

HUMAN-AI INTERACTION

Eunsuk Kang

Required reading:

Building Intelligent Systems by Geoff Hulten (2018), Chapter 8.

Guidelines for Human-AI Interaction. Saleema Amershi, et al., in CHI 2019.

Optional reading:

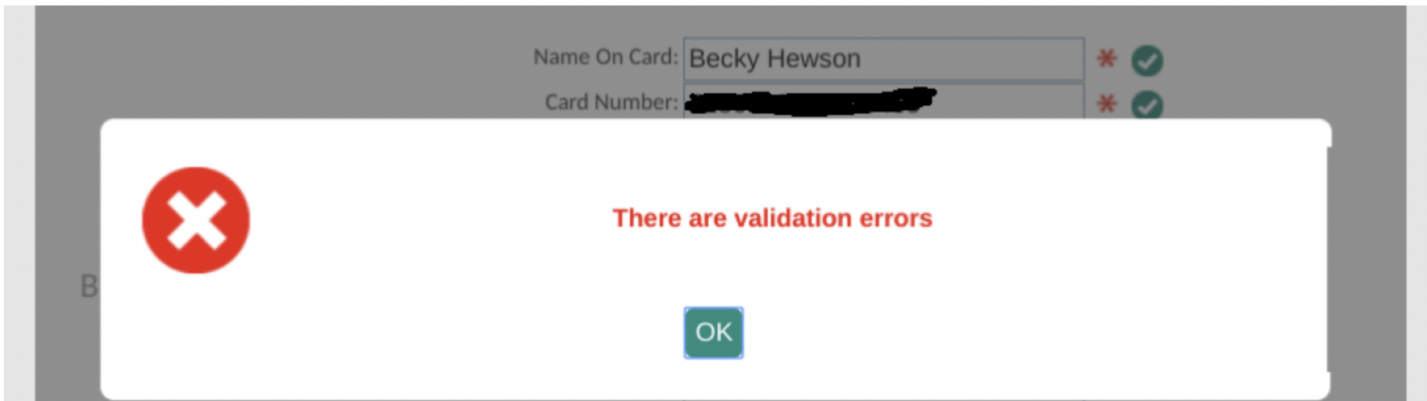
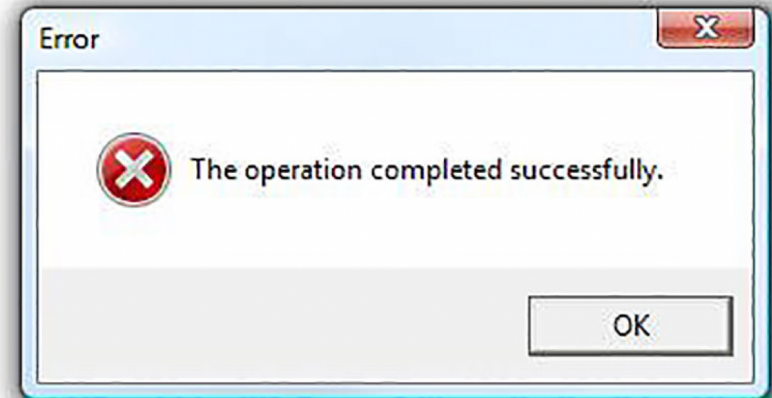
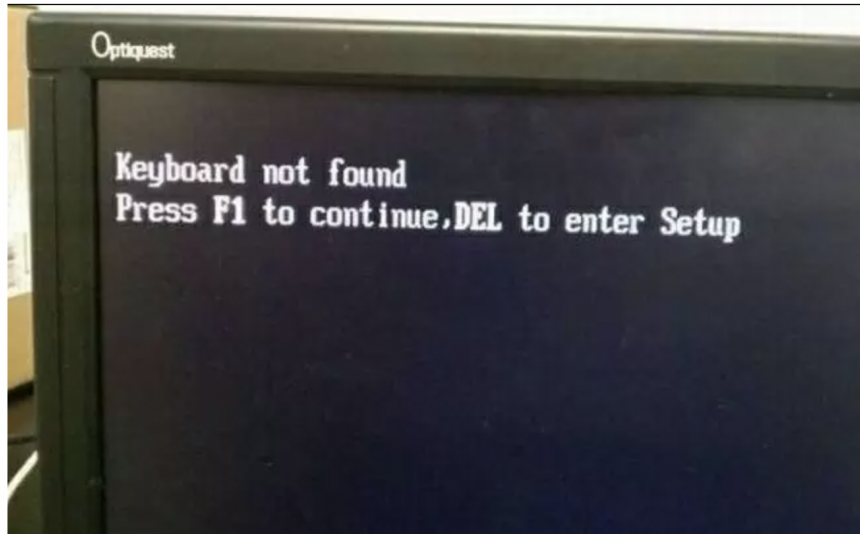
Will You Accept an Imperfect AI? Exploring Designs for Adjusting End-user Expectations of AI Systems. Kocielnik, et al., in CHI 2019

LEARNING GOALS

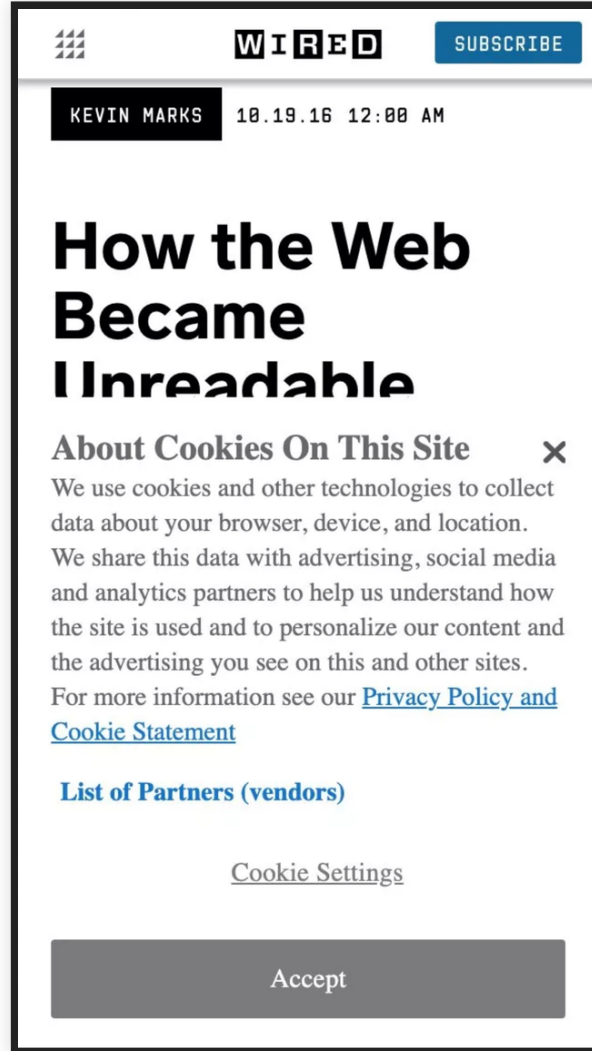
- Understand the risks of poor interaction design
- Understand the challenges behind designing human-AI interactions
- Understand the basic elements of user interaction design
- Consider design considerations for AI-based systems
 - Modes of interaction: Automate or augment?
 - Mental model: User understanding of what AI is doing
 - Dealing with errors: Guide user towards recovery & prevention
 - Feedback and control: Align user feedback with AI improvement

RISKS OF POOR INTERACTION DESIGN

POOR INTERACTION DESIGN CONFUSES USERS



POOR INTERACTION DESIGN ANNOYS USERS



The image shows a screenshot of a Wired article page. At the top, there is a navigation bar with the Wired logo, the word "WIRED" in a stylized font, and a "SUBSCRIBE" button. Below the navigation bar, the author's name "KEVIN MARKS" and the date "10.19.16 12:00 AM" are displayed. The main headline of the article is "How the Web Became Unreadable". A cookie consent overlay is positioned in the middle of the page, partially obscuring the article text. The overlay has a title "About Cookies On This Site" with a close button (X). The text of the overlay explains that cookies are used to collect data about the user's browser, device, and location, and that this data is shared with advertising, social media, and analytics partners. It provides a link to the "Privacy Policy and Cookie Statement" and a link to a "List of Partners (vendors)". At the bottom of the overlay, there is a "Cookie Settings" link and a large "Accept" button.

WIRED SUBSCRIBE

KEVIN MARKS 10.19.16 12:00 AM

How the Web Became Unreadable

About Cookies On This Site ×

We use cookies and other technologies to collect data about your browser, device, and location. We share this data with advertising, social media and analytics partners to help us understand how the site is used and to personalize our content and the advertising you see on this and other sites. For more information see our [Privacy Policy and Cookie Statement](#)

[List of Partners \(vendors\)](#)

[Cookie Settings](#)

Accept

POOR INTERACTION DESIGN HINDERS USERS

APPLE \ MOBILE \ TECH \

What happened to Apple design?

