

Usability of a Leading mHealth App: Key to Patient Engagement with Technologies

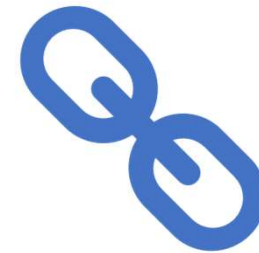
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Learning Objectives



At the completion of the session, participants should be able to:



Describe the **link** between **usability** of health-related apps, **patient engagement**, and **behavior change**



Introduction

- Think of an app you use
 - Why do you use it? It serves some purpose that you have.
 - Is it easy to use? If it wasn't, would you continue to use the app?
 - Is the app useful to you? There's lots of apps, I assume you use those that are useful to you. If it wasn't, would you continue to use it.
 - What goal are you trying to achieve in using it? Communicating with others? If
- Let's say the purpose of the app involves self-management of your disease – like diabetes.
 - What might happen if it isn't easy to use? Errors? Disengagement?
 - What about if it wasn't useful, there was no meaning to you? Disengage?
 - What about if it did help you achieve your desired goal(s)? Like maintaining your serum glucose between a and y 95%, maintaining or losing weight, whatever? If it was easy to use and useful but didn't help maintain your HbA1c, would you continue to use it?

Who makes most healthcare decisions?

Nurses?

Doctors?

Patients?

Others?



Anyone
Anywhere
Anytime
About Anything

Usability

- Ease of use and usefulness in achieving the desired goal.¹
 - Poor usability
 - Major usability issues → confusion, errors²
 - Minor usability issues → slow navigation, inconvenience²

¹Zhang J, Walji MF. TURF: toward a unified framework of EHR usability. *J Biomed Inform.* 2011;44(6):1056-1067. <https://www.sciencedirect.com/science/article/pii/S1532046411001328>

²Nielsen J. Finding usability problems through heuristic evaluation. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI 1992, 1992;373-380, <https://doi.org/10.1145/142750.142834>

REVISED & EXPANDED EDITION

The DESIGN
of EVERYDAY
THINGS



DON
NORMAN



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Purpose

Purpose: Evaluate app usability

- Top-rated diabetes app
 - Poor usability deters use
 - Significance
 - Prevalence and mortality of diabetes³
 - Impact of self-management on long-term prognosis³
 - Dependent on self-care behaviors employed to manage this complex chronic condition³

Hermanns N, Ehrmann D, Fink-Groene K, Kulzer B. Trends in diabetes self-management education: where are we coming from and where are we going? A narrative review. *Diabet Med* 2020; 37: 436-447. doi: 0.1111/dme.14256³

Leading Diabetes App

- App intended to support disease self-management
 - Multifunctional
 - Documentation, monitoring, decision making
 - Blood glucose, HbA_{1C}, medication, diet, activity, weight



Method

Method: Heuristic Evaluation

- Used to determine compliance of user interface with a set of heuristics⁴
 - Uncovers usability issues in a user interface design
 - Requires 3-5 usability experts⁵
 - Researchers independently identify location, heuristic violated, description, and severity⁵
 - Identifies 74-87% of usability problems⁵
 - Recommend multimethod design

⁴Harrington, L. Parker, C., Ulanday K., Harrington, C. Heuristic evaluation of a top-rated diabetes self-management app. *Appl Clin Inform.* In press.

⁵Nielsen J. 10 usability heuristics for user interface desiring. 2020. Available at: <https://www.nngroup.com/articles/ten-usability-heuristics/>. Accessed February 3, 2022.

Nielsen's^x Usability Heuristics

- visibility of system status
- match between system and the real world
- user control and freedom
- consistency and standards
- error prevention
- recognition rather than recall
- flexibility and efficiency of use
- aesthetic and minimalist design
- help users recognize, diagnose, and recover from errors; and
- help and documentation.

