be traced back to the mid-1980s, when Larry Tesler, a computer scientist at Xerox PARC, was helping to develop the language of interaction design—a set of principles, standards, and best practices for defining the structure and behavior of interactive systems that was key to the development of the desktop computer and desktop publishing. Tesler realized that interface consistency would benefit not only users but also developers because standards could be encapsulated in shared software libraries. It was later in his career, while working on the Mac app object-oriented framework at Apple, that Tesler created an intermediate "generic application" that enabled developers to build their own applications by modifying the generic application in an object-oriented way. Tesler defined the law of conservation of complexity as a way to sell the idea to Apple management and independent software vendors with the express purpose of establishing standards in mass-market software, but also, more importantly, to reduce complexity for customers. Tesler reasoned that “if a million users each waste a minute a day dealing with complexity that an engineer could have eliminated in a week by making the software a little more complex, you are penalizing the user to make the engineer’s job easier.”[1]

PSYCHOLOGY CONCEPT

COMPLEXITY BIAS

In Chapter 6 we talked about *cognitive bias*, which serves as a mental shortcut that increases our efficiency by enabling us to make quick decisions without the need to thoroughly analyze a situation. In essence, cognitive bias helps us reserve mental energy so we can use it when it matters most, e.g., for complex problem solving, creative thinking, etc. We get an incredible amount of benefit from our cognitive bias, but there are some downsides as well: it often leads to errors in memory, judgment, and decision making.

Complexity bias is our tendency to favor complex and intricate solutions over straightforward ones, often because complexity is associated with intelligence, expertise, or depth of understanding.[2] Simply put, we often give undue credit to complex concepts or view something that is easy to understand as complex and difficult when we are confused or haven't taken the time to truly understand it. This fallacy was clearly demonstrated in a 1989 paper by Hilary H. Farris and Russell Revlin that studied how people make hypotheses.[3] In one experiment, participants were given three numbers and asked to figure out a rule. They could ask if other number sequences followed the same rule, but the real rule was simple: list three numbers that go up. The participants could have said anything like “1, 2, 3” or “3, 7, 99” and been correct. Most didn’t guess it was that simple, opting instead for more complicated rules.

Our inherent bias toward complexity can be especially problematic when we design because it can lead to more complex solutions. When we opt for more complex solutions, we sidestep the need to understand the underlying problem. The more complexity and assumptions a solution has, the greater the chance of failure. When we find ourselves favoring a more complex solution, it’s a good sign that we don’t have enough information or that we need to better understand the underlying problem. In these instances, we can avoid making unfounded assumptions and/or overly complex solutions by spending more time with the problem and deepening our understanding through observation and experience.

Examples

One common way to illustrate Tesler’s law is through the humble email. When you write an email, there are two required pieces of information: who the message is from (you), and to whom it should be sent. The email cannot be sent if either of these is missing, and therefore it’s a necessary complexity. To reduce this complexity, a modern email client will do two things: pre-populate the sender (it can do this because it is aware of your email address), and provide suggestions for the recipient as you begin to type their address, based on prior emails and/or your contacts (Figure 9-1). The complexity isn’t entirely gone; it’s just abstracted away to reduce the effort required of the user. In other words, the experience of writing an email is made a little simpler by moving the complexity of filling in the sender’s and, if possible, the recipient’s address to the email client, which was designed and developed by a team that assumed that burden of complexity when building it.

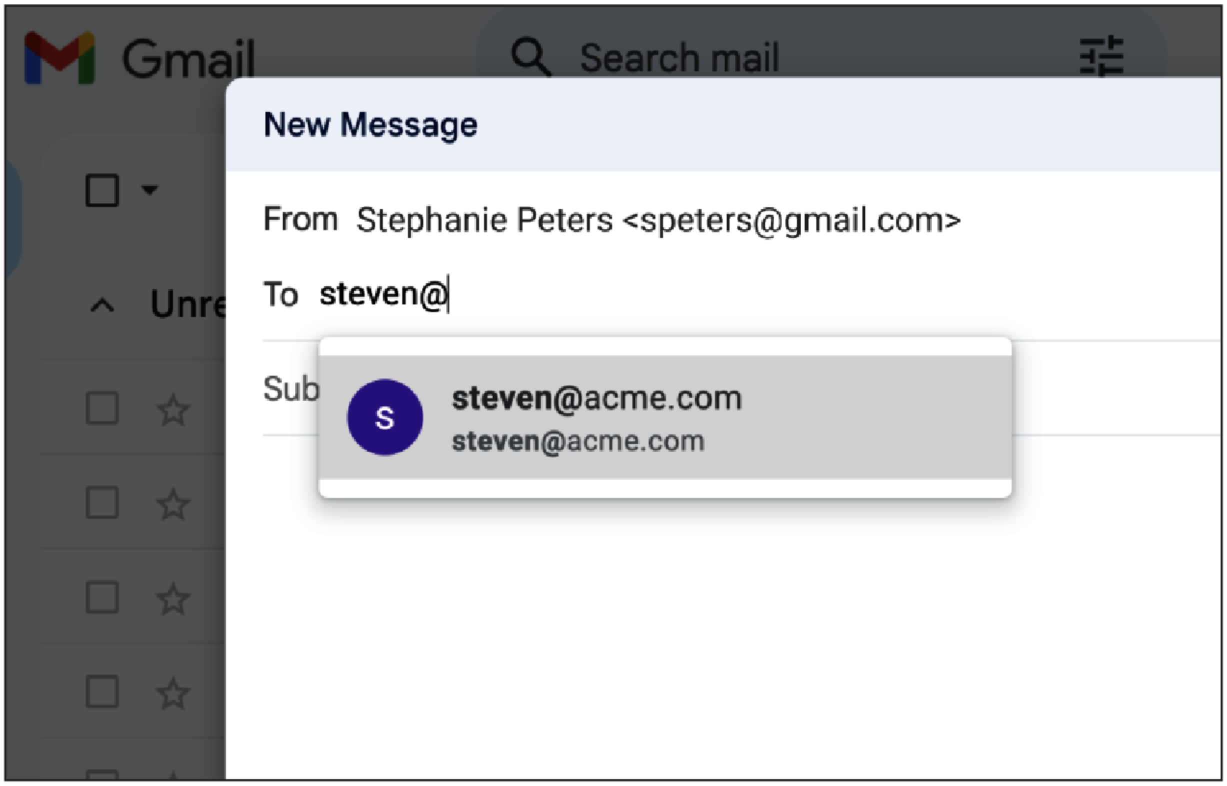


Figure 9-1. Modern email clients reduce complexity by populating the "from" line and suggesting the "to" line based on prior emails (source: Gmail, 2023)

Taking that a step further, Gmail now leverages artificial intelligence (AI) within your emails through a feature called *Smart Compose* (Figure 9-2). This intelligent feature can scan what you've typed and use that content to suggest words and phrases to finish your sentences, thus saving you additional typing and time. It should be noted that Smart Compose is not the first time-saving feature introduced to Gmail by way of AI—there's also *Smart Reply*, which scans an email for context and suggests several relevant quick-reply options.

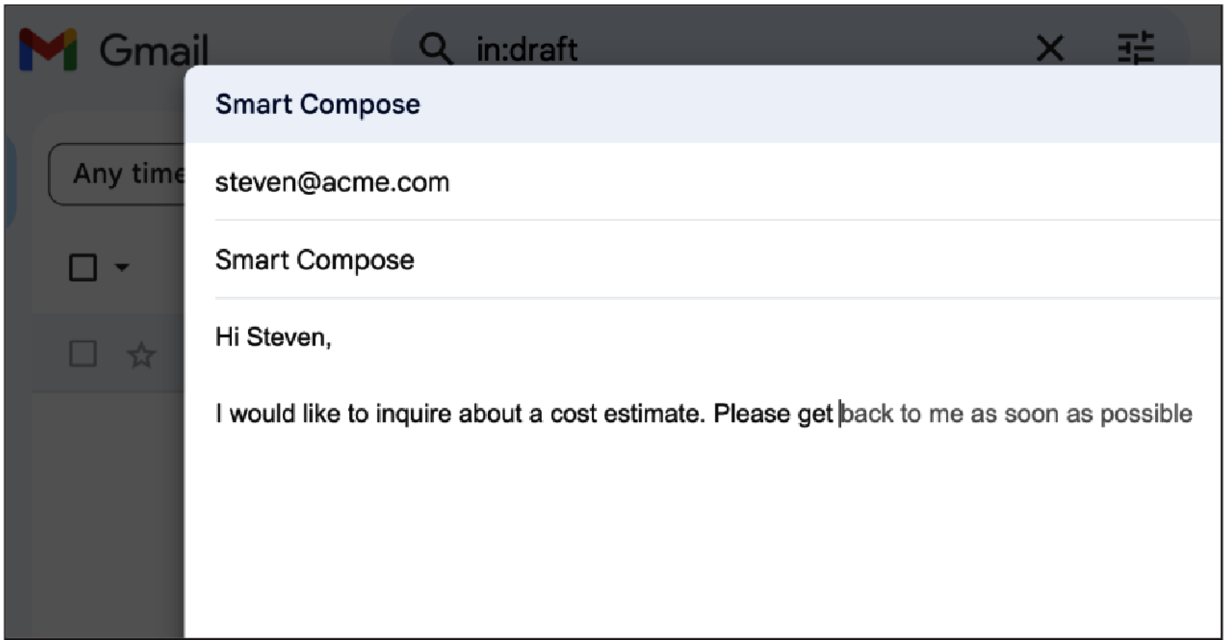


Figure 9-2. Example of Gmail's Smart Compose feature (source: Gmail, 2023)

Another place that Tesler's law can commonly be observed is in the ubiquitous checkout process found on online shopping sites. Purchasing items online requires customers to provide lots of repetitive information, including billing and shipping details. To simplify this process for customers, it is common to see online stores enable users to have their shipping address inherit the information from their billing address (Figure 9-3). This option simplifies the checkout process for customers in many cases because it prevents them from having to enter duplicate information for shipping. The resulting experience for customers has been effectively simplified, while the complexity required to enable the feature has shifted to the designers and developers responsible for implementing it up front. Simplifying the checkout process even further are services such as Apple Pay (Figure 9-4), which makes paying for items both online and in person even easier for customers. Once they've set up an account, people using Apple Pay or similar payment services can purchase items simply by selecting the option during checkout and verifying the details of their purchase—no need to enter any additional information. The customer experience thus becomes significantly less complex, with the complexity again shifted to the designers and developers responsible for the service.

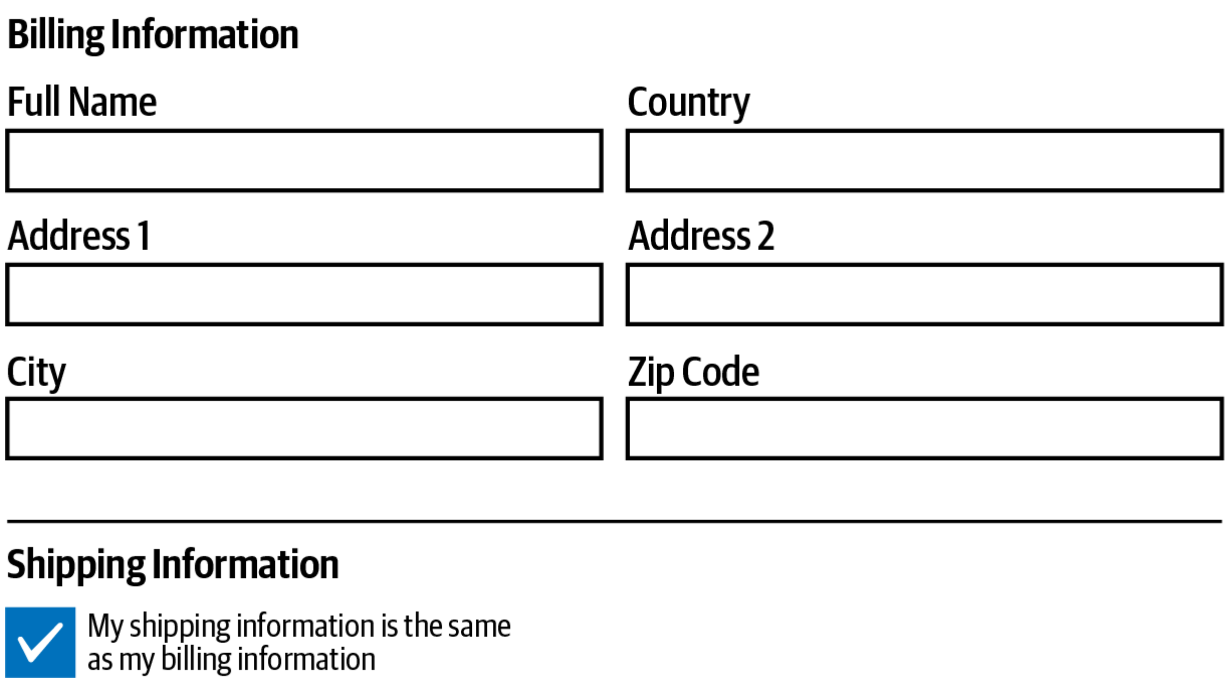


Figure 9-3. The ability to inherit a shipping address from billing details within an ecommerce checkout simplifies the process and removes the need to type redundant information