Unapologetically bad



POOR INTERACTION DESIGN CAUSES HARM

Alexa recorded a woman's private conversation and sent it to a random contact

Kyle Wiggers

@Kyle_L_Wiggers

May 24, 2018 7:38 AM

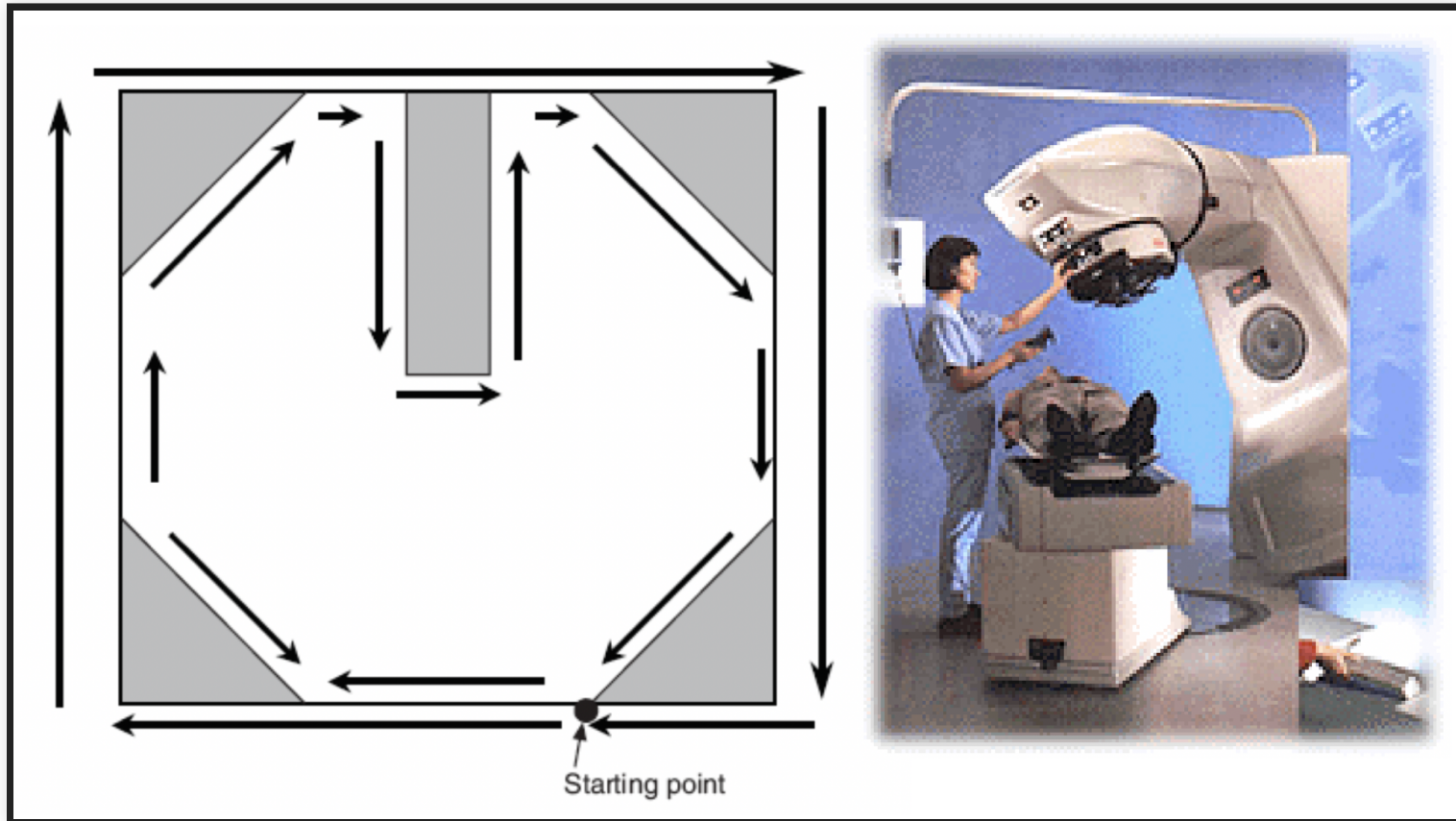
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POOR INTERACTION DESIGN CAUSES HARM

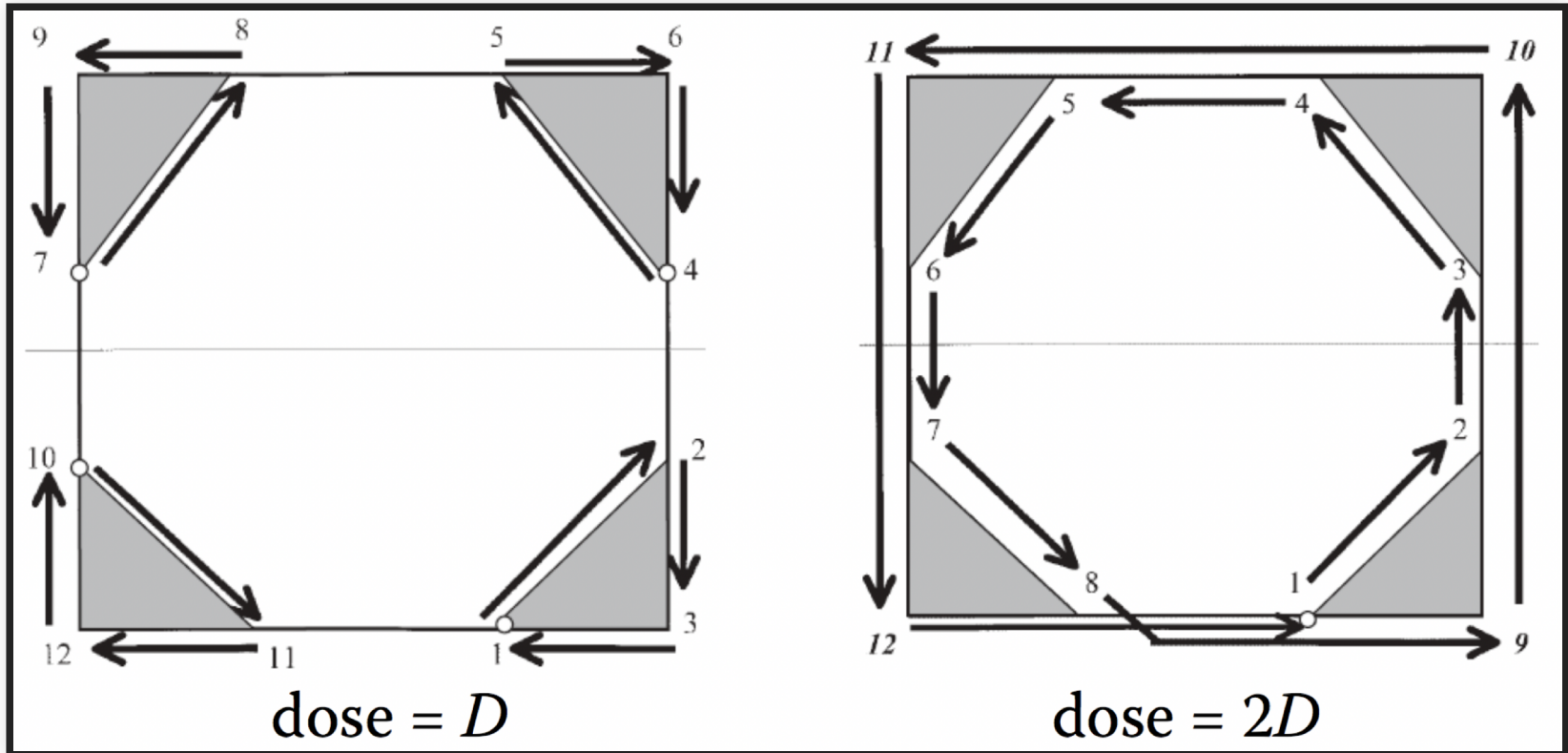


POOR INTERACTION DESIGN CAUSES HARM



- Radiation therapy system at Panama City public hospital (2001)
 - Therapist draws block shapes to determine treatment area
 - Software computes final radiation settings

POOR INTERACTION DESIGN CAUSES HARM



- Same shape drawn in different order, double the radiation dose
- 28 patients overdosed; 8 dead
 - Therapists charged with 2nd degree murder (but are they really to blame?)

RISKS OF POOR INTERACTION DESIGN

- Interaction design is not just about visual presentation!
- Poor interaction design can:
 - Cause confusion or misunderstanding
 - Prevent the user from effectively performing their task
 - Increase mental and physical burden
 - Drive users away from the product
 - Contribute to security or privacy issues
 - Cause physical (injuries, deaths) and societal harms (bias, misrepresentation)

USABILITY CONCEPTS

DIMENSIONS OF USABILITY

<https://www.nngroup.com/articles/usability-101-introduction-to-usability/>

DIMENSIONS OF USABILITY

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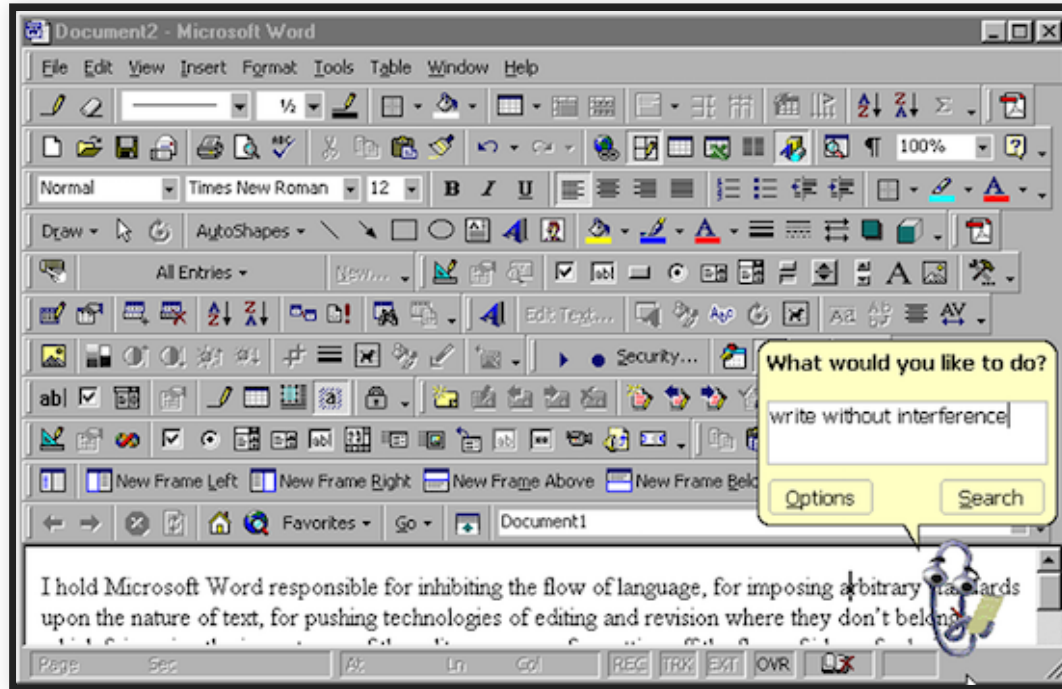
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- Errors: How often do users make errors, how severe are these errors, and how easily can they recover from the errors?
- Satisfaction: How pleasant is it to use the design?