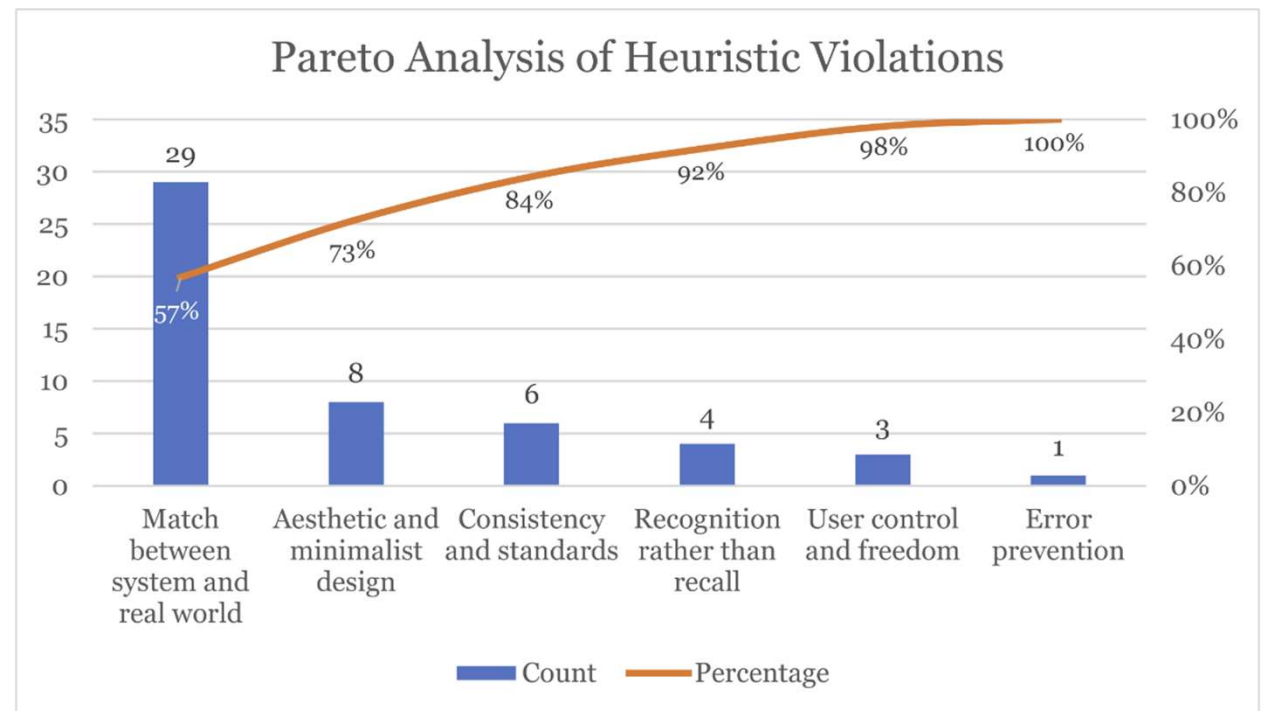
⁵Nielsen J. 10 usability heuristics for user interface desiring. 2020. Available at: <https://www.nngroup.com/articles/ten-usability-heuristics/>. Accessed February 3, 2022.



Results

Pareto Analysis

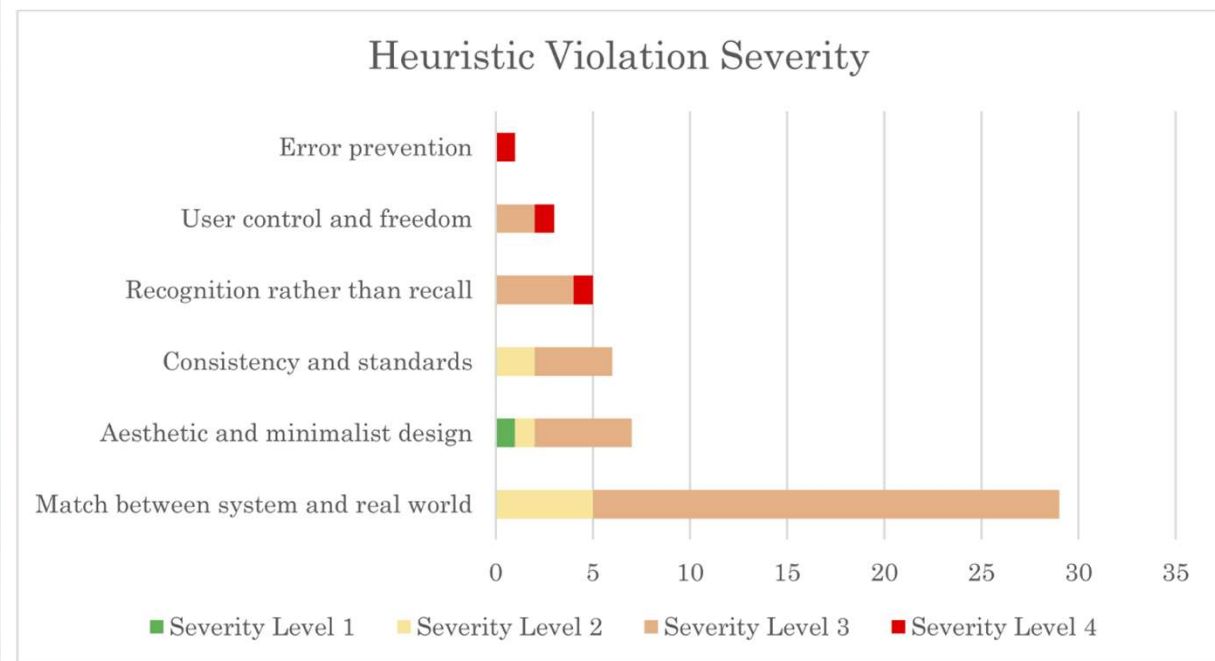
- Frequency of each type of heuristic violated
 - Contribution of each type to the total



⁴Harrington, L. Parker, C., Ulanday K., Harrington, C. Heuristic evaluation of a top-rated diabetes self-management app. *Appl Clin Inform.* In press.