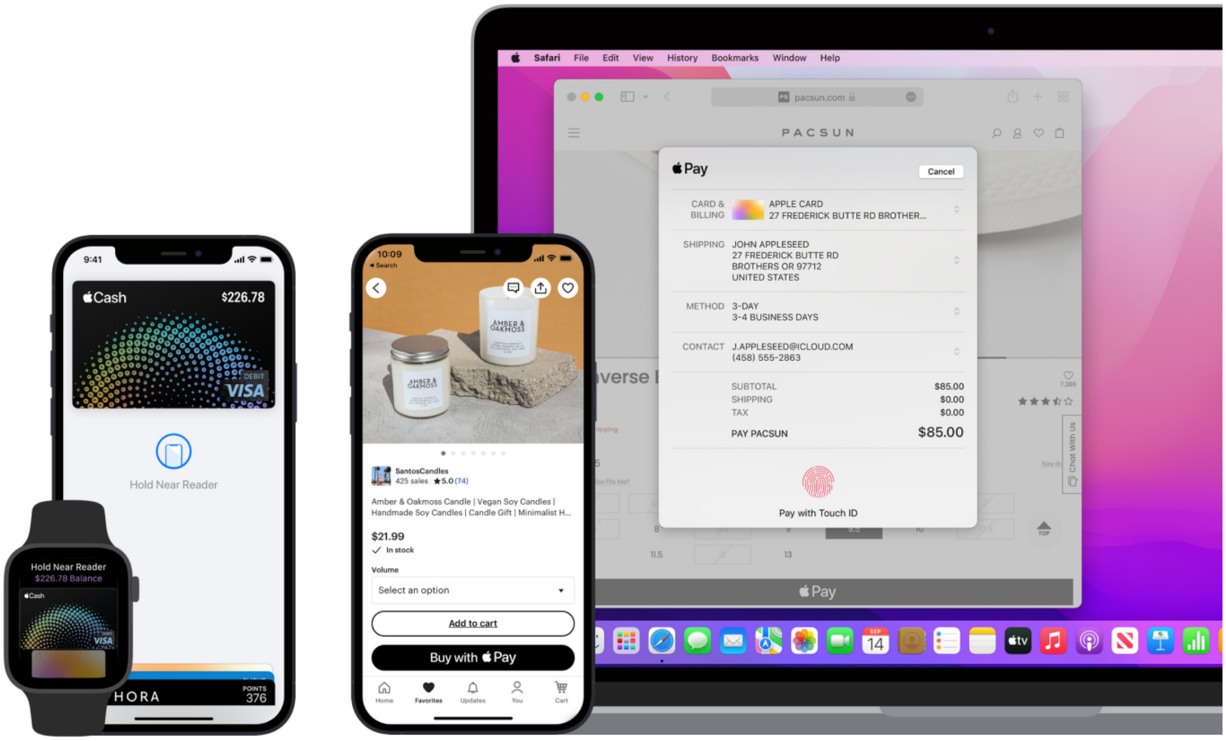


Figure 9-4. Apple Pay makes the checkout process as easy as selecting the payment option and verifying your purchase (source: Apple, 2023)

Retail is an area in which you can find many innovative ways to abstract complexity away from users. Take, for example, Amazon’s Go stores (Figure 9-5), which provide a checkout-free shopping experience. First appearing as an experiment in downtown Seattle, they are now popping up in major metropolitan areas all over the United States. With the Amazon Go app installed on their smartphone, a customer can simply check in with the app when they enter the store, grab what they need, and walk out, without ever needing to wait in line, scan their items, or even pay in the store. A little later, the customer receives a receipt, and their Amazon account is charged.

Figure 9-5. The first Amazon Go store in Seattle (source: Wikipedia, 2019; photographer, Brianc333a)

The dizzying array of technology involved in a checkout-free shopping experience like that found in Amazon Go stores is nothing short of astounding. Advanced technology like machine learning, computer vision, and AI must be deeply integrated to allow for people to simply walk into the store, grab the items they wish to purchase, and then walk out. While the friction of shopping is drastically reduced for customers, the complexity that comes along with it must be absorbed by the designers and developers responsible for ensuring it all works.

Advancements in artificial intelligence (AI) are introducing a whole new interaction paradigm in computing history in which users can tell the computer what outcome they want via natural language. This intent-based paradigm sits in stark contrast to the command-based paradigm we've lived with for the last couple of decades, which requires commands via user actions within a graphical user interface (GUI), resulting in feedback from the system. With intent-based interaction, the complexity of the system is abstracted away from the user, enabling them to simply describe the outcome they'd like to see. Take, for example, Spark, from product analytics company Mixpanel, which enables users to conduct in-depth analyses of data by simply asking questions in natural language (Figure 9-6).

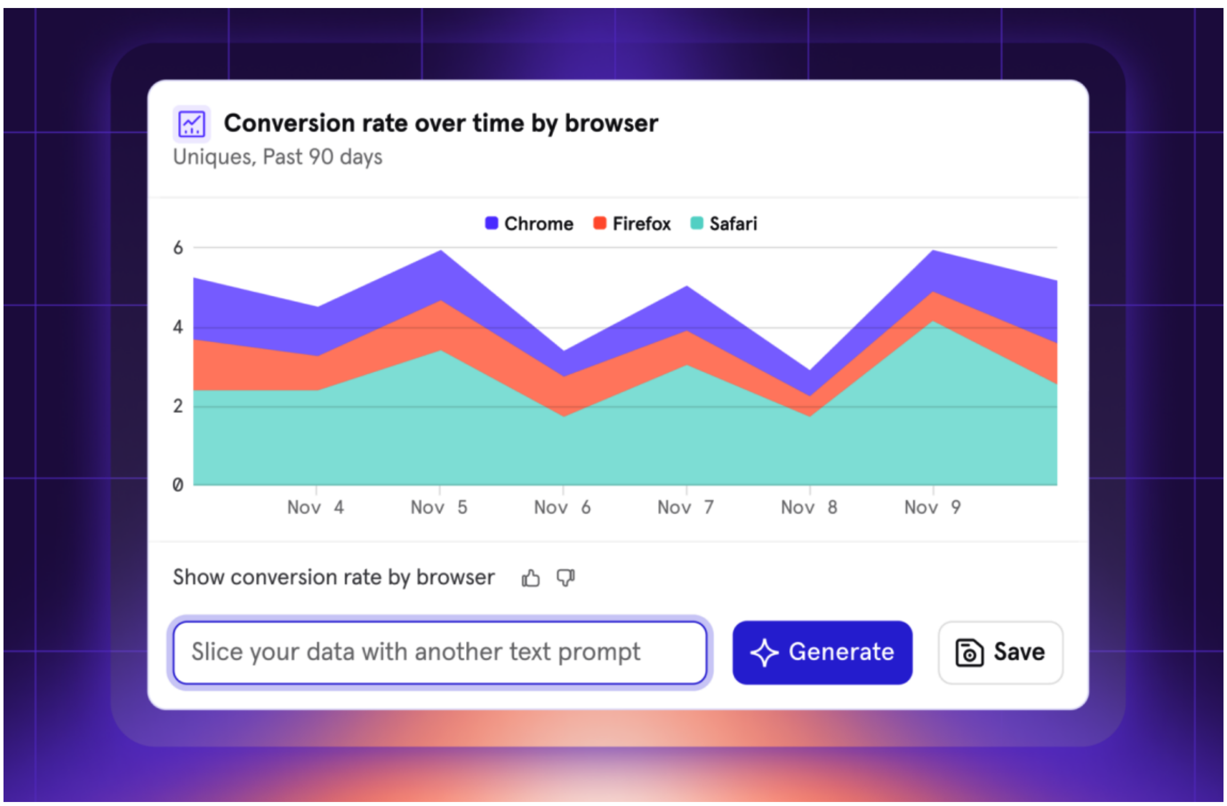


Figure 9-6. Mixpanel's natural language Spark feature (source: Mixpanel, 2023)

Intent-based interaction via natural language lowers the barrier of knowledge required to interact with software, which is particularly effective with complex products with sophisticated feature sets. This interaction paradigm democratizes access to software and empowers users who know what they want to do but don't know how to do it to simply describe the outcome they'd like. The barrier for entry required of users to reach "power user" status fades away while giving them access to the same powerful features.

KEY CONSIDERATION

PARADOX OF THE ACTIVE USER

When it comes to designing software, there's a very important consideration to remember: users never read software manuals but instead start using the software immediately. This happens because users are often motivated to complete their immediate tasks, and therefore they don't want to spend time up front reading documentation. It is, of course, a paradox, because users will save time in the long term if they first take time to learn and optimize around the system.

This paradox was first introduced by Mary Beth Rosson and John Carroll in 1987 to explain a common observation in several user studies done at the IBM User Interface Institute.[4] They found that new users were not reading the manuals supplied with computers and instead would just get started using them, even if it meant getting into errors and running into roadblocks.

The lesson here is that we must remember to not build products and services for an idealized, rational user, because people don't always behave rationally in real life. Instead, we can account for this paradox by making guidance accessible throughout the product experience. We can design it to fit within the context of use so that it can help these active new users, no matter what path they choose to take (e.g., tooltips with helpful information).

TECHNIQUE

PROGRESSIVE DISCLOSURE

Progressive disclosure is an interaction design technique that displays only important actions or content by default, while making additional features or content easily accessible. The result is a more streamlined interface that helps to keep the user's attention focused by reducing clutter, confusion, and cognitive load. Anytime we use a dropdown, accordion, or toggle that reveals content that is hidden by default, we are utilizing progressive disclosure. This strategy is incredibly useful for simplifying designs because it enables us to defer less important actions, advanced features, or additional content to a secondary screen (like a dropdown, accordion, or content toggle).

A great example of progressive disclosure can be found on Stripe's website (Figure 9-7): when you hover the mouse over any item in the primary navigation, a menu will appear that reveals the various links in that category. Stripe has created a simple interface in which users can quickly scan and find relevant information without needing to dig through a mountain of content in the process.

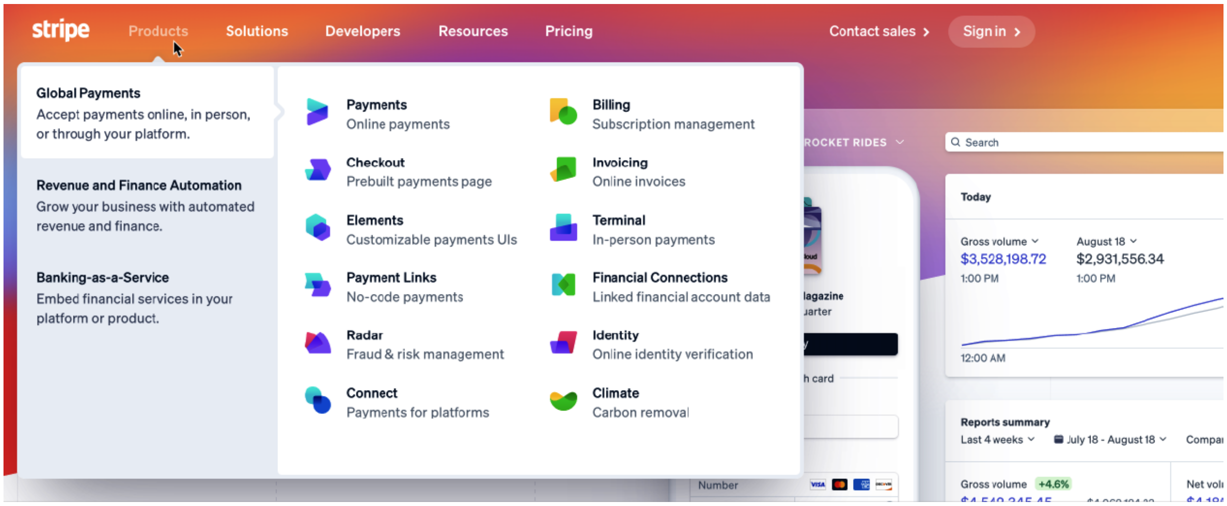


Figure 9-7. Progressive disclosure menu on Stripe.com (source: Stripe, 2023)

Conclusion

Tesler's law is important for designers to be aware of because it relates to a fundamental challenge we face throughout our work: how we manage complexity. We must first acknowledge that with any process, there will be a necessary amount of complexity that cannot be removed, no matter how simplified the process becomes as a result of the design process. Everything from a humble email to a highly sophisticated checkout process will have inherent complexity that must be managed. As designers, we have a responsibility to remove inherent complexity from our interfaces, or else we ship that complexity to our users. This can result in confusion, frustration, and a bad user experience. Where possible, designers and developers should handle complexity.

[1] Dan Saffer, *Designing for Interaction: Creating Smart Applications and Clever Devices* (Berkeley, CA: Peachpit Press, 2006), 56.

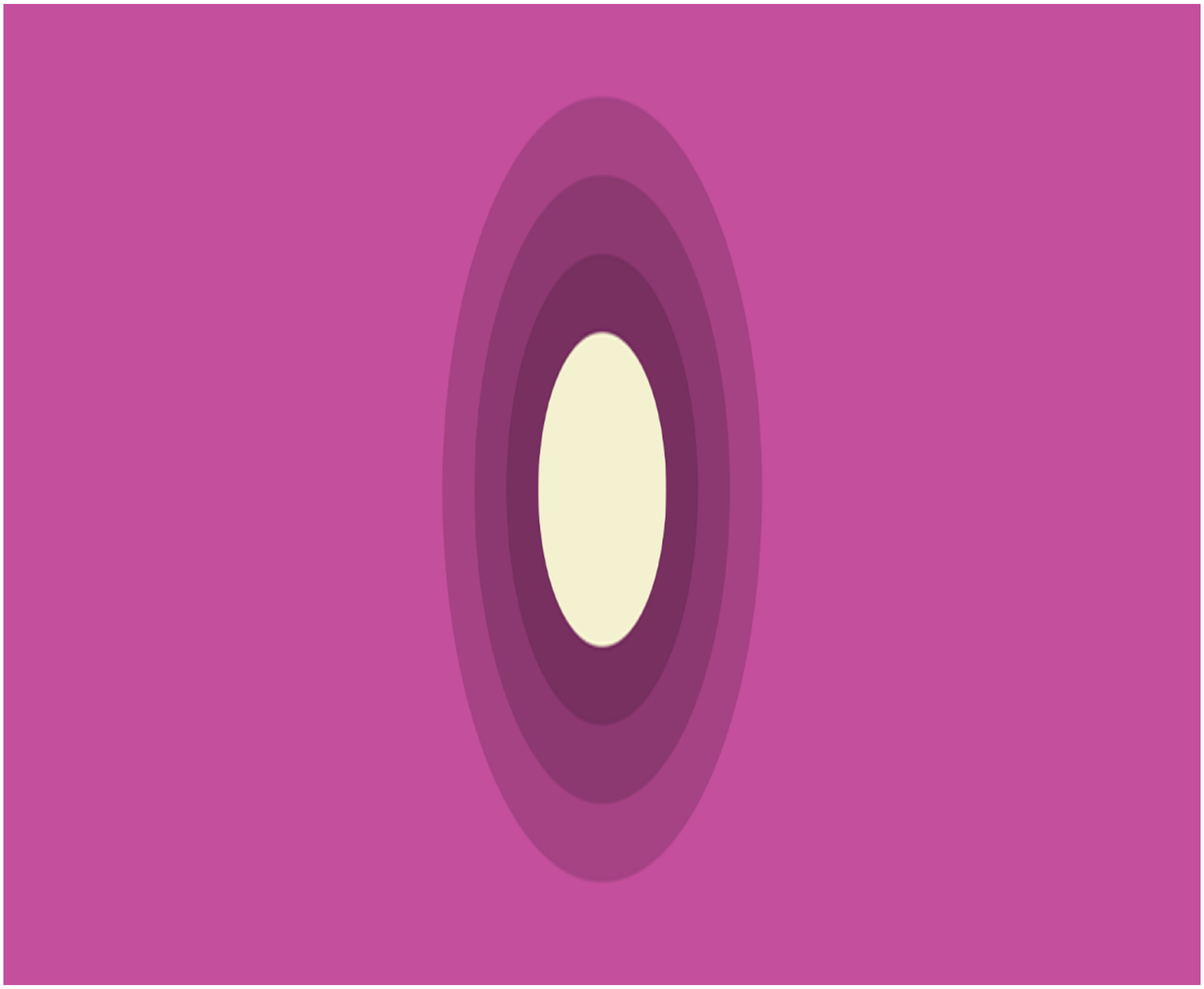
[2] Shane Parrish, “Complexity Bias: Why We Prefer Complicated to Simple,” *Farnam Street*, January 8, 2018, *https://oreil.ly/i9di1*.