<https://www.nngroup.com/articles/usability-101-introduction-to-usability/>

INTERACTION COST



- Mental and physical effort needed to perform a desired task
 - Task memorization & recall, context switch, track system state
 - Reading, scrolling, clicking, typing, waiting for UI changes
- **Goal of usable design:** Minimize interaction cost while allowing users to perform their tasks

USABILITY & AI



- AI has potential to greatly reduce interaction costs
 - Automate tasks through personalization & predictions
- But also introduces new challenges
 - **Unpredictability:** AI makes mistakes, sometimes unexpectedly
 - **Opaqueness:** User has difficulty understanding how system works
 - **Evolution:** AI behavior changes over time, surprising users

DESIGN CONSIDERATIONS FOR AI

- **Modes of interaction:** Automate or augment?
- **Mental model:** User understanding of what AI is doing
- **Dealing with errors:** Guide user towards recovery & prevention
- **Feedback and control:** Align user feedback with AI improvement

MODES OF INTERACTION

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- Automate: Take action on user's behalf
- Augment: Provide options or additional information
 - Prompt: Ask the user if an action should be taken
 - Organize: Display a set of items in an order
 - Annotate: Add information to a display
- Hybrid of above

SELECTING APPROPRIATE MODE OF INTERACTION

- Identify the tasks that the user wants to achieve
- For each task, decide between **automate vs. augment**

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 - High stakes & accountability needed

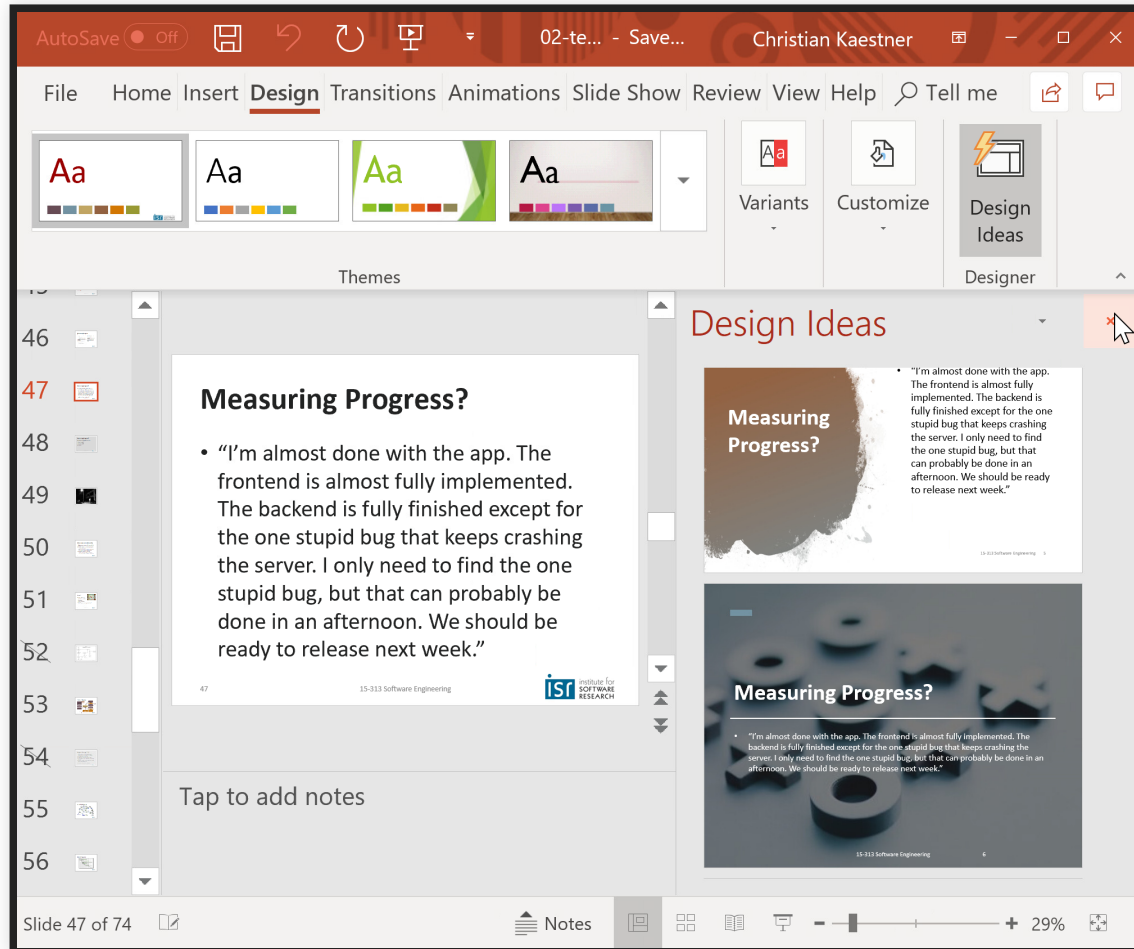
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- Augment when:
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 - Difficult to communicate user's need to AI
 - User enjoys performing the task (e.g., driving)

AUTOMATE OR AUGMENT? WHY?



Design transformations in PowerPoint

AUTOMATE OR AUGMENT? WHY?



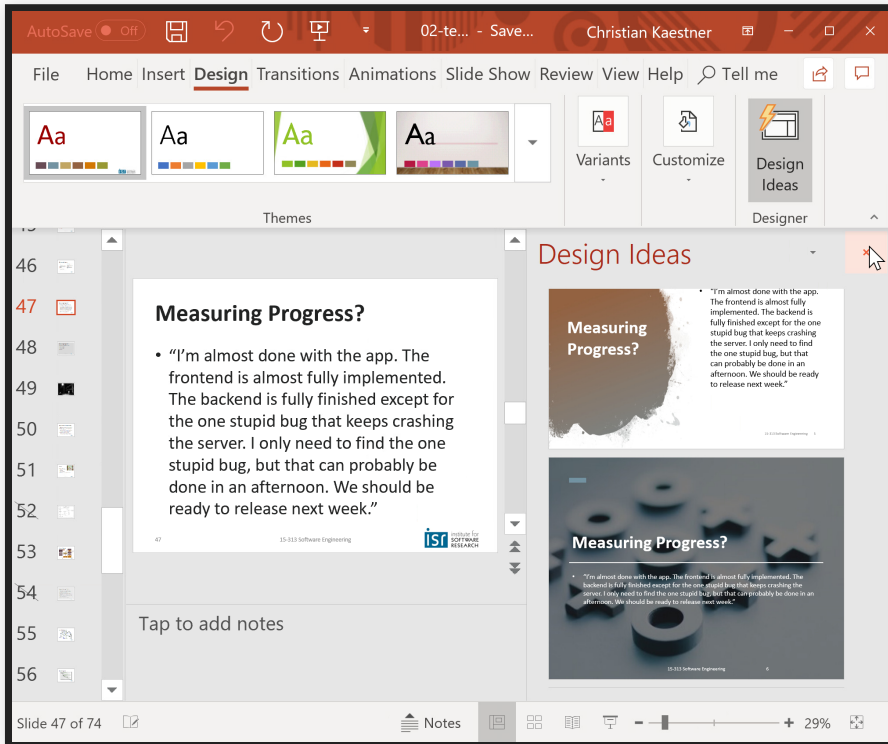
Fall detection in a smartwatch

FACTORS TO CONSIDER

- Forcefulness: How strongly to encourage taking an action?
 - Active: Automate action or interrupt user and ask for confirmation
 - Passive: Suggest action, but do not require immediate answer
- Frequency: How often does interaction occur?
 - When a new prediction is available or model changes
 - Periodically (e.g., suggest action every hour)
 - Only when explicitly initiated by user
- Cost: What is the effect of a wrong prediction?
 - If possible, provide a way to undo the action of AI

FACTORS TO CONSIDER

Slide design transformations:



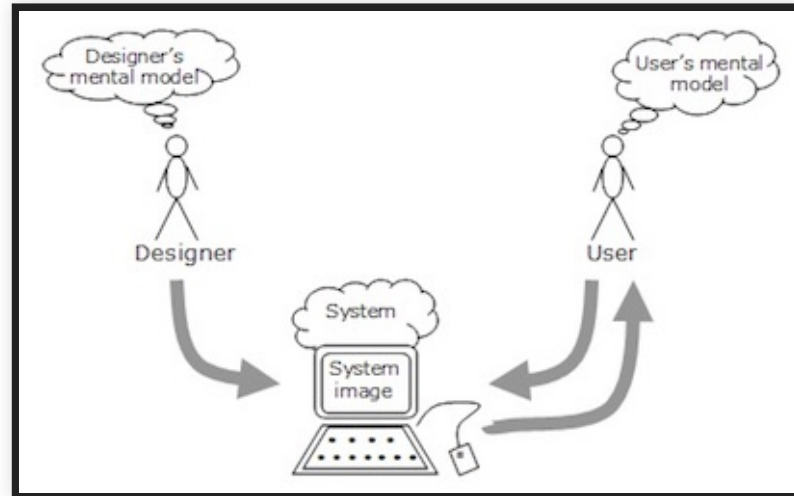
Fall detection:



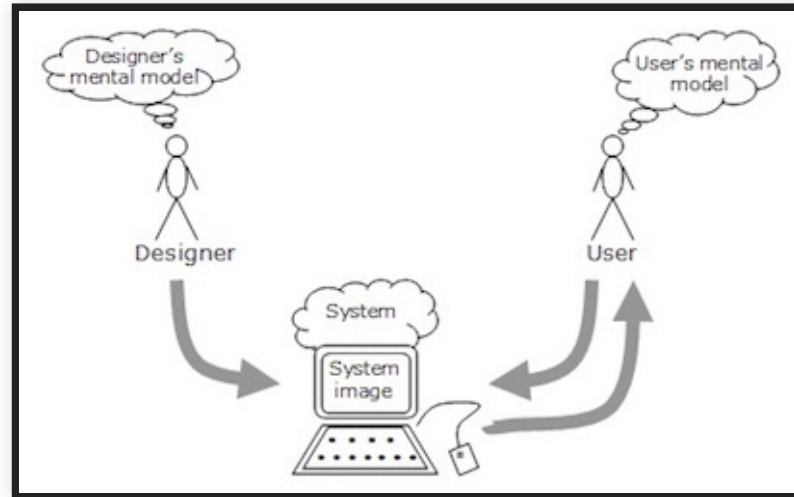
Q. Forcefulness, frequency, cost?