Stacked Bar Analysis

- Level of severity for heuristics violated
 - Comparison of severity score for each type of heuristic violated



⁴Harrington, L. Parker, C., Ulanday K., Harrington, C. Heuristic evaluation of a top-rated diabetes self-management app. *Appl Clin Inform.* In press.



Key Takeaways

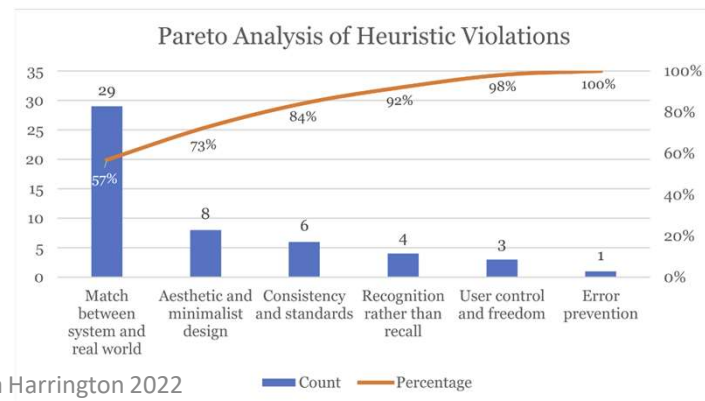
Table 1: Examples of Heuristic Violations from the Study

Heuristic Violated	Description	Examples from Study App	Consequences
Error prevention	2 types of errors: 1) slips - unconscious errors caused by inattention, and 2) mistakes - conscious errors caused by inattention	Abnormal values, such as glucose of 99999 mg/dL, are allowed to be entered by users without an alert, flag, or highlight	Can create safety issues such as users overmedicating themselves
User control and freedom	Users want to feel in control of apps and that if they make a mistake, they can get out of it.	Clicking on “Insights” consistently crashes the app	Users feel confused, trapped, reluctant to explore features, and become dissatisfied with the app
Recognition rather than recall	Recognition involves familiarity; recall involves more details from memory	The app heavily uses icons and uses different icons for the same thing. Universal icons are rare making recognition and meaning of icons difficult. ^d For example, serum glucose is a solid black drop icon or orange-outline drop icon.	Unclear icons create confusion and frustration, impeding users from completing their task
Consistency and standards	Colors, symbols, words, content, layout, should be consistent throughout creating familiarity in users	Serum glucose is associated with solid black drop icon, orange-outline drop icon, word ‘glucose’, word ‘blood sugar’, and abbreviation BG	Lack of consistency confuses users and makes apps more difficult to learn
Aesthetic and minimalist design	Designs should be aesthetically pleasing with high informational value	Fork and knife icon combined with word ‘Food’ whereby ‘Food’ is sufficient, and icon is irrelevant	An icon can replace words if it adds value. Otherwise, icons become clutter slowing user progress
Match between system and the real world	Content should be in user’s language and concepts, and navigation should be logical to them	The icon of insulin is a pill when insulin is an injection	Inappropriate icons create confusion leaving users wondering what to do

^dHarrington, L. Parker, C., Ulanday K., Harrington, C. Heuristic evaluation of a top-rated diabetes self-management app. *Appl Clin Inform.* In press.

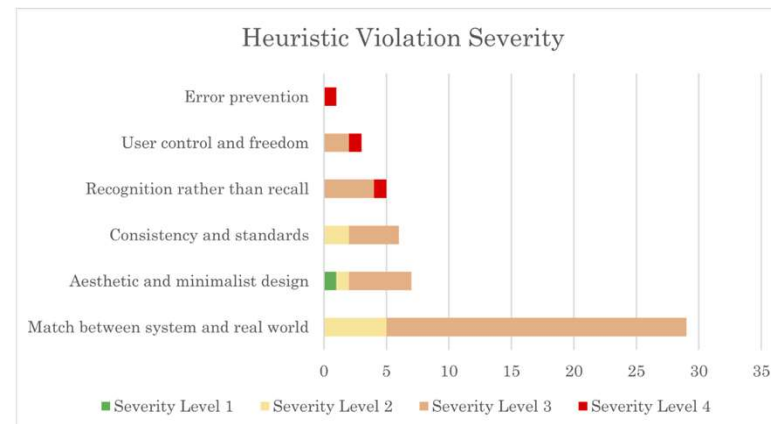
Understanding Pareto and High Contributors