[3] Hilary H. Farris and Russell Revlin, “Sensible Reasoning in Two Tasks: Rule Discovery and Hypothesis Evaluation,” *Memory & Cognition* 17, no. 2 (1989): 221–32, *https://doi.org/10.3758/BF03197071*.

[4] John M. Carroll and Mary Beth Rosson, “Paradox of the Active User,” in *Interfacing Thought: Cognitive Aspects of Human–Computer Interaction*, ed. John M. Carroll (Cambridge, MA: MIT Press, 1987).

Chapter 10. Doherty Threshold

Productivity soars when a computer and its users interact at a pace (<400 ms) that ensures that neither has to wait on the other.



KEY TAKEAWAYS

- Provide system feedback within 400 ms in order to keep users' attention and increase productivity.
- Use perceived performance to improve response time and reduce the perception of waiting.
- Animation is one way to visually engage people while loading or processing is happening in the background.
- Progress bars help make wait times tolerable, regardless of their accuracy.
- Purposefully adding a delay to a process can actually increase its perceived value and instill a sense of trust, even when the process itself actually takes much less time.

Overview

One of the features that is critical to good user experiences is performance. Emotions can quickly turn to frustration and leave a negative lasting impact when users who are trying to achieve a task are met with slow processing, lack of feedback, or excessive load times. Often overlooked as more a technical best practice, speed should be considered an essential design feature that is core to good user experiences. Whether it's the amount of time the product or service takes to initially load, how fast it is to respond to interactions and provide feedback, or how quickly subsequent pages load, the speed at which a system responds is key to the overall user experience.

There are several factors that can impact the performance of websites and apps, but the most significant is overall page weight, or the overall size of a page as a result of its files, scripts, and media. Unfortunately, when it comes to page weight on the web, the average has increased exponentially over the years. According to the HTTP Archive, the average desktop page weight in 2023 was more than 2 MB (2286 KB), with mobile not too far behind at just over 2 MB (2007 KB). This is a vast increase over the average page weights in 2010–2011: 634 KB on desktop and 260 KB on mobile (Figure 10-1).

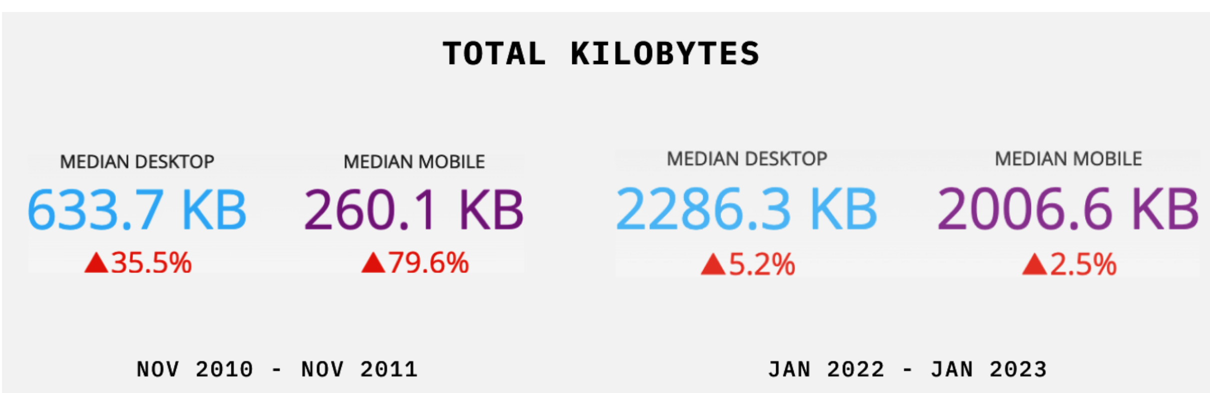


Figure 10-1. Average page weight is increasing each year (source: HTTP Archive, 2023)

This trend means longer wait times, and waiting is not something people like to do when trying to complete a task. Countless studies reinforce the fact that the longer the wait times that people are subjected to, the more likely it is they will grow frustrated and even abandon the task altogether.

Additionally, slow response times from a system lead to a decrease in the productivity of the people using an interface. While a 100 ms response feels instantaneous, a delay of between 100 and 300 ms begins to be perceptible to the human eye, and people begin to feel less in control. Once the delay extends past 1,000 ms (1 second), people begin thinking about other things; their attention wanders, and information important to performing their task begins to get lost, leading to an inevitable reduction in performance. The cognitive load required to continue with the task increases as a result, and the overall user experience suffers.

Origins

In the early days of desktop computing, two seconds was considered an acceptable threshold for response time from a computer when performing a task. The reason for this widely accepted standard was that it provided time for the user to think about their next task. Then, in 1982, two IBM employees, Walter J. Doherty and Ahrvind J. Thadani, published a study called “The Economic Value of Rapid Response Time” in the *IBM Systems Journal* that challenged this previous standard by stating that “productivity increases in more than direct proportion to a decrease in response time” when the threshold is under 400 ms.[1] The authors of the study claimed that “when a computer and its users interact at a pace that ensures that neither has to wait on the other, productivity soars, the cost of the work done on the computer tumbles, employees get more satisfaction from their work, and its quality tends to improve.” Their study set a new standard that would come to be known as the Doherty threshold, based on Doherty’s observation that computer response times have a disproportionate impact on productivity.

PSYCHOLOGY CONCEPT

FLOW

Flow is a mental state in which a person performing an activity is fully immersed in a feeling of energized focus, full involvement, and enjoyment in the process of the activity. Coined by psychologist Mihály Csíkszentmihályi in 1970, it has been widely referred to across a variety of fields (and is particularly well recognized in occupational therapy), though the concept has been claimed to have existed for thousands of years under other names.[2]

Flow is the state that occurs when there is a balance between the difficulty of a task and the level of skill at the given task. It's characterized by intense and focused concentration on the present, combined with a sense of total control. For example, a task that's too difficult can lead to heightened frustration, while a task that's too easy can lead to boredom. Finding the right balance requires matching the challenge with the skill of the user. When users find themselves in a flow state, they are completely absorbed by their tasks, free from inner criticism, and up to five times more productive.[3]

We can design for flow by providing the necessary feedback so that the user knows what action has been done and what has been accomplished, optimizing for efficiency and system responsiveness by removing any unnecessary friction, and making content and features available for discovery to avoid disengagement with the interface.

Examples

In some cases, the amount of time required for processing is longer than what is prescribed by the Doherty threshold (i.e., >400 ms), and there simply isn't much that can be done about it. But that doesn't mean we can't provide feedback to users in a timely fashion while the necessary processing is happening in the background. This technique helps to create the perception that a website or an app is performing faster than it actually is.

One common example used by platforms such as Instagram (Figure 10-2) is the presentation of a skeleton screen when content is loading. This technique makes the site appear to load faster by instantly displaying placeholder blocks in the areas where content will eventually appear. The blocks are progressively replaced with actual text and images once they are loaded. This reduces the impression of waiting, which increases the perception of speed and responsiveness even if the content is loading slowly. Additionally, skeleton screens prevent the jarring and disorienting experience of content jumping around as adjacent material loads by reserving space for each item up front.

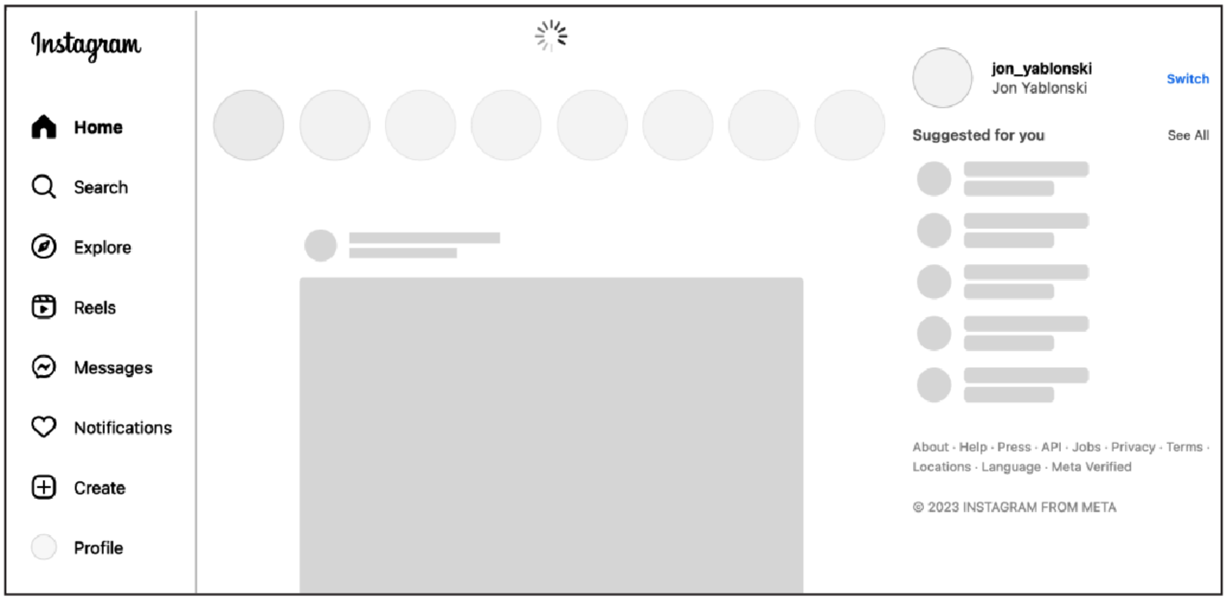


Figure 10-2. Instagram's skeleton screen helps the site appear to load faster (source: Instagram, 2023)

Another way to optimize load times is known as the "blur up" technique. This approach focuses specifically on images, which are often the main contributor to excessively long load times in both web and native applications. It works by first loading an extremely small version of an image and scaling it up in the space where the larger image will eventually be loaded. A Gaussian blur is applied to eliminate any obvious pixelation and noise as a result of scaling up the low-resolution image (Figure 10-3). Once the larger version of the image is loaded in the background, it is placed behind the low-resolution version and revealed by fading out the top image. Not only does this technique ensure faster load times by prioritizing performance over content, but it also allocates room for full-sized images up front to prevent page jumping once the high-resolution version of the image is fully loaded.

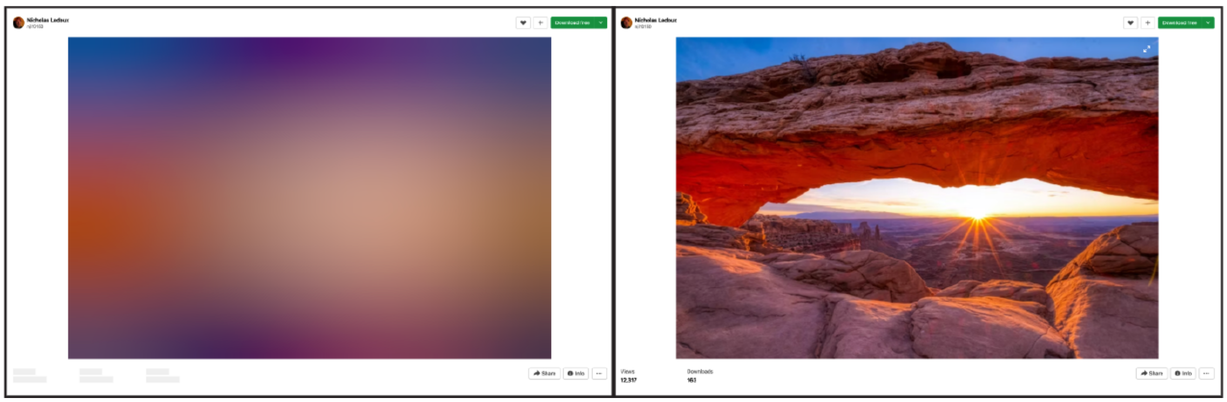


Figure 10-3. Unsplash uses the "blur up" technique to enable faster page loading (source: Unsplash.com, 2023)

Animation is yet another way to visually engage people while loading or processing is happening in the background. A common example is "percent-done progress indicators," also known as progress bars. Research has shown that simply seeing a progress bar can make wait times seem more tolerable, regardless of its accuracy.[4]

This simple UI pattern is effective for several reasons:

- It reassures people that their action is being processed.

- It provides visual interest while they wait.
- It reduces the perception of waiting by shifting focus to the animation of the progress bar as opposed to the actual process of waiting.

While we can't always circumvent the need for processing and the subsequent waiting, we can increase the user's willingness to wait by providing visual feedback.

An example of animation being used to reduce the uncertainty and frustration associated with wait times can be found in Google's famous email client, Gmail (Figure 10-4). The loading screen uses an animated version of its logo in combination with a simple progress bar while the app loads. The effect of this simple yet distinctive animation creates the perception of a shorter wait time and improves the overall user experience by reassuring people that the app is loading.

Figure 10-4. Gmail uses a simple yet distinctive animation to shorten the perceived wait time (source: Gmail, 2023)

Ten seconds is the commonly recognized limit for keeping the user's attention focused on the task at hand—anything exceeding this limit, and they'll want to perform other tasks while waiting.[5] When wait times must extend beyond the maximum of ten seconds, progress bars are still helpful but should be augmented with an estimation of the time remaining until completion and a description of the task that is currently being performed. This additional information helps give users an idea of how much time they have to wait until the task is finished and frees them up to do other tasks in the meantime. Take, for example, Apple's installation screen (Figure 10-5), which is displayed when an update is underway.