MENTAL MODEL

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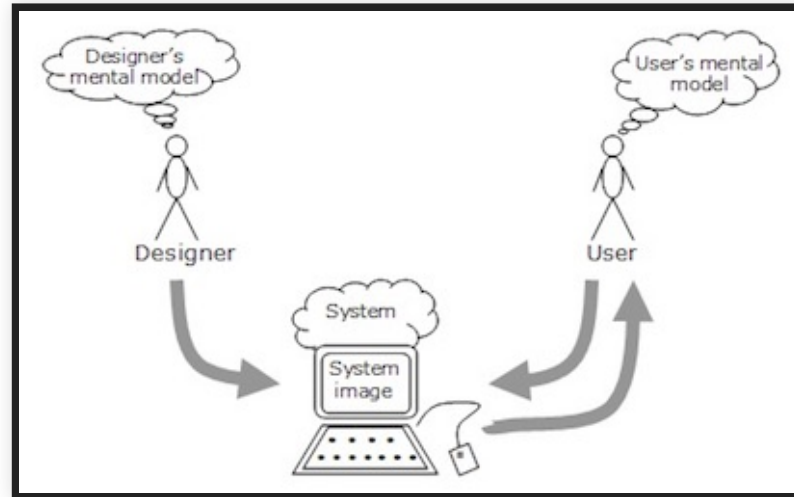


MENTAL MODEL



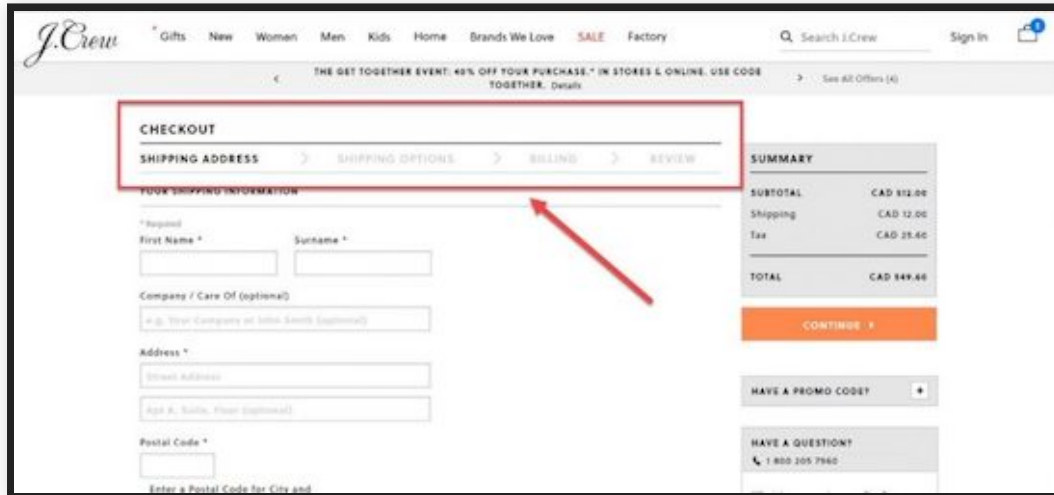
- What the user believes about the system
 - "How does the system work? How does it respond to my actions?"
 - User plans actions and reacts to system based on this mental model

MENTAL MODEL



- What the user believes about the system
 - "How does the system work? How does it respond to my actions?"
 - User plans actions and reacts to system based on this mental model
- Challenge: Aligning system with the user's mental model
 - Inherent mismatch between user's & designer's models
 - User's model may be preconceived based on prior experience
 - User's model and/or system evolves over time

EXAMPLE: SHOPPING CART CHECKOUT



The screenshot shows the J.Crew checkout process. At the top, there's a navigation bar with categories like Gifts, New, Women, Men, Kids, Home, Brands We Love, SALE, and Factory. Below that, a promotional banner reads "THE GET TOGETHER EVENT: 40% OFF YOUR PURCHASE.* IN STORES & ONLINE. USE CODE TOGETHER. Details". The main checkout area is titled "CHECKOUT" and features a progress bar with four steps: "SHIPPING ADDRESS", "SHIPPING OPTIONS", "BILLING", and "REVIEW". A red box highlights this progress bar, and a red arrow points to the "BILLING" step. Below the progress bar, the "YOUR SHIPPING INFORMATION" section contains form fields for "First Name", "Surname", "Company / Care Of (optional)", "Address", and "Postal Code". To the right, a "SUMMARY" table shows the following items:

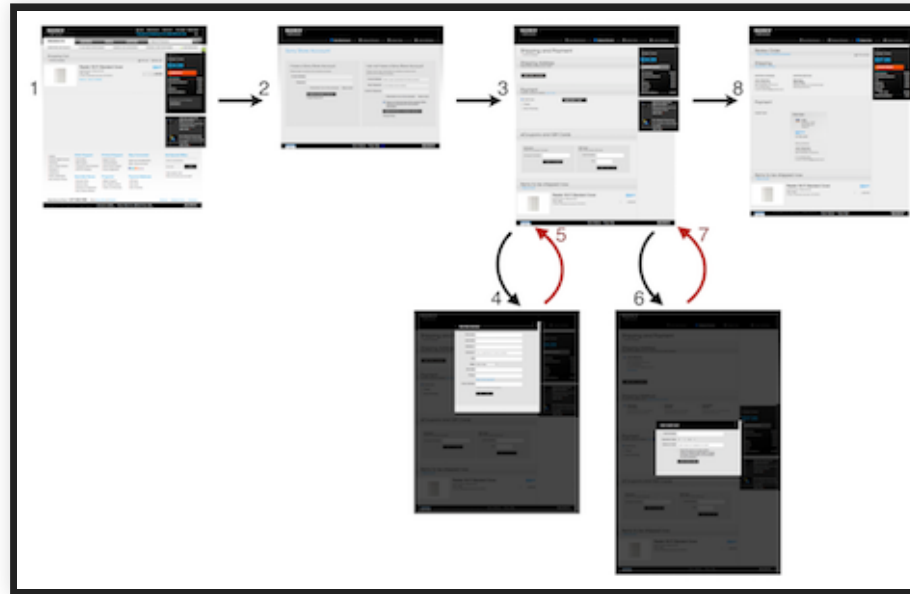
SUMMARY	
SUBTOTAL	CAD 812.00
Shipping	CAD 12.00
Tax	CAD 25.60
TOTAL	CAD 849.60

Below the summary is a "CONTINUE" button and sections for "HAVE A PROMO CODE?" and "HAVE A QUESTION?".

Mental model for shopping cart = A linear sequence of familiar steps

1. Browse for items
2. Add items to cart
3. Choose checkout
4. Enter shipping & billing data
5. Press submit
6. Get confirmation

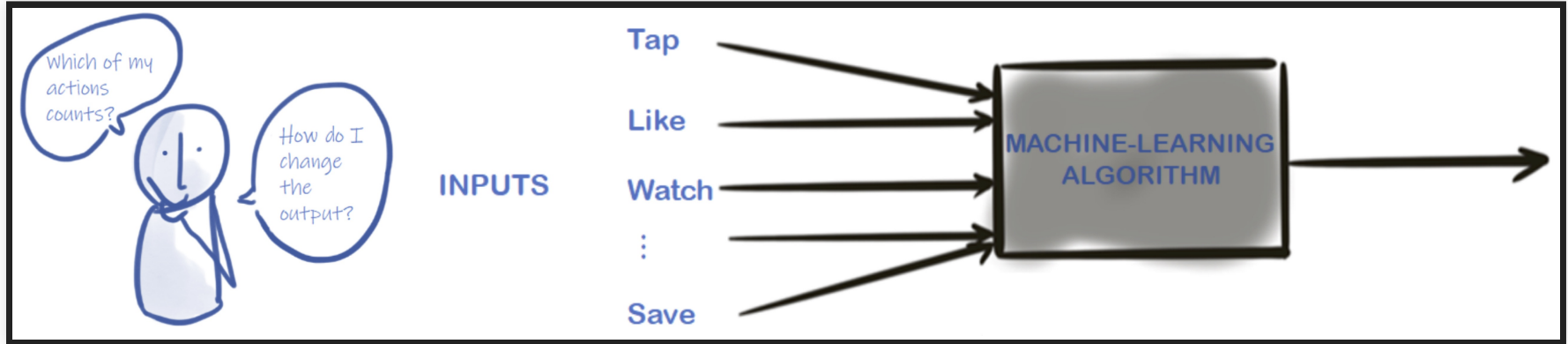
BREAKING MENTAL MODEL



- Anti-pattern: Interrupt linear flow & bring user back to a previous step
 - Create an account, open a new dialog to enter preferred address...
 - Breaks user's mental model => failure to convert into sales
- ~60% of customers abandon their shopping cart

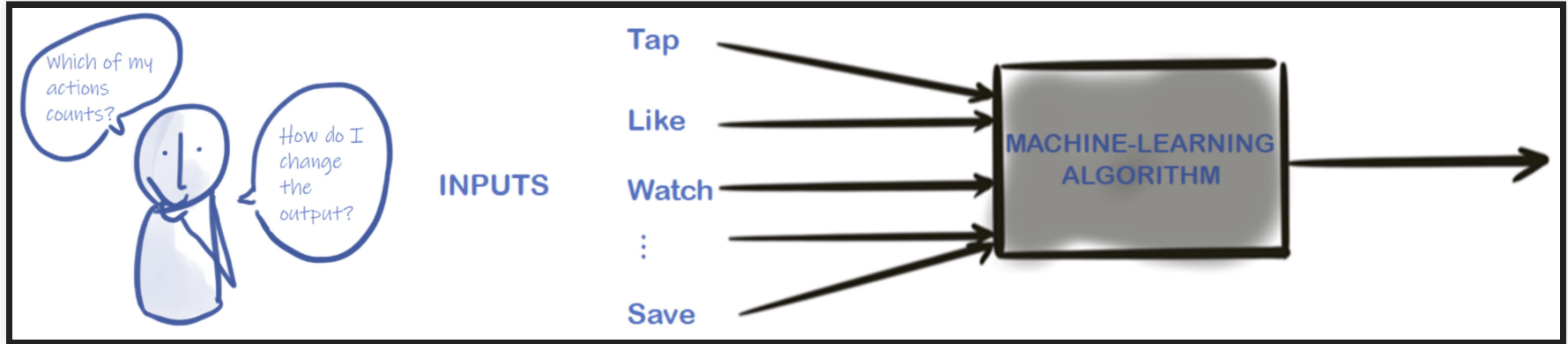
<https://baymard.com/blog/checkout-process-should-be-linear>