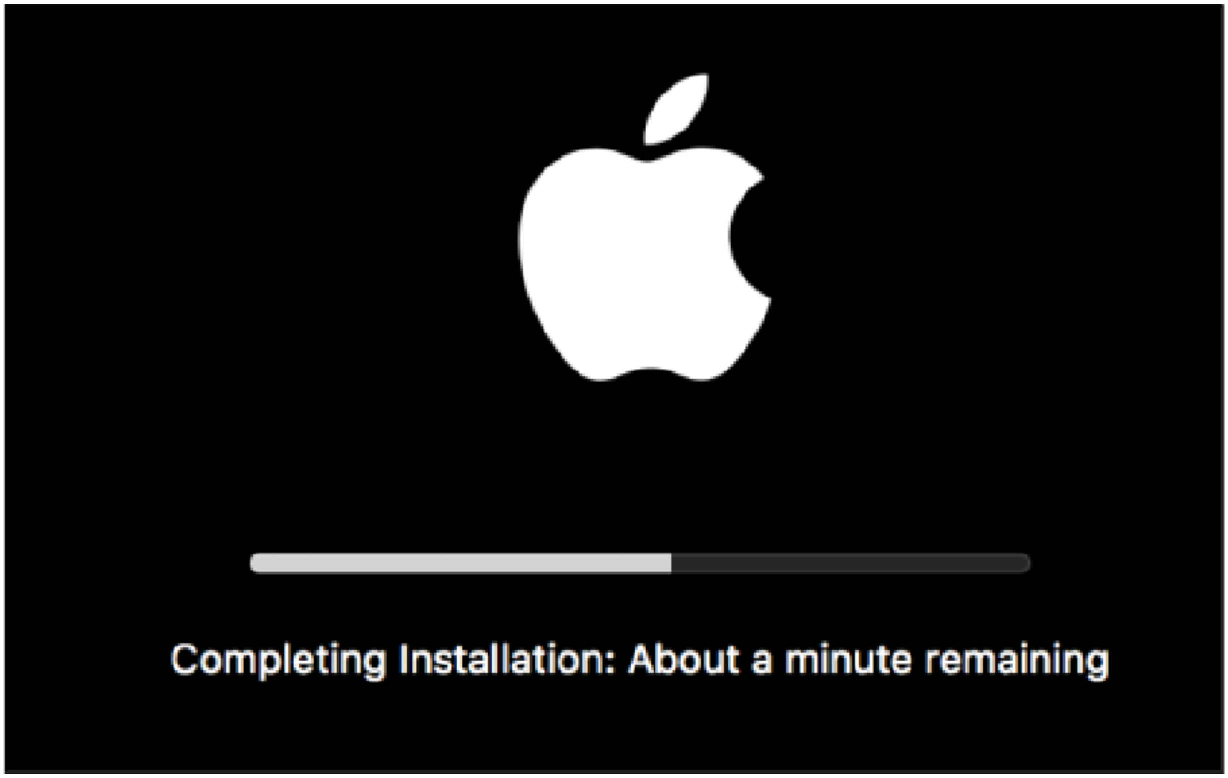


Figure 10-5. Apple provides an estimated time to completion along with a progress bar during updates (source: Apple macOS)

Another clever technique for improving perceived performance is the *optimistic UI*. It works by optimistically providing feedback that an action was successful while it is being processed, as opposed to providing feedback only once the action has been completed. For example, Instagram displays comments on photos before they are actually posted (Figure 10-6). This makes the app's response time seem faster than it actually is: it immediately provides visual feedback that assumes the comment will be successfully posted, and only displays an error afterward in the event that the action isn't successful. The required processing still happens in the background, but the user's perception of the app's performance is improved.

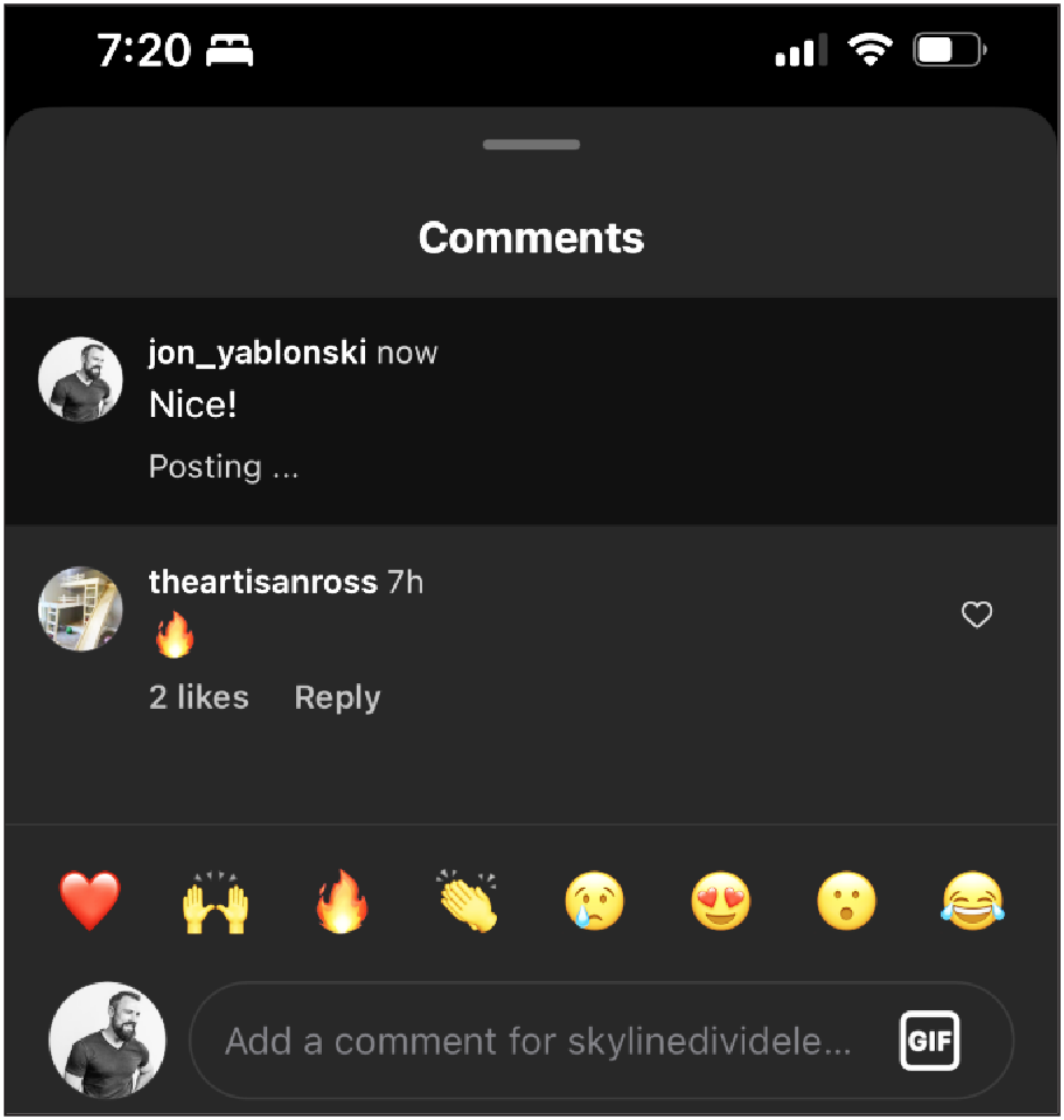


Figure 10-6. Instagram optimistically displays comments on photos before they are actually posted to improve perceived performance (source: Instagram, 2023)

KEY CONSIDERATION

FRICTION

Most issues around response times boil down to them being too slow. It might seem counterintuitive, but it's important to also consider when response times might be too *fast*. When the system responds more quickly than the user expects it to, a few problems can occur. First, a change that happens a little too fast may be completely missed—this is especially true when the change is not the result of an action taken by the user but something that happens automatically. Another issue that can occur when a response time is too fast is that it can be difficult for the user to comprehend what happened, since the speed of the change does not allow sufficient time for mental processing. Finally, a too-fast response time can result in mistrust if it doesn't align with the user's expectations about the task being performed. Purposefully adding a delay to a process can actually increase its perceived value and instill a sense of trust, even when the process actually takes much less time.[6] Friction can be carefully utilized when a more considered response is required from users. Take, for example, a confirmation modal, which can be enough friction to activate the effortful and evaluative mental process known as System 2 thinking (see Chapter 7, "Aesthetic–Usability Effect"), and thus decrease the likelihood of mistakes or errors. Another example is Google's

Privacy Checkup process (Figure 10-7), which scans your account for potential privacy vulnerabilities. Google uses it as an opportunity to educate people about what is being scanned and adds additional time to the process to instill trust that the scan is thorough.

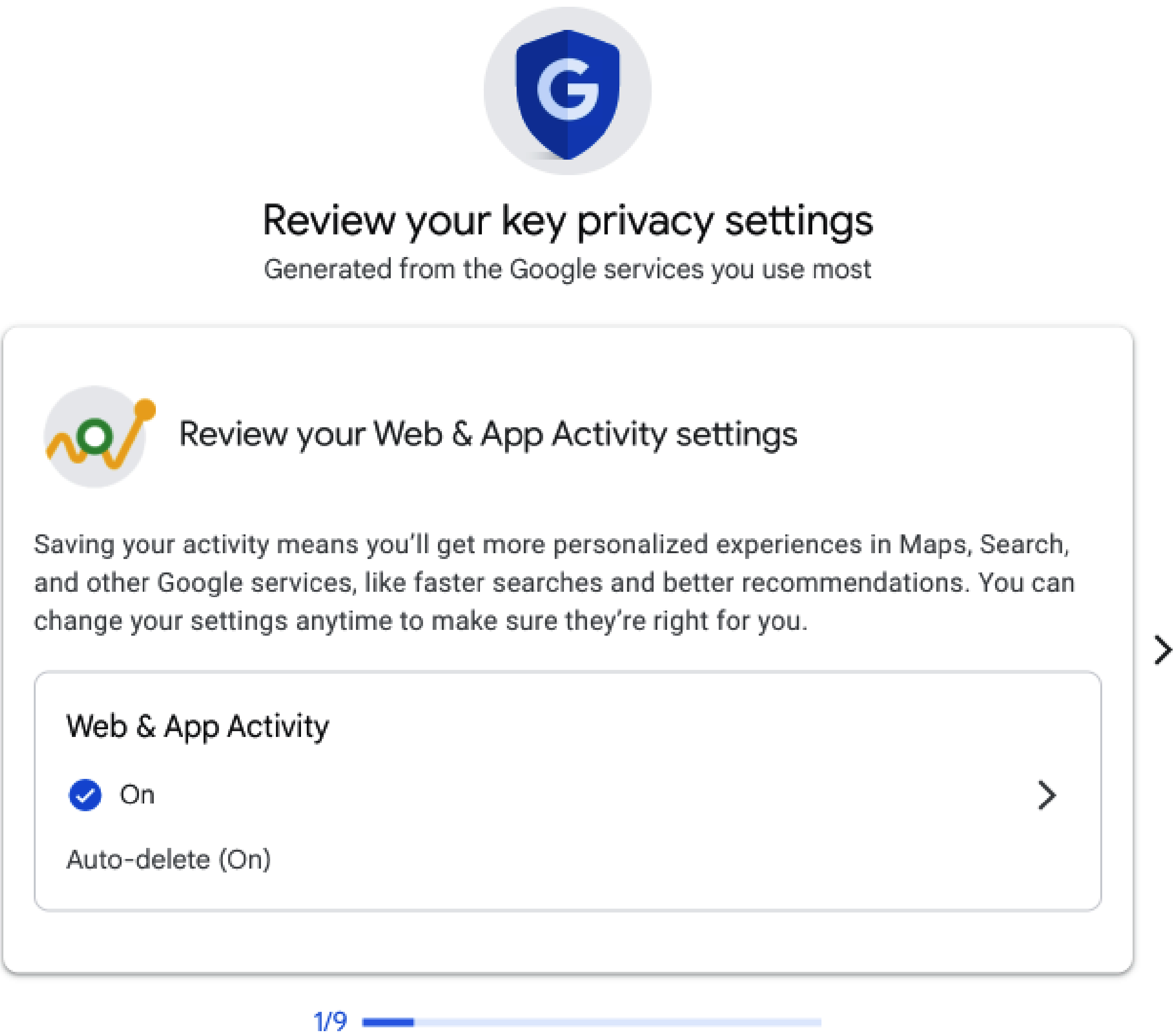


Figure 10-7. Google's Privacy Checkup process scans your account for potential privacy vulnerabilities, extending the time the process actually requires and taking the opportunity to educate you (source: Google, 2023)

Conclusion

Performance is not just a technical consideration for our development colleagues—it is an essential design feature. As designers, it is our responsibility to help ensure the people who use our products and services can achieve their tasks as quickly and efficiently as possible. To this end, it's important that we provide the appropriate feedback, leverage perceived performance, and use progress bars to reduce the overall sense of waiting.

[1] The original study has been lost to time, but you can read a copy of it on *Jim Elliott's Mainframe Blog*: *https://oreil.ly/8Gpua*.

[2] Mihály Csíkszentmihályi, *Flow: The Psychology of Optimal Experience* (New York: Harper & Row, 1990).

[3] Joshua Gold and Joseph Ciorciari, "A Review on the Role of the Neuroscience of Flow States in the Modern World," *Behavioral Sciences* 10, no. 9 (2020): 137, *https://doi.org/10.3390/bs10090137*.

[4] Brad A. Myers, "The Importance of Percent-Done Progress Indicators for Computer–Human Interfaces," in *CHI '85: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (New York: Association for Computing Machinery, 1985), 11–17.

[5] Robert B. Miller, “Response Time in Man–Computer Conversational Transactions,” in *Proceedings of the December 9–11, 1968, Fall Joint Computer Conference, Part I*, vol. 33 (New York: Association for Computing Machinery, 1968), 267–77.

[6] Mark Wilson, “The UX Secret That Will Ruin Apps for You,” *Fast Company*, July 6, 2016, *https://oreil.ly/meoX2*.

Chapter 11. Applying Psychological Principles in Design

The wealth of knowledge afforded to designers by behavioral and cognitive psychology research provides an invaluable foundation for creating human-centered user experiences. Much like how an architect with an intimate knowledge of how people experience space will create better buildings, designers with an understanding of how humans behave will create better designs. The challenge becomes how to build that intimate knowledge and make it part of the design process. In this chapter, we'll explore some ways designers can internalize and apply the psychological principles we've looked at in this book and then articulate them through design principles that relate back to the goals and priorities of their teams.

Building Awareness

Building awareness is perhaps the most obvious but effective way for designers to internalize and apply the psychological concepts covered in this book. The following are a few strategies I've seen implemented within teams to do this.

Visibility

The first and easiest way to internalize the principles discussed in this book is to make them visible in your working space. Since launching my Laws of UX project, I've received countless photos from teams that have printed out each of the posters available on the website and put them up on the walls for everyone to see (Figure 11-1). It makes me incredibly proud to see my work on office walls all around the world, but I also realize it serves a functional purpose: building awareness. By being constantly visible to the teams, these posters help to remind them of the various psychological principles that can help guide decisions during the design process. In addition to this, the posters serve as a reminder of the way humans perceive and process information. The result is a shared collective knowledge and vocabulary around these principles that's cultivated within the organization. Ultimately, this leads to team members capable of articulating the principles and how they can be applied to the design work being produced.

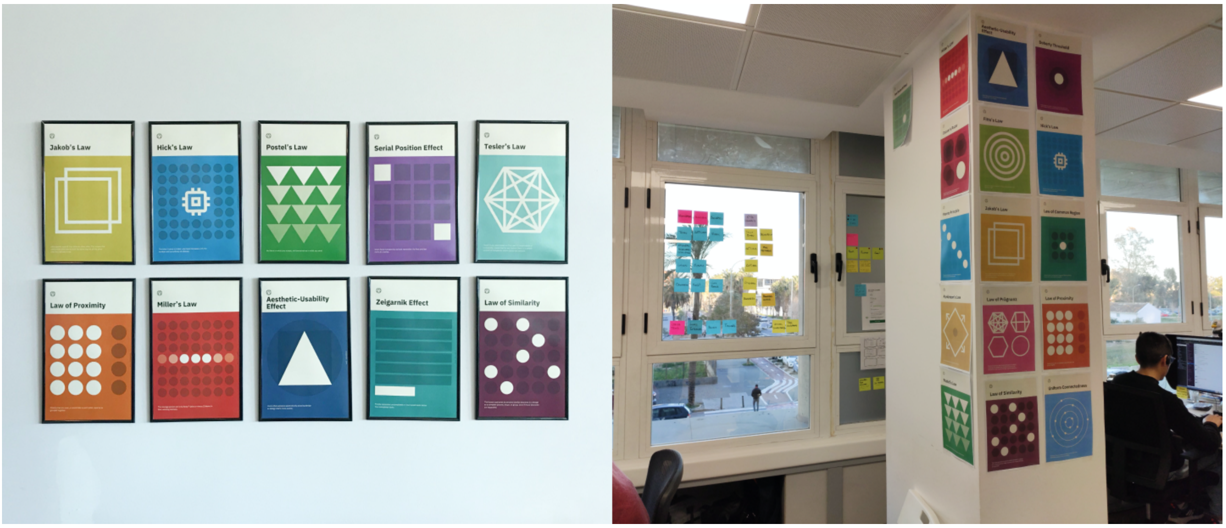


Figure 11-1. Laws of UX posters helping to build awareness (sources: Xtian Miller of Vectorform [left], and Virginia Virduzzo of Rankia [right])

Show-and-Tell

Another method for building awareness within teams on any topic is the classic *show-and-tell*: the practice of showing something to an audience and telling them about it. Like many of you, I was first exposed to this activity in my early years through school, and it's always been something I've enjoyed. Grade school teachers often use this activity as a way to teach students about public speaking, but it's also a great format for team members to share knowledge and learnings among themselves.

The design teams I've been part of that have established a regular dedicated time for knowledge sharing have benefited from this practice in a number of ways. First, it's an effective way to share information that could be useful to other team members. It's a low-cost means of distributing information in a format that's likely to be remembered. Everything from design techniques and new tools to usability test findings and project recaps—and yes, psychology principles—will be valuable to someone on the team. Additionally, show-and-tells are great for building speaking confidence in team members and giving people an opportunity to establish themselves as subject matter experts, and they indicate an overall dedication to and investment in continual learning on the part of the organization. It's about creating a culture of dialogue and knowledge building within the team, which I've found means a lot to team members, myself included.

While simply building awareness might not firmly embed these principles into the design process of an entire team, it definitely can help influence design decisions. Next up, we'll take a look at how these principles can be made instrumental to the design process within a team, and how to further embed them into decision making.

Design Principles

As design teams grow, the number of design decisions that must be made on a daily basis will increase proportionally. More often than not, this responsibility will land on design leadership, who must shoulder it alongside their numerous other responsibilities. Once the team reaches a certain threshold and the volume of design decisions to be made exceeds what is possible for leadership to manage, the output of the team will slow down and become blocked. Another scenario could be that design decisions are made by individual team members without approval, and therefore without the assurance that their decisions meet the standard of quality, objectives, or overall design vision of the team. In other words, design gatekeepers can become an obstacle to consistency and scalability. To add to this problem, the priorities and values of the team can become less clear, resulting in individual team members defining what good design looks like to them, not necessarily to the overall team. I've seen this happen firsthand, and as you might imagine, it's problematic, because the definition of "good design" within the team becomes a moving target. The result is less consistent output from the team overall. The output of the team will inevitably suffer as a result of inconsistency and lack of a clear vision.

One of the most effective ways we can ensure consistent decision making within the design process is by establishing *design principles*: a set of guidelines that represent the priorities and goals of a design team and serve as a foundation for reasoning for decision making. They help to frame how a team approaches problems and what it values. As a team grows and the amount of decisions to be made increases proportionally, design principles can serve as a North Star: guiding values that embody what good design looks like for the team. Gatekeepers are no longer a bottleneck, as the team has a shared understanding of what a successful design solution looks like in the context of these shared values and goals. Design decisions become quicker and more consistent, and the team has a common mindset and overall design vision. When done correctly, the ultimate impact this has on a team is profound and has the potential to influence the entire organization.

Next, we'll take a look at how you can begin to define your team's guiding values and resulting design principles in order to ultimately connect these to foundational psychological principles.

Defining Your Principles

You can use a variety of methods to define a set of design principles that reflect your team's goals and priorities. While a comprehensive look at the various ways to enable team collaboration and orchestrate workshops is outside the scope of this book, it's worth giving some context. The following is a common process for defining a team's guiding design principles:

Identify the team

Defining design principles is commonly done during a workshop or series of workshop activities, so the first step is to identify the team members who will participate. A common approach is to keep things open to anyone who wishes to contribute—especially those whose work will be directly affected by the principles. It may also be a good idea to open the process to design leadership and stakeholders outside of the immediate team, as they will bring a different perspective that's also valuable. The more people you can get involved, the easier it will be to ensure widespread adoption.

Align and define

Once the team is identified, it's time to carve out some time and kick things off by first aligning on success criteria. This means not only creating a shared understanding of design principles and the purpose they serve, but also defining the goals of the exercise—for example, defining what criteria each design principle must meet to be valuable for the team.

Diverge

The next step is commonly centered around idea generation. Each team member is asked to brainstorm as many design principles as they can for a defined amount of time (say, 10–15 minutes), writing each idea on a separate sticky note. By the end of this exercise, each participant should have a stack of ideas.

Converge

After divergence comes convergence, so the next step is to bring all those ideas together and identify themes. Participants are usually asked during this phase to share their ideas with the group and to organize those ideas according to themes that surface during the exercise, with the help of a facilitator. After all the participants have shared their ideas, they are asked to vote on the themes they feel are the most appropriate for the team and the organization. A common exercise for this is “dot voting,” where each person receives a finite number of adhesive dots (usually 5–10) that they use to vote. The themes they choose to vote on are entirely up to them, and they can even use multiple dots on a single theme if they feel particularly strongly about it.

Refine and apply

The next step will vary per team, but it's common to first undergo a refinement stage and then identify how the principles can be applied. Themes should be consolidated where possible and then articulated clearly. Next, it's a good idea to identify where and how these principles can be applied within the team and throughout the organization as a whole.

Circulate and advocate

The final step is to share the principles and advocate for their adoption. Circulation can come in many forms: posters, desktop wallpapers, notebooks, and shared team documentation are all common media. The goal here is to make them readily accessible and visible to all members of the design team. Additionally, it's critical that team members who participated in the workshop advocate for these principles both within and outside the team.

Best Practices

Design principles are valuable only when they can effectively provide guidance and frame decision making. The following are a few best practices to help ensure the design principles your team adopts are useful:

Good design principles aren’t truisms

Good design principles are direct, clear, and actionable, not bland and obvious. Truisms can’t help with decision making because they are too vague and lack a clear stance (for example, “design should be intuitive”).

Good design principles solve real questions

You’ll want to make sure the principles you define can clearly resolve real questions and drive design decisions. Be careful, though—you don’t want them to become too scenario-specific.

Good design principles are opinionated

The principles you define should have a focus and a sense of prioritization, which will push the team in the right direction when needed and drive them to say no when necessary.

Good design principles are memorable

> Design principles that are hard to remember are less likely to be used. They should feel relevant to the needs and ambitions of the team and the organization as a whole.

Connecting Principles to Laws

Once your team has established a set of design principles, consider each principle in light of the psychological principles discussed in this book. By doing this, you can make the connection between what the design principle is seeking to accomplish and the psychological reasoning behind it. Suppose, for example, that your design principle is "clarity over abundance of choice." This principle is quite useful because it not only prioritizes clarity but also establishes the trade-off (loss of abundant choice). To align this principle with a law, we must identify the one that most relates to this goal of providing clarity. Hick's law (Chapter 4), which states that "the time it takes to make a decision increases with the number and complexity of choices available," seems to be a good match in this case.

Once the connection is made between a design principle and the appropriate psychological law, the next step is to establish a rule for team members to follow in the context of the product or service. Rules help to provide constraints that guide design decisions in a more prescriptive way. Continuing with the previous example, we've identified Hick's law as the appropriate law to connect to our design principle of "clarity over abundance of choice," and we can now deduce rules that are appropriate for that design principle. For example, one rule that aligns with this law would be to "limit choices to no more than three items at a time." Another rule that could be appropriate is to "provide brief explanations when useful that are clear and no more than 80 characters." These are simple examples that are meant to illustrate the point—the ones you'd define would be appropriate for your project or organization.

We now have a clear framework (Figure 11-2) that consists of a goal (design principle) and an observation (law) and establishes guidelines (rules) that designers can follow to meet this goal. You can repeat this process for each of the design principles that your team has agreed upon to create a comprehensive design framework.

Clarity over abundance of choice

According to Hick's law, we know that the time it takes to make a decision increases with the number and complexity of choices available.

To achieve this goal, we must:
• Limit choices to no more than three items at a time.
• Provide brief explanations when useful that are clear and no more than 80 characters.

Figure 11-2. An example design principle, observation, and rules

Let's take a look at another example: "familiarity over novelty." This passes the criteria we've set for what a good design principle should be, so it's time to identify the law that most relates to this goal of providing familiarity. Jakob's law (Chapter 1), which states that "users spend most of their time on other sites, and they prefer your site to work the same way as all the other sites they already know," is a pretty good match. The next step is to establish rules for team members to follow in order to provide further guidance and ensure the principle is actionable. Familiarity is supported by the use of common design patterns, so we'll start by establishing that we should "use common design patterns to reinforce familiarity with the interface." Next, we can further recommend that designers "avoid distracting the user with a flashy UI or quirky animations." Once again, we now have a clear framework (Figure 11-3) that consists of a goal and an observation and establishes rules that designers can follow to meet this goal.

Familiarity over novelty

According to Jakob's law, we know that users spend most of their time on other sites, and they prefer your site to work the same way as all the other sites they already know.

To achieve this goal, we must:

• Use common design patterns to reinforce familiarity with the interface.
• Avoid distracting the user with a flashy UI or quirky animations.

Figure 11-3. Another example design principle, observation, and rules

Conclusion

The most effective way to leverage psychology in the design process is to embed it into everyday decision making. In this chapter, we explored a few ways designers can internalize and apply the psychological principles we've looked at in this book and then articulate them through design principles that relate back to your team's goals and priorities. We started by looking at how you can build awareness through making these principles visible in your working space. Next, we looked at a simple method for cultivating a culture of dialogue and knowledge building within the team through the classic show-and-tell format. Last, we explored the value and benefits of design principles, how to establish design principles, and how to make the connection between what each principle is seeking to accomplish and the psychological reasoning behind it. You can do this by establishing the goal, the psychological observation that supports this goal, and finally the means by which it will be applied through design. Once this process is complete, your team will have a clear road map that not only lays out its shared values through a set of clear design guidelines but also provides both the psychological validation to support these guidelines and an agreed-upon set of rules that help ensure the team can consistently meet them.

Chapter 12. With Power Comes Responsibility

In the previous chapters, we looked at how to leverage psychology to build more intuitive, human-centered products and experiences. We identified and explored some key principles from psychology that can be used as a guide for designing for how people actually are, instead of forcing them to conform to technology. This knowledge can be quite powerful for designers, but with power comes responsibility. While there's nothing inherently wrong with leveraging the insights from behavioral and cognitive psychology to help create better designs, it's critical that we consider how products and services have the potential to undermine the goals and objectives of the people using them, why accountability is critical for those creating those products and services, and how we can slow down and be more intentional.

How Technology Shapes Behavior

The first step in making more responsible design decisions is to acknowledge and understand the ways in which the human mind is susceptible to persuasive technology and how behavior can be shaped. There are a number of studies that provide a glimpse into the fundamentals of behavior shaping, but perhaps none are as influential or foundational as those conducted by American psychologist, behaviorist, author, inventor, and social philosopher B. F. Skinner. Through a process he called “operant conditioning,” Skinner studied how behaviors could be learned and modified by creating an association between a particular behavior and a consequence. Using a laboratory apparatus that came to be named after him (Figure 12-1), Skinner studied how the behavior of animals could be shaped by teaching them to perform desired actions in response to specific stimuli in an isolated environment. His earliest experiments involved placing a hungry rat into the chamber and observing it while it discovered that a food pellet would be dispensed when it came into contact with a lever on one side.[1] After a few chance occurrences, the rat quickly learned the association between pushing the lever and receiving food, and each time it was put in the box it would go straight to the lever—a clear demonstration of how positive reinforcement increases the likelihood of a behavior being repeated. Skinner also experimented with negative reinforcement by placing a rat inside the chamber and subjecting it to an unpleasant electrical current, which would be turned off when the lever was pressed. Much like the results of his previous experiments that rewarded the rats with food, the animal learned to avoid the current quickly by going straight to the lever once placed in the box.