MENTAL MODEL FOR AI-BASED SYSTEMS



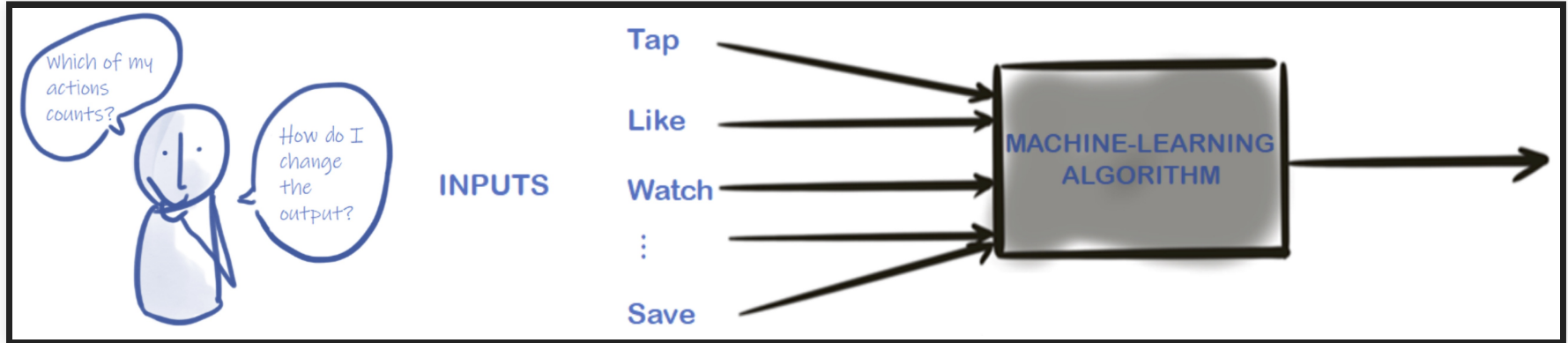
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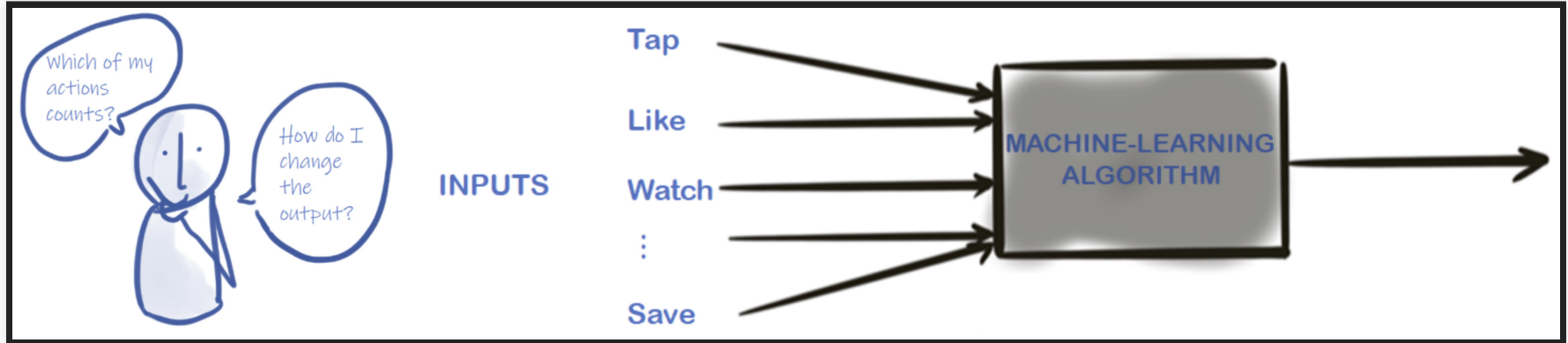
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- Lack of trust over output: How do I know the output is correct?

MENTAL MODEL FOR VOICE ASSISTANTS?



Q. Can you describe what it does? What it can't do?

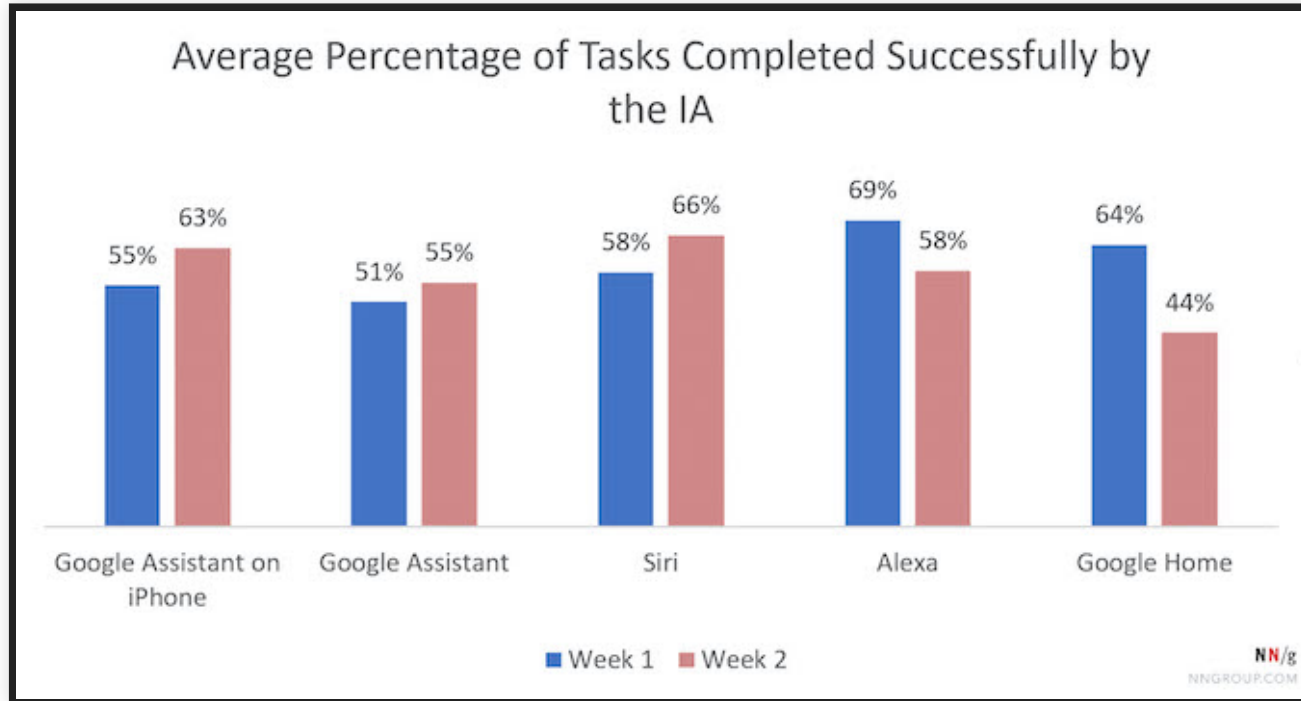
MENTAL MODEL FOR VOICE ASSISTANTS?



- Unclear, inconsistent mental model
 - An interface for other services?
 - "Handy helper"?
 - Knowledge repository? Fact-finding tool?

<https://www.nngroup.com/articles/mental-model-ai-assistants/>

MISALIGNMENT IN VOICE ASSISTANTS



- AI often fails to meet user expectations
 - (1) User doesn't know how to get AI to do X
 - (2) User says X, but AI can't do X well
- Users settle on simple tasks over time; small but limited improvements

<https://www.nngroup.com/articles/mental-model-ai-assistants/>

MISALIGNMENT IN MENTAL MODELS

“So, this week, I realized that I don't use my IA nearly as much as I thought I did. I do use it often. However it's very much normally the same like five things over and over again.”

- User settles on a suboptimal mental model & fails to benefit from the full capabilities of AI