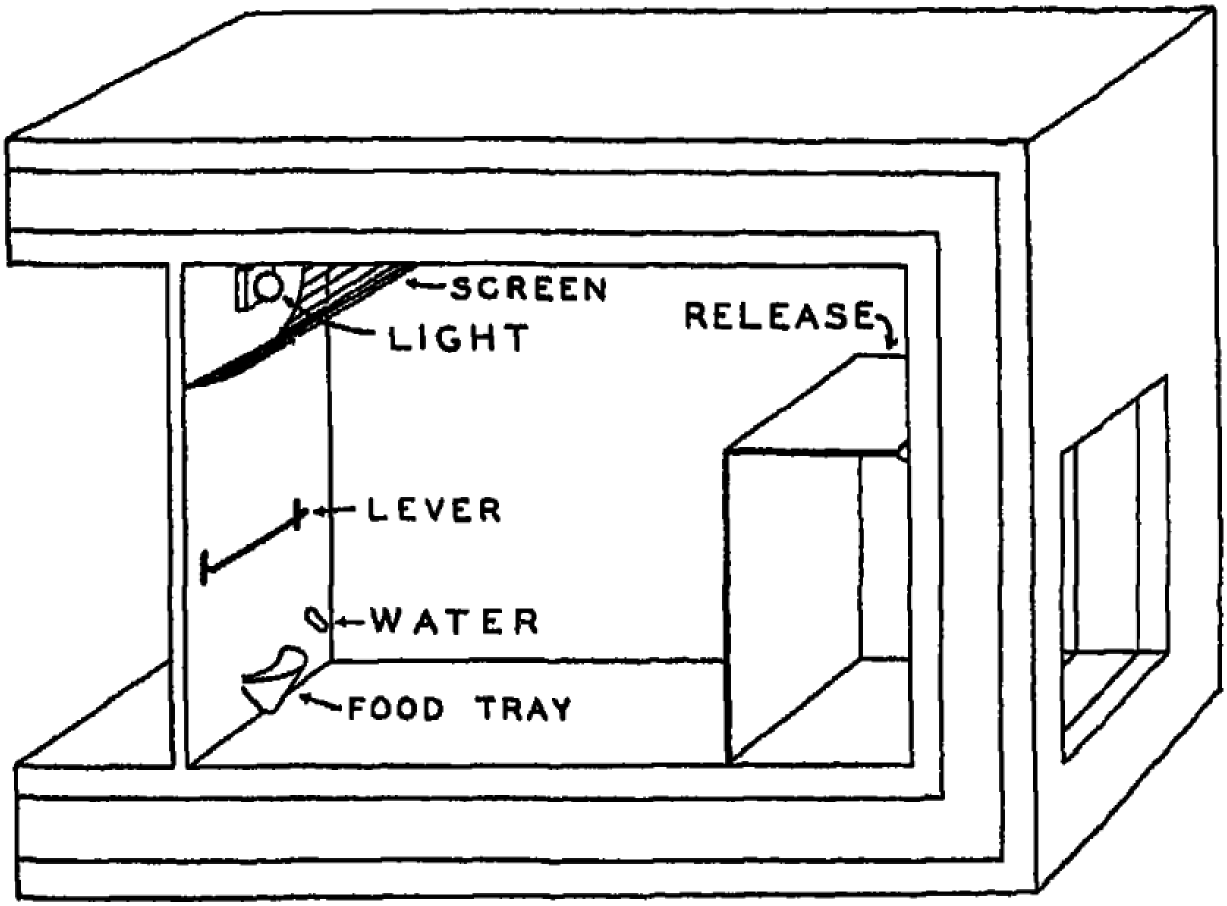


Figure 12-1. B. F. Skinner's operant conditioning chamber, also known as the "Skinner box" (source: Skinner, 1938)

Skinner later discovered that different patterns of reinforcement affected the speed and frequency at which the animals would perform the desired behavior.[2] For example, rats that were rewarded with food every time they pressed the lever would press it only when they became hungry, and rats that were rewarded too infrequently would stop pressing the lever altogether. By contrast, rats that were rewarded with food in unpredictable patterns would repeatedly press the lever and continue doing so without reinforcement for the longest time. In other words, the rats' behavior could most effectively be shaped by reinforcing it at variable times, as opposed to every time or not frequently enough. Too much or too little reinforcement led to the animals losing interest, but random reinforcement led to impulsive, repeated behavior.

Fast-forward to today, and it's clear that Skinner's research has been applied beyond the isolated box that bears his name. It can also be observed with human subjects in casinos around the world, where you'll find slot machines that have perfected operant conditioning. These machines are an excellent modern-day example of the Skinner box: gamblers pay to pull a lever, occasionally being rewarded for doing so. In her book *Addiction by Design*,[3] cultural anthropologist Natasha Dow Schüll explores the world of machine-aided gambling and describes how slot machines are designed to mesmerize people into a state of "continuous productivity" in order to extract maximum value through a continual feedback loop. Additionally, their activity is often recorded into a data system that creates a risk profile for each player, informing the casino observers how much the player can lose and still feel satisfied. When a player approaches their algorithmically calculated “pain point,” casinos often dispatch a “luck ambassador” to supplement the holding power of the slot machine by dispensing meal coupons, show tickets, gambling vouchers, and other incentives. It’s a stimulus–response loop that’s optimized to keep people in front of the machines, repeatedly pulling the levers and spending money—all while being tracked in order to maximize their time on the device.

Digital products and services have also been known to employ various methods with the goal of shaping human behavior, and we can see examples in many of the apps we use every day. Everything from keeping you on a site for as long as possible to nudging you to make a purchase or tempting you to share content is behavior that can be shaped through reinforcement at the right time. Let’s take a closer look at some of the more common methods technology employs to shape behavior, whether intentionally or unintentionally.

Intermittent Variable Rewards

Skinner demonstrated that random reinforcement on a variable schedule is the most effective way to influence behavior. Digital platforms can also shape behavior through the use of variable rewards, and this can be observed each time we check our phones for notifications, scroll through a feed, or pull to refresh. The results are similar to what Skinner observed in his lab: studies show that the average person interacts with their smartphone over 2,500 times a day, and some people up to 5,400 times, amounting to two to four hours each day.[4] Let's look at a specific example that demonstrates variable rewards: pull to refresh (Figure 12-2). This common interaction pattern is used by many mobile apps to enable the loading of new content by swiping down on the screen when at the top of a content feed. It doesn't take a stretch of the imagination to see the similarities between this and a slot machine—not only in the physical interaction, but also in the variable "reward" it generates.

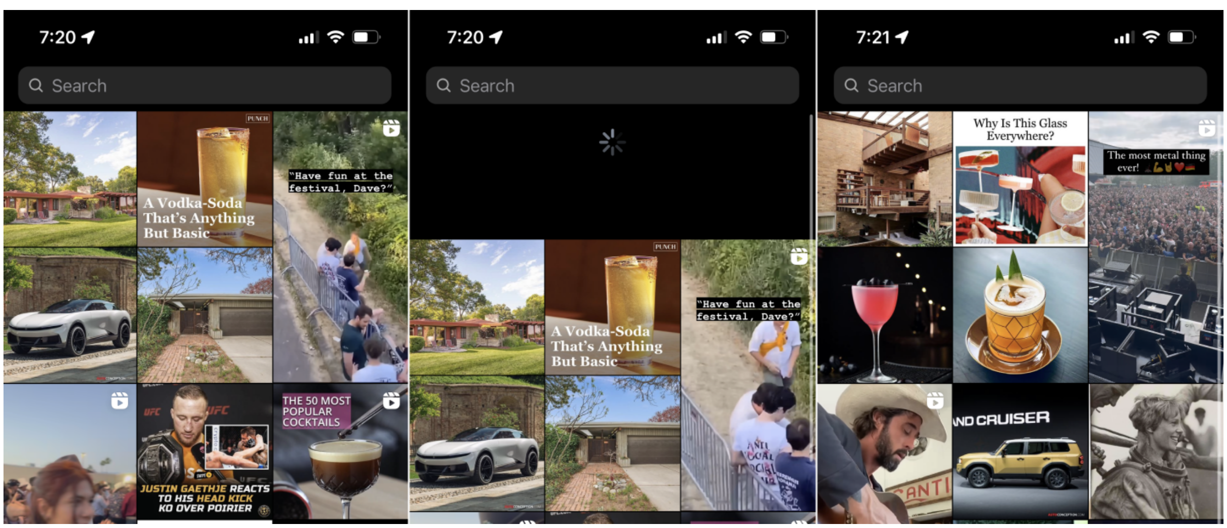


Figure 12-2. Pull-to-refresh example on Instagram (source: Instagram, 2023)

Infinite Loops

Infinite loops such as autoplay videos (Figure 12-3) and infinite scrolling feeds are designed to maximize time on site by removing friction. Without the need for the user to make a conscious decision to load more content or play that next video, companies can ensure that passive consumption on their sites or apps continues uninterrupted. Ads are typically interspersed with the looping content, so more time on site means more ads viewed—a model that is significantly more effective in generating revenue than displaying static ads.

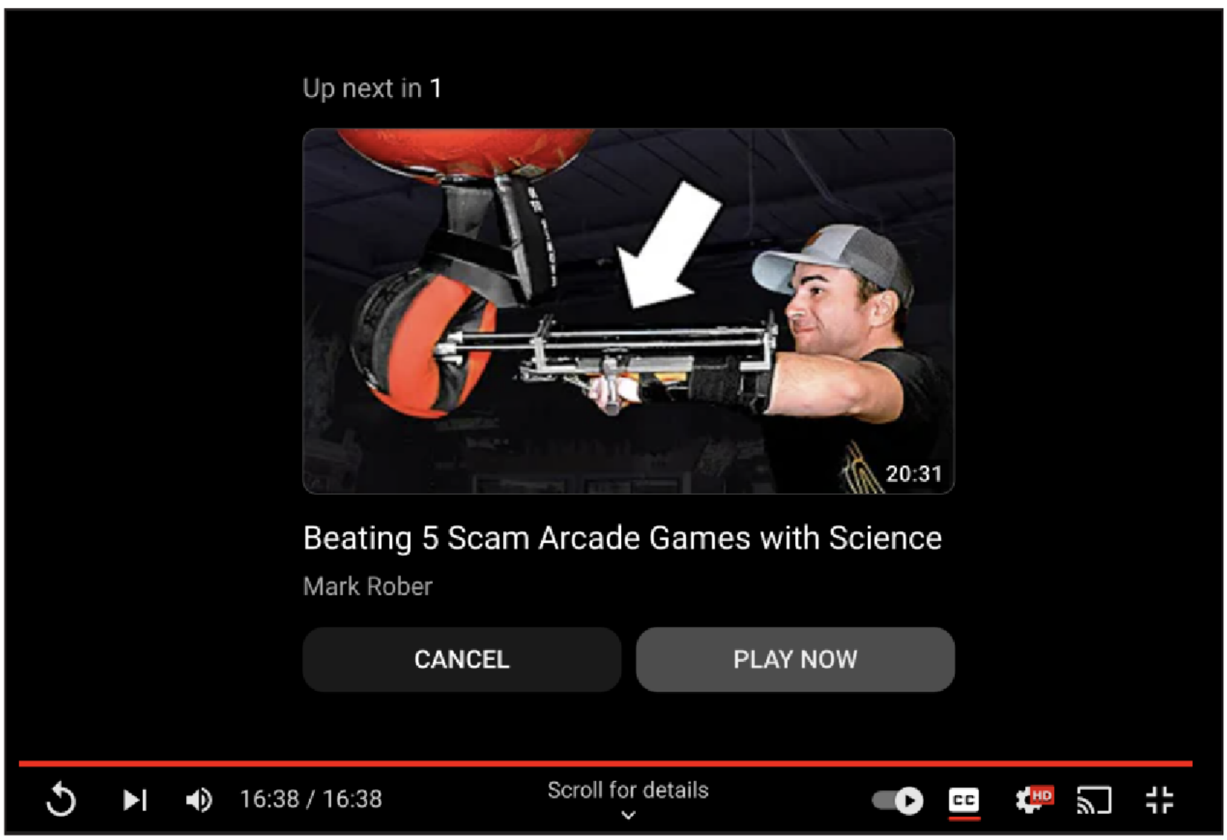


Figure 12-3. YouTube autoplays the next video (source: YouTube, 2023)

Social Affirmation

We humans are inherently social creatures. The drive to fulfill our core needs for a sense of self-worth and integrity extends to our lives on social media,[5] where we seek social rewards (Figure 12-4). Each "like" or positive comment we receive on content we post online temporarily satisfies our desire for approval and belonging. Such social affirmation delivers a side dish of dopamine, the chemical produced by our brains that plays a key role in motivating behavior.

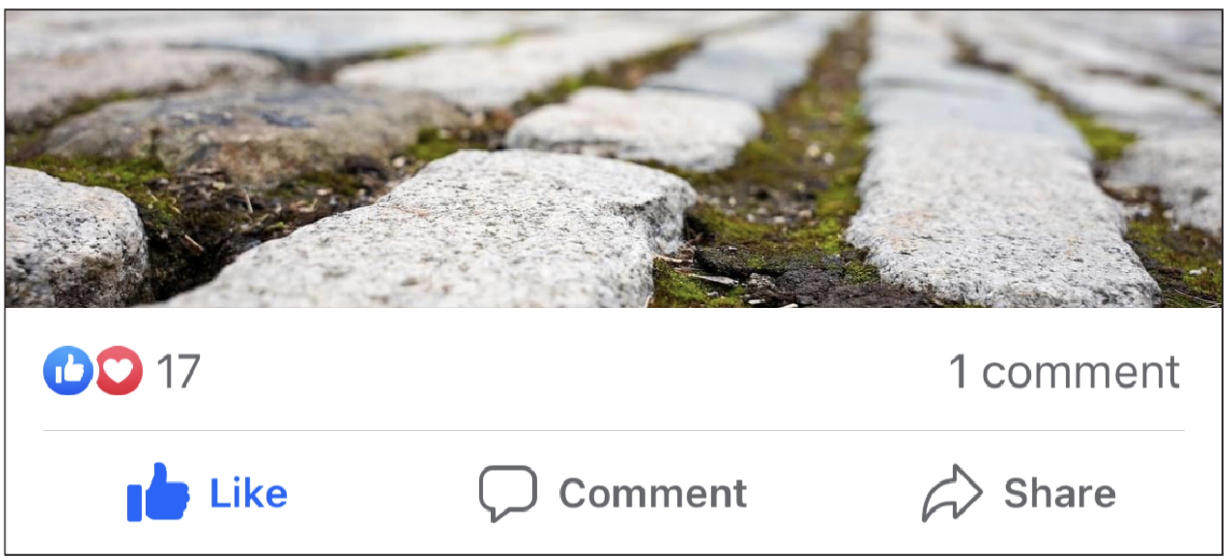


Figure 12-4. Facebook's "like" button, first introduced in 2009 and now a ubiquitous feature in social media (source: Facebook, 2023)

Personalization

Social media platforms frequently make use of machine learning algorithms to personalize experiences through predictive recommendations. They do this by collecting data that simultaneously uses the results to improve itself, producing a feedback loop of random reinforcement. More time spent interacting with content within the platform increases algorithmic quality, resulting in more time spent on the platform, more data signals collected, and more ads viewed. The more personalization a platform can achieve, the more relevance for users, which leads to more time spent on the platform and improved conversion rates. Take, for example, TikTok, which utilizes its interface to capture data signals in the form of user interaction in order to personalize content recommendations engineered to keep users on the platform longer (Figure 12-5). The unfortunate downside to this degree of personalization is that it can lure users deep into an addictive rabbit hole of increasingly extreme content or expose them to information and opinions that conform to and reinforce their preexisting beliefs and biases (commonly referred to as a *filter bubble*). Additionally, research suggests this sort of content consumption can lead to a significant decrease in attention span and working memory.

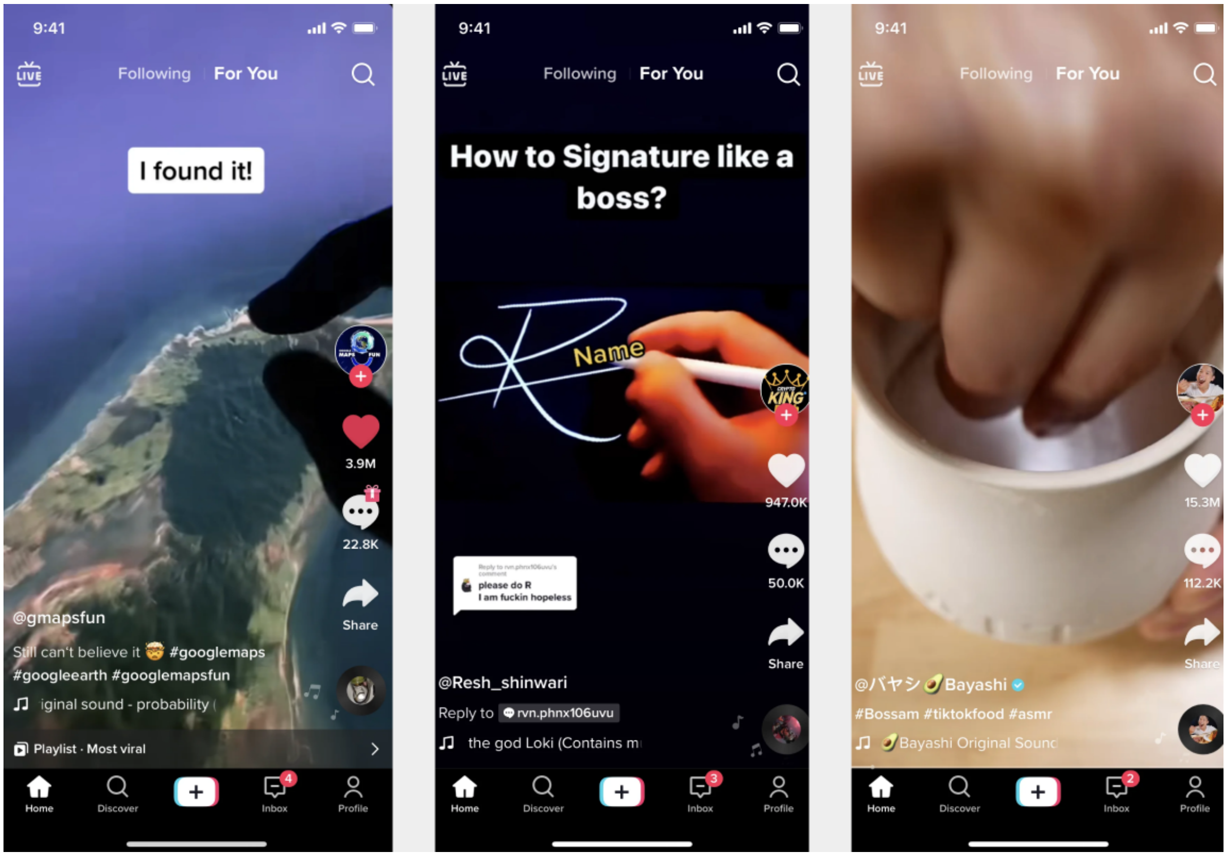


Figure 12-5. TikTok's personalized content recommendations powered by machine learning algorithms (source: Tiktok, 2023)

Defaults

Default settings matter when it comes to choice architecture because most people never change them. These settings, therefore, have incredible power to steer decisions, even when people are unaware of what's being decided for them. As a result, defaults can often exert influence over people in a way that's not always aligned with their best interest. For example, a 2011 study found that Facebook's default privacy settings (Figure 12-6) matched users' expectations only 37% of the time, leading to their content and personal information being visible to more people than they expected.[6]

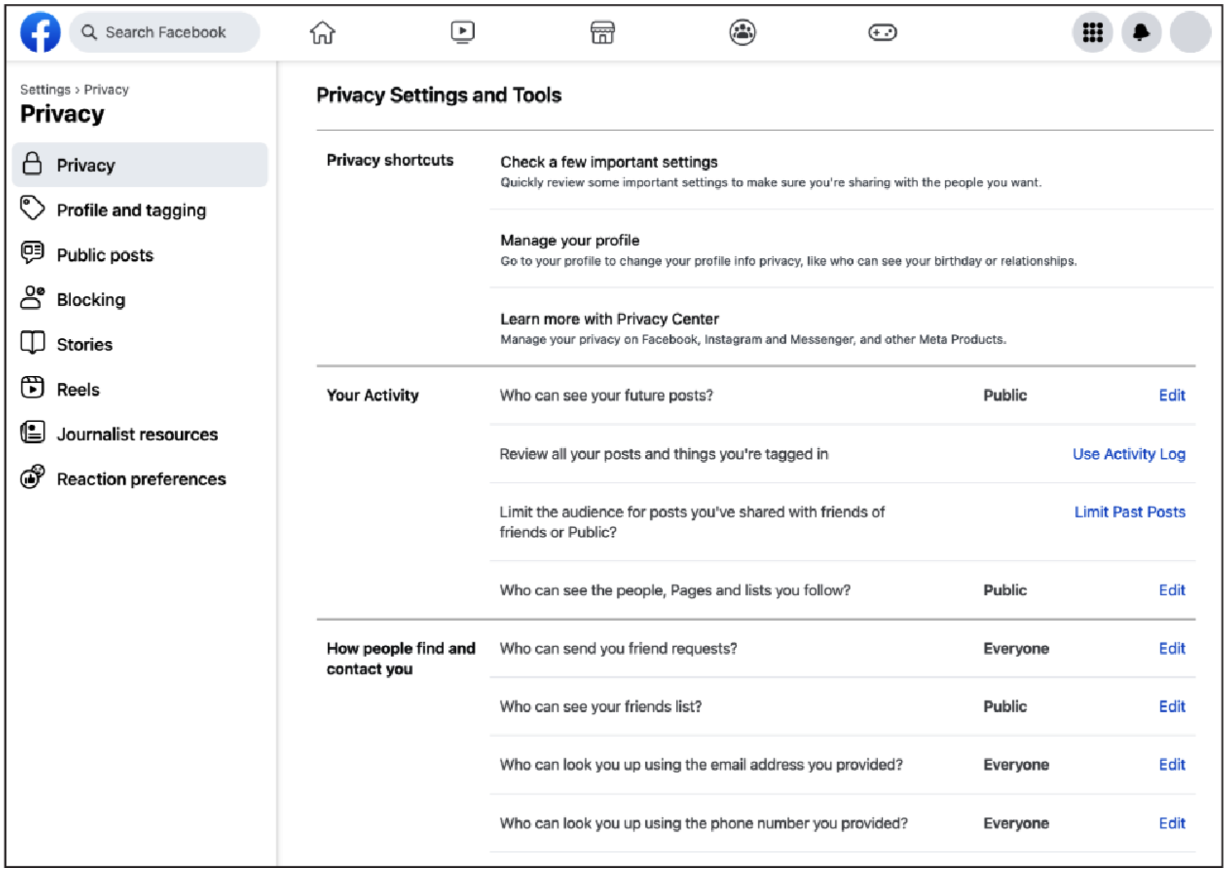


Figure 12-6. Facebook's privacy settings (source: Facebook, 2023)

Despite these potential mismatches, studies suggest that default options often lead people to rationalize their acceptance and reject alternatives.[7]

(Lack of) Friction

Another way to shape behavior with digital products and services is to remove as much friction as possible—especially friction around actions you want people to take. In other words, the easier and more convenient you make an action, the more likely people will be to perform that action and form a habit around it. Take, for example, Amazon Dash buttons (Figure 12-7), small electronic devices that enabled customers to order frequently used products simply by pressing a button, without even visiting the Amazon website or app. The physical buttons have since been deprecated in favor of digital-only versions, but this example illustrates just how far companies will go to shape behavior by attempting to remove as many obstacles as possible.

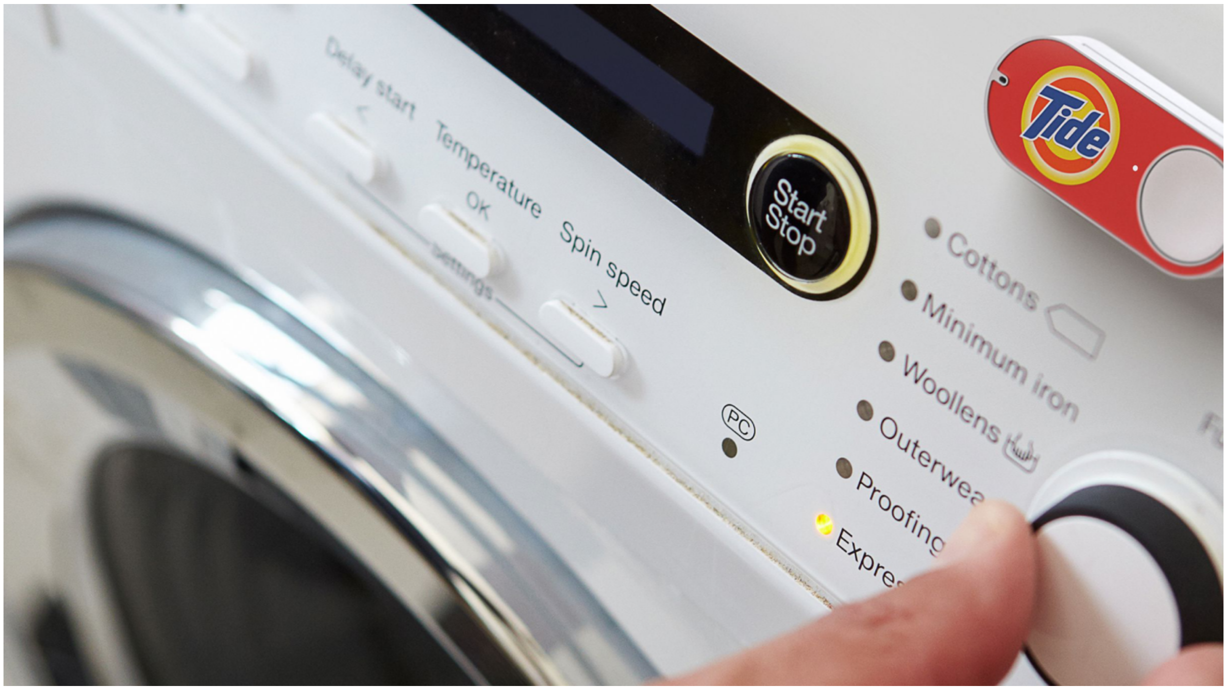


Figure 12-7. An example of Amazon's now-deprecated Dash button (source: Amazon, 2019)

Reciprocity

Reciprocation, or the tendency to repay the gestures of others, is a strong impulse we share as human beings. It's a social norm we've come to value and even rely on as a species. It's also a strong determining factor of human behavior that can be exploited, intentionally or not. Technology can tap into our impulse to reciprocate the gestures of others and shape our behavior as a result. Take, for example, LinkedIn, which utilizes reciprocity to keep users coming back to the platform in order to accept a connection request, respond to a direct message, or endorse someone back for a skill. When someone invites you to connect on LinkedIn, they may not have actively chosen to invite you but instead are simply responding to the platform's list of suggested contacts (Figure 12-8). In other words, your own unconscious desire to add someone may turn into a social obligation that the other person feels compelled to reciprocate. The end result is more time spent on the platform by both people and more profit for LinkedIn.