<https://www.nngroup.com/articles/mental-model-ai-assistants/>

PRINCIPLES FOR ALIGNING MENTAL MODEL

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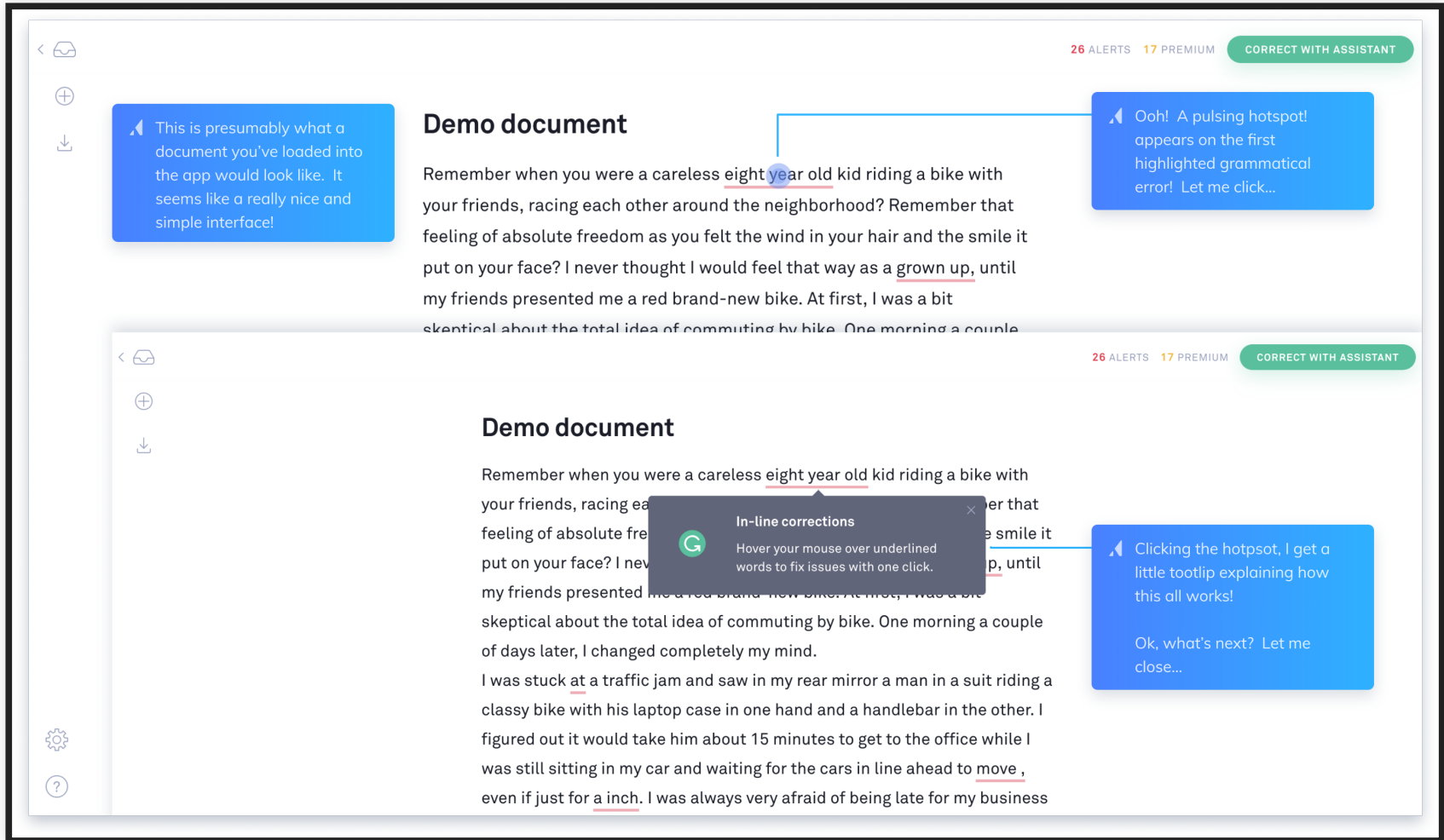
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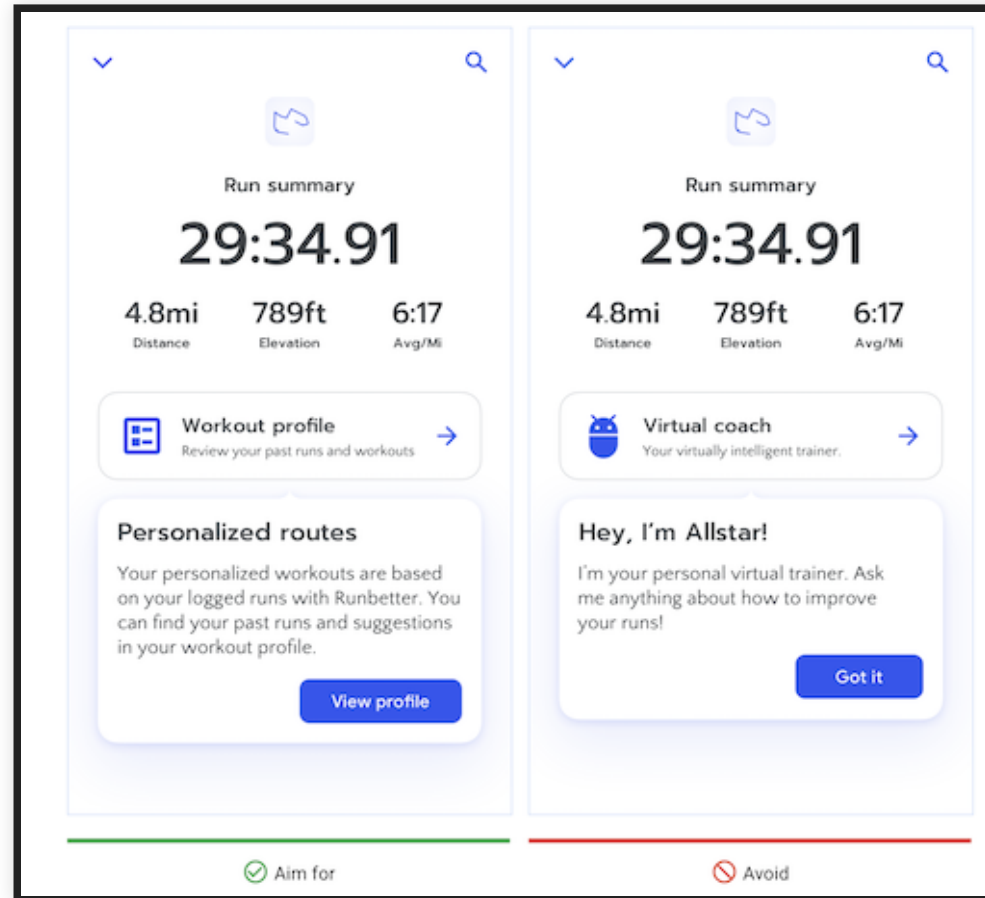
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- Improve/adjust the user's mental model
 - Set the user's expectations through onboarding
 - Increase transparency and explain decisions made by AI
 - Allow user to adjust system behavior to match their expectations

ONBOARDING: SET USER EXPECTATIONS



- Provide examples of how it works

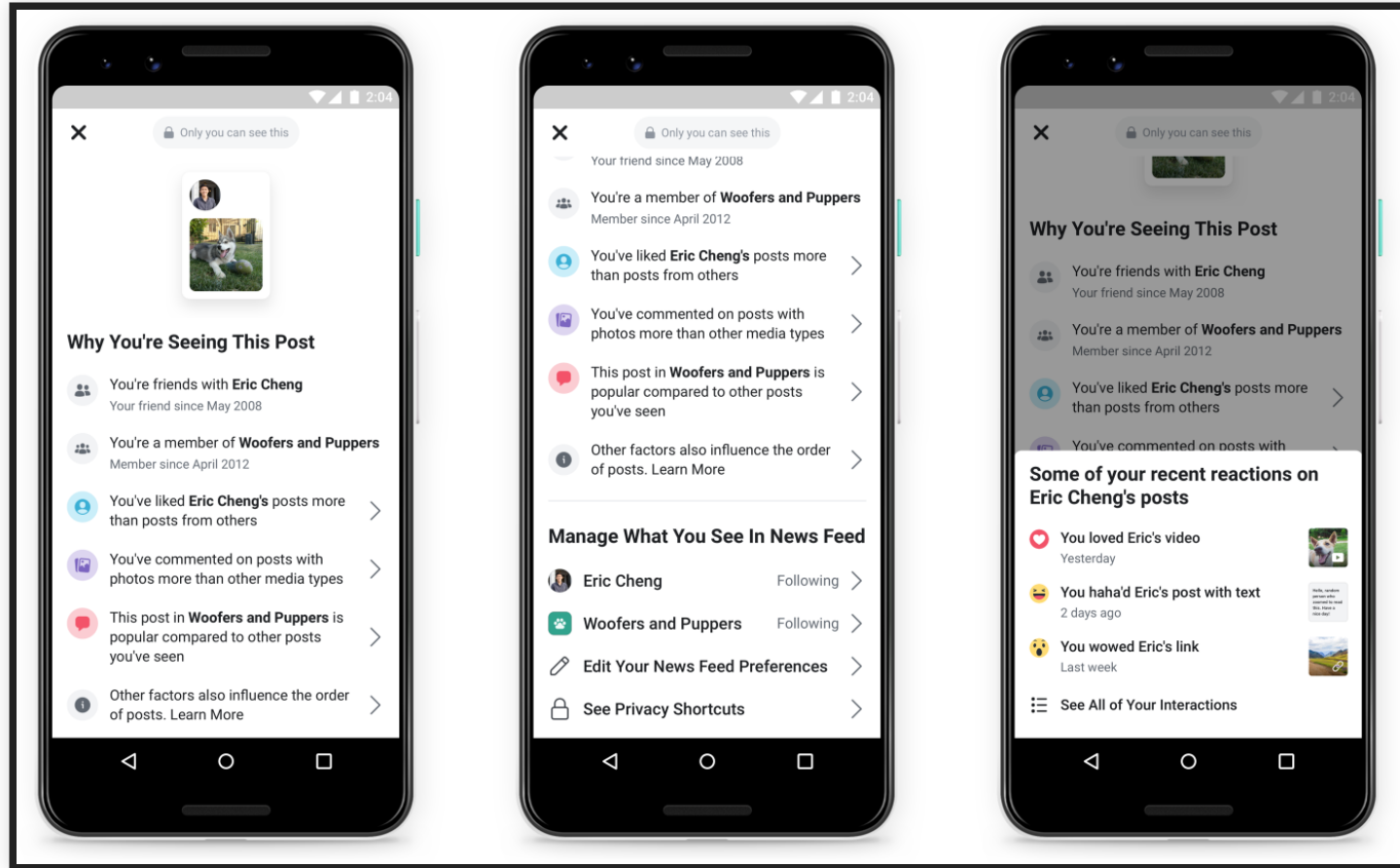
ONBOARDING: SET USER EXPECTATIONS



- Be clear about what system can(not) do

<https://pair.withgoogle.com/chapter/mental-models/>

TRANSPARENCY: EXPLAIN HOW DECISIONS ARE MADE



- Explain how the user's actions influence output

DEALING WITH ERRORS

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- User errors: Mistakes made by users (e.g., click on a wrong button)
 - Lots of work in cognitive science & human factors
 - Error taxonomies, human performance modeling, task analysis, ergonomic analysis, etc.,
- System errors: Failure to provide an outcome expected by the user
 - We will focus on this

EXAMPLE: SCHEDULING ASSISTANT

The screenshot illustrates an email interface with an AI scheduling assistant. The interface is divided into three main sections: A, B, and C.

- Section A (Inbox):** A list of emails. The top email is from John Bass, dated Saturday December 29, with the subject "We will plan on Meeting at Al's Formal Wear at 1P...". Below it are emails from Kate Bush, Daphne Co, and Sally Beck.
- Section B (Email Content):** The content of the selected email from John Bass, dated Wednesday August 22, 2018, 10:57 AM, from Eric Ramiro. The body text reads: "We will plan on Meeting at Al's Formal Wear at 1PM on that Saturday. I will see you all then. Jason". A "Reply" button is visible in the top right corner.
- Section C (AI Assistant):** A pop-up window titled "We think we've found an event". It displays the inferred event details: "Date: Sat Aug 25 2018" and "Time: 01:00 pm". At the bottom of the window are three buttons: "Create Appointment" (highlighted in blue), "Cancel", and "Edit details".

- Analyze e-mail content for possible meeting scheduling
- Suggest creating a new meeting based on inferred information

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 - False positives vs. false negatives
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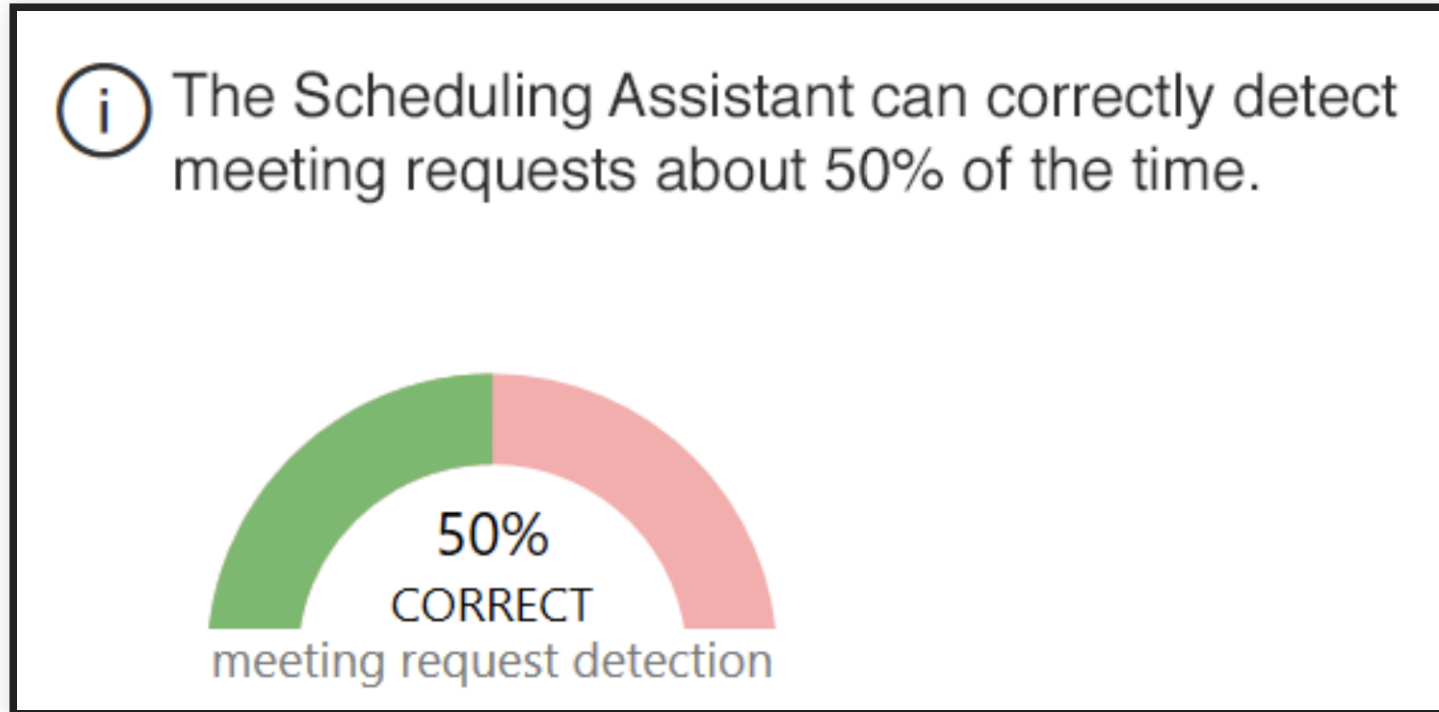
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- Provide meaningful error messages to user
 - Provide an explanation for the error
 - Suggest actions to fix the error (e.g., "Edit details" option)

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 - Suggest actions to fix the error (e.g., "Edit details" option)
- Give user controls to recover from and mitigate the effect of an error
 - e.g., delete or modify incorrect meeting schedule

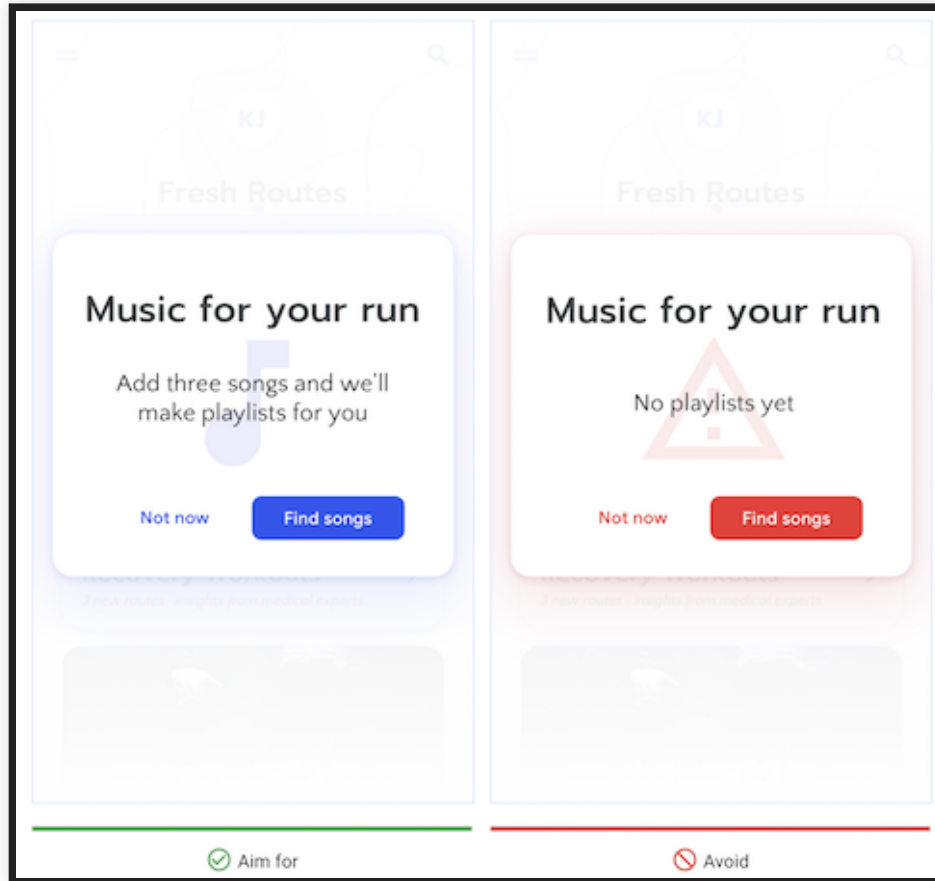
SETTING USER EXPECTATIONS FOR ML ERRORS



- Be upfront about how well the system performs (e.g., model accuracy)
- Temper the user's expectations and avoid surprises

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ERROR MESSAGES: SUGGEST USER ACTIONS



- Tell the user what the AI needs in order to behave as intended
- Guide the user towards ways to recover from/prevent further errors

<https://pair.withgoogle.com/chapter/errors-failing/>

ERRORS IN VOICE ASSISTANTS



“...sometimes it says it does — like the reminders and the sending messages. It says it will do it. But then at the end we found that it didn’t really send the message.”

- Q. How do we detect an error?
- Q. How can we notify/guide the user when an error occurs?

<https://www.nngroup.com/articles/mental-model-ai-assistants/>

FEEDBACK AND CONTROL

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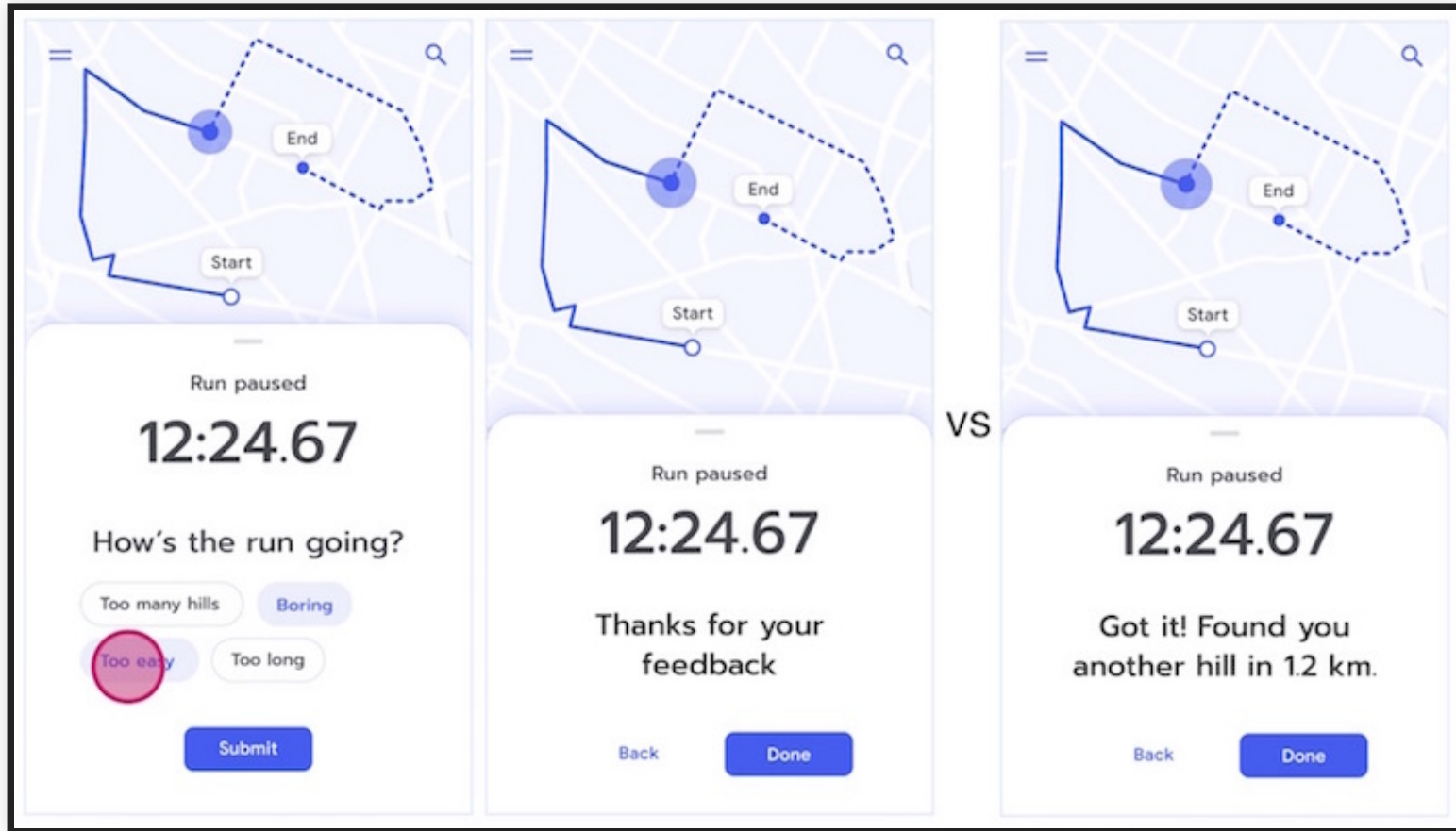
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- Design considerations for feedback
 - Align feedback with improving interactions (and AI)
 - Acknowledge user feedback & respond immediately