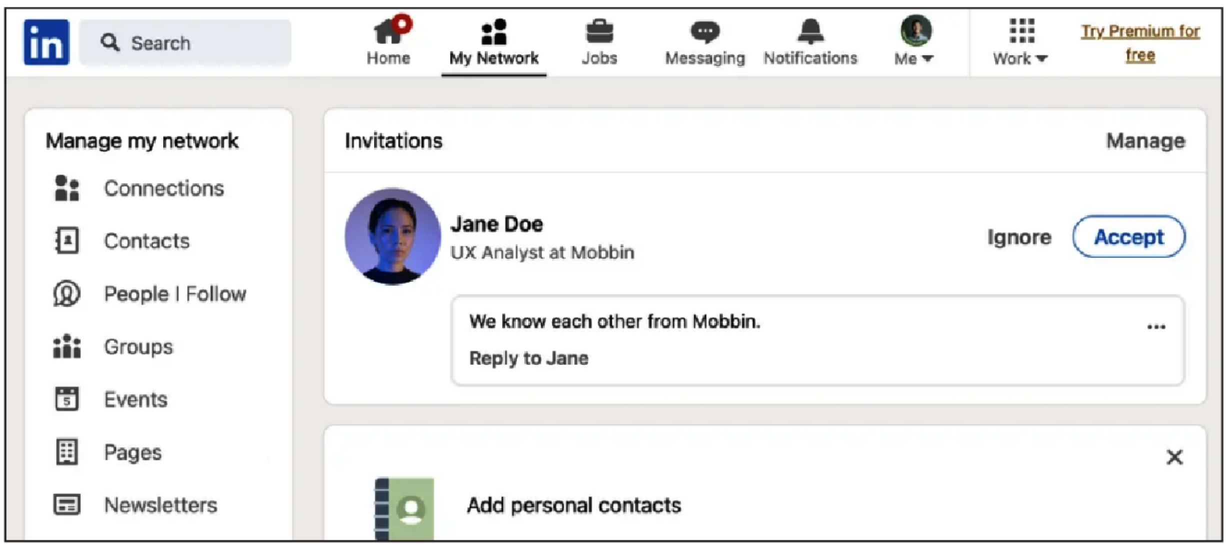


Figure 12-8. LinkedIn connection request notification (source: LinkedIn, 2023)

Dark Patterns

Dark patterns are yet another way technology can be used to influence behavior, by making people perform actions that they didn't intend to for the sake of increasing engagement or to convince users to complete a task that is not in their best interest (make a larger purchase, share unnecessary information, accept marketing communications, etc.). Unfortunately, these deceptive techniques can be found all over the internet. In a 2019 study, researchers from Princeton University and the University of Chicago analyzed about 11,000 shopping websites looking for evidence of dark patterns. Their findings were nothing short of alarming: they identified 1,818 instances of dark patterns, with the more popular sites in the sample being more likely to feature them.[8] To illustrate, consider Instagram, which makes use of the forced action pattern by providing no alternative option but to allow access to private data in order to proceed (Figure 12-9).

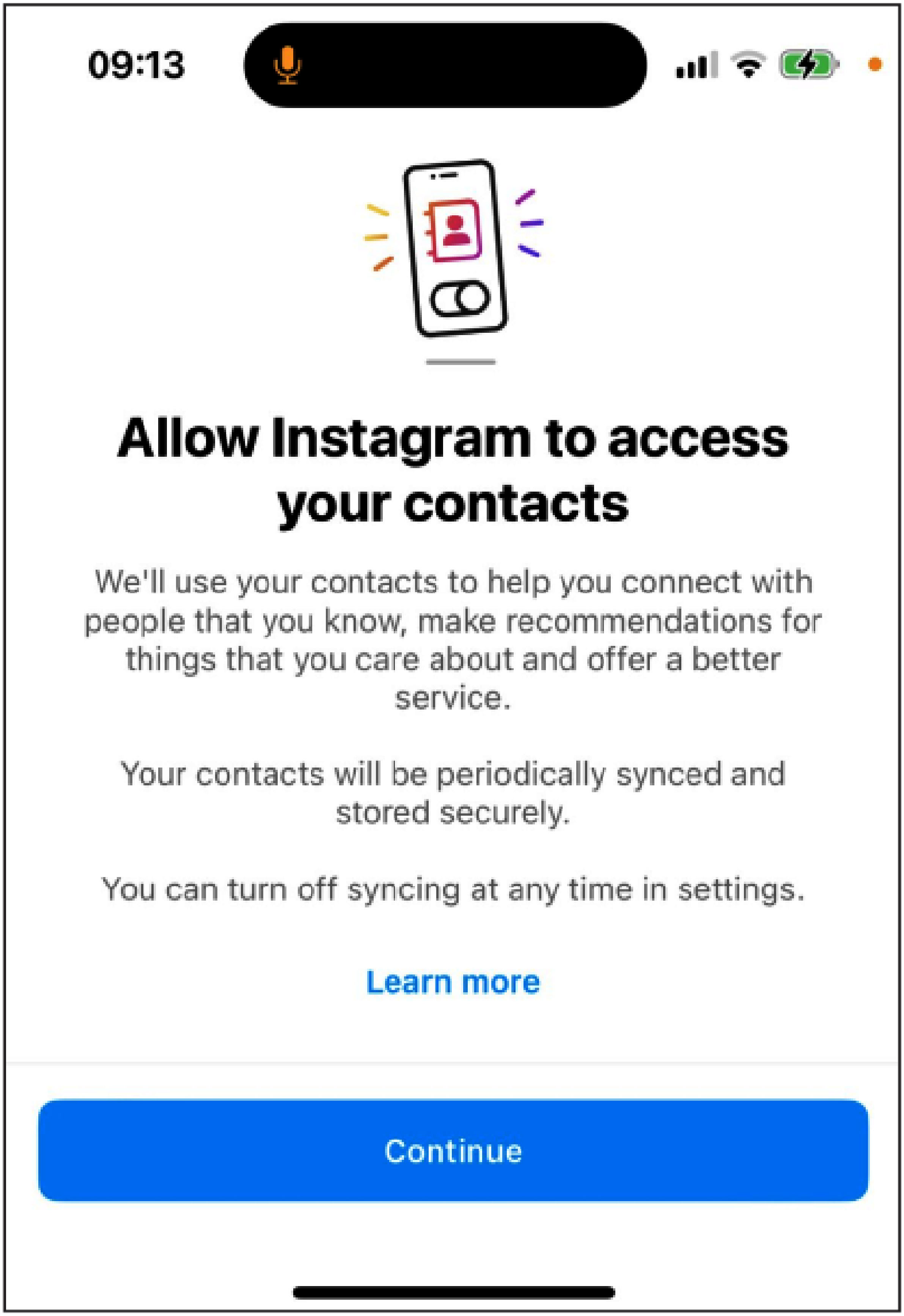

09:13
Allow Instagram to access your contacts
We'll use your contacts to help you connect with people that you know, make recommendations for things that you care about and offer a better service.
Your contacts will be periodically synced and stored securely.
You can turn off syncing at any time in settings.
Learn more
Continue

Figure 12-9. An example of the forced action dark pattern (source: Instagram, 2023)

These are only some of the more common methods by which technology can be used to shape behavior in subtle ways. Data collected about user behavior can be used to fine-tune how a system responds to an individual, and these methods are constantly increasing in sophistication and accuracy, while the psychological hardware we share as humans remains the same. Now, more than ever, it's important that designers consider the ethics of influencing behavior.

Why Ethics Matter

Now let's explore why exploitative technology should matter to those in the technology industry. It seems as if digital technology grows increasingly more embedded in our daily lives with each passing year. Since the arrival of the smartphone and other "smart" devices, we've become more and more reliant on the miniaturized computers we keep in our pockets, wear on our wrists, embed in our clothing, or carry in our bags. Everything from transportation and accommodation to food and consumer goods is just a few taps and swipes away, all thanks to these convenient little digital companions. The convenience these devices bring us is liberating and empowering, but it is not without consequences. Sometimes companies with the best of intentions create technology that ultimately produces unintended results.

Good Intentions, Unintended Consequences

Companies seldom set out to create harmful products and services. When Facebook introduced the “like” button in 2009, it probably didn’t intend for the feature to become such an addictive feedback mechanism, providing a small dopamine hit of social affirmation to users who found themselves returning to the app time and time again to measure their self-worth. Facebook probably also didn’t intend for people to spend so many hours mindlessly scrolling through their news feeds once infinite scrolling was introduced. Snapchat probably didn’t intend for its filters to change how many see themselves or present themselves to others, or to drive some to pursue cosmetic surgery in an effort to recreate the look provided by the filters in the app. And it surely didn’t intend for the app’s disappearing videos to be used for sexual harassment or to become a haven for sexual predators.

Sadly, I could fill a whole chapter with examples like these—but I think you get the point. It’s hard to imagine these companies intended the negative consequences that resulted from the services they provided or the features they introduced. And yet those consequences did occur, and the harm created by these examples and countless others is not excusable just because it was unintended by the creators.

Things have moved so fast in the technology industry that we haven't always had time to see the things that have been broken in the process. Now the research is starting to catch up and enlighten us about the lasting effects of "progress." It appears that the mere presence of our smartphones reduces our available cognitive capacity, even when the devices are turned off.[9] Additionally, links have been made between social media use and its disturbing effects on some of society's most vulnerable: increases in depression and loneliness in young adults[10] and a rise in suicide-related outcomes or deaths among adolescents.[11] Unfortunate side effects like these continue to surface as researchers take a closer look at the ways in which technology is impacting people's lives and society as a whole.

The Ethical Imperative

Human vulnerabilities often get exploited on digital platforms that lose sight of the human problems that they once sought to solve. The same technology that enables us to so easily purchase, connect, or consume can also distract us, affect our behavior, and impact the relationships we have with others around us. Psychology and its application in user experience design plays a critical role in all of this: behavior design is useful for keeping people “hooked,” but at what cost? When did “daily active users” or “time on site” become a more meaningful metric than whether a product is actually helping people achieve their goals or facilitating meaningful connections?

Ethics must be an integral part of the design process, because without this check and balance, there may be no one advocating for the end user within the companies and organizations creating technology. The commercial imperatives to increase time on site, streamline the consumption of media and advertising, or extract valuable data don’t match up with human objectives of accomplishing a task, staying connected with friends or family, and so on. In other words, the corporate goals of the business and the human goals of the end user are seldom aligned, and more often than not, designers are a conduit between them. If behavior can be shaped by technology, who holds the companies that build technology to account for the decisions they make?

It’s time that designers confront this tension and accept that it’s our responsibility to create products and experiences that support and align with the goals and well-being of users. In other words, we should build technology that augments the human experience rather than replacing it with virtual interaction and rewards. The first step in making ethical design decisions is to acknowledge how the human mind can be exploited. We must then take accountability for the technology we help to create and ensure it respects people's time, attention, and overall digital well-being. No longer is "moving fast and breaking things" an acceptable means of building technology—instead, we must slow down and be intentional with the technology we create and consider how it's impacting people's lives.

Slow Down and Be Intentional

To ensure we are building products and services that support the goals of the people using them, it's imperative that ethics are integrated into the design process. The following are a few common approaches to ensuring the *human* part of "human-centered design" remains at the forefront.

Think Beyond the Happy Path

Scenarios provide a frame of reference for designers—they're essential to defining critical features and functionality that must be available when a person uses a product or service. Unfortunately, teams that move fast and break things tend to focus exclusively on the idealized scenarios around idealized users that provide the path of least resistance. These "happy paths" are, by their very nature, devoid of use cases for when things go wrong outside of simple technical errors. This means that failure to anticipate the long-term consequences of design decisions in favor of short-term gain often leads to negligent and sometimes harmful outcomes. In other words, technology that scales without considering scenarios that stray from the happy path become ticking time bombs that leave the people existing outside these idealized scenarios vulnerable.

A better approach is to change the definition of the minimum viable product (MVP) to focus on nonideal scenarios first, as opposed to the path of least resistance. By placing edge cases at the center of our thinking, we can ensure that we're creating more resilient products and services that consider the most vulnerable cases by default.

Diversify Teams and Thinking

Homogeneous teams often have difficulty identifying blind spots that exist outside their own shared life experiences. This inevitably leads to less-resilient products and services, which can have disastrous results when things go wrong. To avoid the pitfalls of homogeneous thinking, there are a number of things that teams responsible for building technology can do. First, they can ensure they're as diverse as possible—a team comprising different genders, races, ages, and backgrounds brings a broader spectrum of human experience into the design process from the outset. It's also important to ensure the personas derived from target audience research aren't exclusively focused on the user segments considered essential for an MVP—the more diverse the audience you design for, the more likely it is that you'll catch blind spots before they become bigger problems.

Look Beyond Data

Quantitative data tells us lots of useful things, such as how quickly people are performing tasks, what they are looking at, and how they are interacting with the system. What this data doesn't tell us is why users are behaving a certain way or how the product is impacting their lives. It's critical to consider other metrics in order to gain insight into the *why*, and to do that we must both listen and be receptive to our users. This means getting out from behind a screen, talking with them, and then using this qualitative research to inform how we evolve the design in an impactful way.

Technology has the ability to significantly affect people's lives, and it's crucial that we ensure that impact is positive. It's our responsibility to create products and experiences that support and align with the goals and well-being of users. We can make ethical design decisions by acknowledging how the human mind can be exploited and take accountability for our work by thinking beyond the happy path scenarios, building more diverse teams, and talking with users to gain qualitative feedback on how the products and experiences we build affect their lives.

Embrace Friction

Steve Jobs once referred to the personal computer as a "bicycle for the mind": a tool that could expand our capabilities and improve our lives. Fast-forward to now, and in many ways, that's exactly what has been achieved. Many of us carry personal computers small enough to fit in our back pockets, with more computing power than anything available at the time of Jobs's famous analogy. But we've also seen something that perhaps Jobs didn't anticipate: instead of technology enhancing our abilities as humans, it's become a vehicle for extracting our attention, monetizing our personal information, and exploiting our psychological vulnerabilities.

At the heart of this effort is the total elimination of friction. We've been made to think that any friction within a user journey is negative and should be eliminated wherever possible, to the point that *frictionless* has become synonymous with good user experience. But friction can also be a valuable tool when used appropriately, from preventing errors, enhancing security, and avoiding unintentional actions and consequences to building credibility, promoting critical thought, or encouraging moderation. We can embrace friction to prevent abuse, protect privacy, steer people toward healthier digital habits, and encourage the consideration of long-term consequences versus short-term gain.

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About the Author

Jon Yablonski is a multidisciplinary designer who specializes in simplifying complex technology and making it intuitive through user research and interaction design. With over a decade of experience in design and development across various industries such as entertainment, retail, automotive, aerospace, and product, Jon brings a deep understanding of the relationship between human psychology and technology. When he's not creating journey maps or crafting prototypes, Jon is creating digital tools to help designers, such as such as Laws of UX and Humane by Design.

Colophon

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