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 - Acknowledge user feedback & respond immediately
- In addition to feedback, provide a way for user to adjust AI behavior

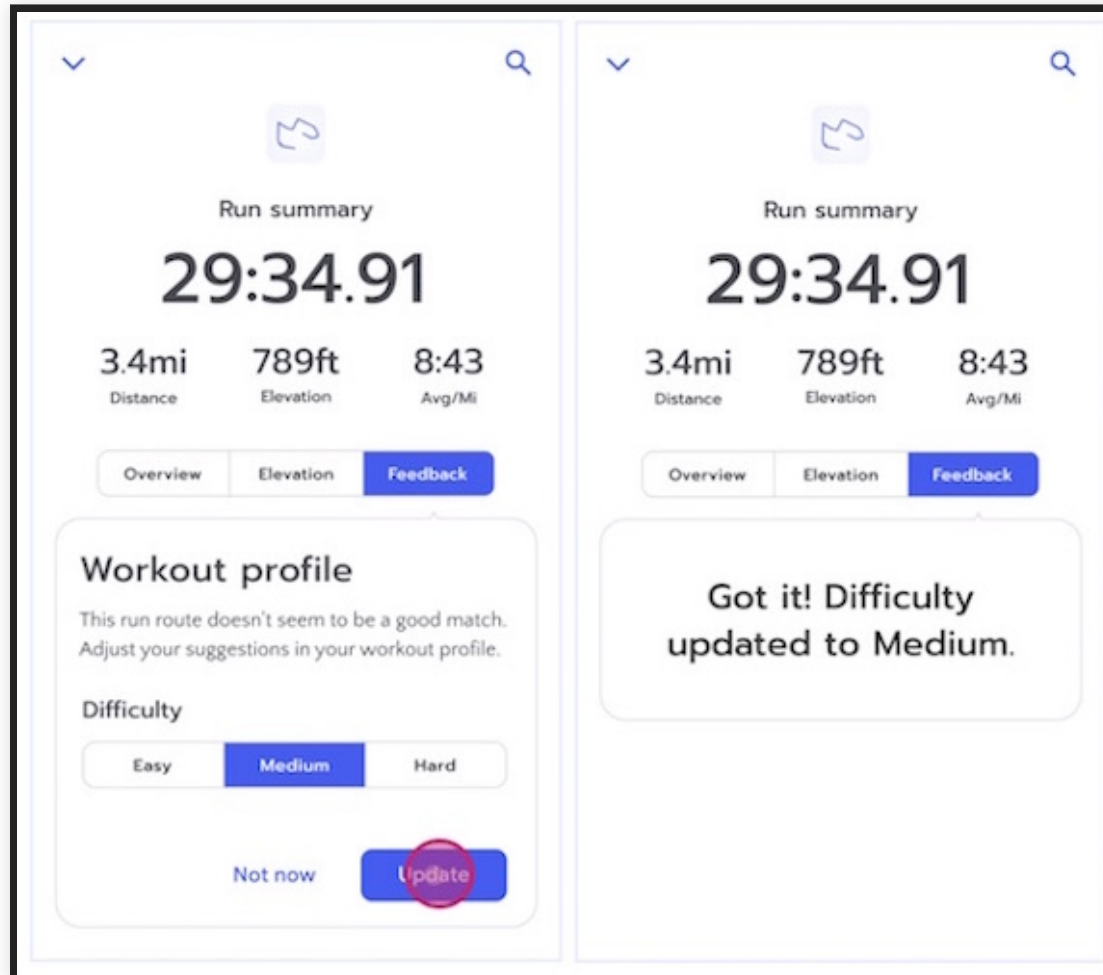
RESPONDING TO FEEDBACK



- When possible, respond to feedback with an adjustment to AI behavior

<https://pair.withgoogle.com/chapter/feedback-controls/>

GIVING USER CONTROL



- Provide a mechanism for user to adjust system behavior

GIVING USER CONTROL OVER ML BEHAVIOR



Adjust how aggressive you would want the Scheduling Assistant to be in detecting meetings in your emails:



Fewer detections

some requests
might be missed



More detections

more non-requests
might be suggested



- Provide a mechanism for the user to control the types of ML errors
- Scheduling assistant: Adjust thresholds to achieve trade-offs between precision vs recall

USER FEEDBACK IN VOICE ASSISTANTS

"All of the things that even Siri herself said she could do — for example 'I can send money via Venmo, just try and say this.' I tried and it didn't work, and maybe there are settings that I need to fix. But when those types of things happened, there was no button that said 'Hey, in order to make this work in the future, click this and we'll take you to the permissions or whatever.'"

- **Q. How do we collect user feedback? Implicit? Explicit?**
- **Q. What kind of control do we provide to the user?**

<https://www.nngroup.com/articles/mental-model-ai-assistants/>

GUIDELINES FOR HUMAN-AI INTERACTIONS

Guidelines for Human-AI Interaction

INITIALLY

1
INITIALLY

Make clear what the system can do.

Help the users understand what the AI system is capable of doing.

2
INITIALLY

Make clear how well the system can do what it can do.

Help the user understand how often the AI system may make mistakes.

DURING INTERACTION

3
DURING INTERACTION

Time services based on context.

Time when to act or interrupt based on the user's current task and environment.

4
DURING INTERACTION

Show contextually relevant information.

Display information relevant to the user's current task and environment.

5
DURING INTERACTION

Match relevant social norms.

Ensure the experience is delivered in a way that users would expect, given their social and cultural context.

6
DURING INTERACTION

Mitigate social biases.

Ensure the AI system's language and behaviors do not reinforce undesirable and unfair stereotypes and biases.

WHEN WRONG

7
WHEN WRONG

Support efficient invocation.

Make it easy to invoke or request the AI system's services when needed.

8
WHEN WRONG

Support efficient dismissal.

Make it easy to dismiss or ignore undesired system services.

9
WHEN WRONG

Support efficient correction.

Make it easy to edit, refine, or recover when the AI system is wrong.

10
WHEN WRONG

Scope services when in doubt.

Engage in disambiguation or gracefully degrade the AI system's services when uncertain about a user's goals.

11
WHEN WRONG

Make clear why the system did what it did.

Enable the user to access an explanation of why the AI system behaved as it did.

OVER TIME

12
OVER TIME

Remember recent interactions.

Maintain short-term memory and allow the user to make efficient references to that memory.

13
OVER TIME

Learn from user behavior.

Personalize the user's experience by learning from their actions over time.

14
OVER TIME

Update and adapt cautiously.

Limit disruptive changes when updating and adapting the AI system's behaviors.

15
OVER TIME

Encourage granular feedback.

Enable the user to provide feedback indicating their preferences during regular interaction with the AI system.

16
OVER TIME

Convey the consequences of user actions.

Immediately update or convey how user actions will impact future behaviors of the AI system.

17
OVER TIME

Provide global controls.

Allow the user to globally customize what the AI system monitors and how it behaves.

18
OVER TIME

Notify users about changes.

Inform the user when the AI system adds or updates its capabilities.

The Guidelines for Human-AI Interaction will help you create AI systems and features that are human-centered. We hope you use them throughout your design process – as you evaluate existing ideas, brainstorm new ones, and collaborate with the multiple perspectives involved in creating AI.

These guidelines synthesize more than 20 years of thinking and research in human-AI interaction. Learn more: <https://aka.ms/aiguideelines>.



HUMAN-AI INTERACTIONS

Human-AI interactions must be considered throughout the entire ML lifecycle!

- Requirements & design
 - Understand user needs & their mental models
 - Explicitly design system to match the mental model
- During interaction
 - Consider factors for interaction (automate vs augment, forcefulness, frequency)
- When errors occur
 - Provide an explanation & actionable information
 - Provide ways for user to adjust AI behavior
- Maintenance and evolution
 - Collect user feedback and improve model
 - Adjust system design to reduce mental model mismatch

SUMMARY

- Goal of usable design: Minimize interaction cost
 - Automation does not necessarily imply reduced cost!
- Interaction design considerations for AI
 - Modes of interaction: Automate or augment?
 - Mental model: User understanding of what AI is doing
 - Dealing with errors: Guide user towards recovery & prevention
 - Feedback and control: Align user feedback with AI improvement