- Each heuristic has improvement strategies
 - High contribution was match between system and real world (57%)
 - Strategy: focus on better matching user interface with users' world
 - Example: Words, phrases, familiar concepts and dictionary
 - Limitation of Pareto = overshadowing of critical information



Understanding Stacked Bar Charts and Low Contributors

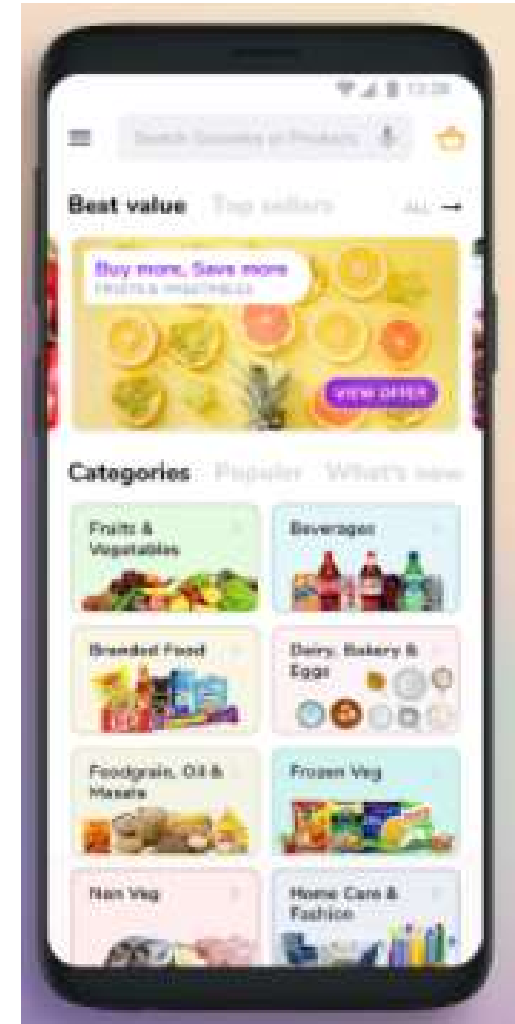
- ALERT: High contributors in Pareto outshone low contributors in severity
 - Only 3 heuristic violation 4.0/4.0 severity
 - Each in lowest contributing type of heuristics isolated
 - Impacts strategy for fixing
 - Highlights importance of multimethod



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Context

- Home screen
 - Every user sees the home screen
 - 51 heuristic violations on the home screen alone
- Experience with the home screen of an app
 - confused, frustrated
 - enabled errors
 - No help
 - How likely are you to engage?
 - And for how long?



Discussion: Commercialization of apps

- Direct-to-consumer business model
 - Often bypasses clinical informaticists resulting in apps⁶
 - Developers often lack resources⁷
 - Fund premarket prospective usability studies⁷
 - Compounded by pressure from early investors⁷
 - Demonstrate quick product growth⁷
 - Rapid entry into the marketplace⁷
 - Apps downloaded based on high user rating⁸
 - Poor usability⁸
 - Undesired consequences⁸
 - Low value to harm⁸

⁶Singh K, Drouin K, Newmak JL, et al. Health Aff. 2016; 35 (12): 2310-2318

⁷Rowland SP, Fitzgerald JE, Holme T, Powell J, McGregor A. What is the clinical value of mHealth for patients? NPJ Digit Med 2020;3:4. doi: 10.1038/s41746-019-0206-x

⁸Cohen AB, Mathews SC, Dorsey ER, Bates DW, Safavi K. Direct-to-consumer digital health. Lancet 2020; 2: e163-e165. doi: 10.1016/S2589-7500(20)30057-1

Timing of Usability Studies

- Debug usability issues during design phase
 - Design, test, design, test, design, test
- Debugging apps in production/live environment
 - Risks
 - Errors, safety, harm
 - Patient disengagement
 - Negative impacts on desired outcomes
- We don't have time to test!
 - Testing ALWAYS occurs!
 - Testing environment
 - Live environment
 - Risks (see above)

Conclusions

- Apps over paper-based or video patient education
 - **Behavior change**⁹
 - People want to change.
 - I want to change. I want to be healthier. I want to have a better life. I want . . .
 - Users want mobile health apps that are easy to use, reduce self-management burden, and are well-suited for the intended purpose.^{10,11}
- Poor usability
 - Undiscovered errors
 - Frustration
 - Abandonment
 - “I give up.”

⁹Harrington L. Behavior change techniques in apps: Moving beyond patient education to improve health outcomes. *AACN Adv Crit Care*. 2020;31(1):12-15.

¹⁰van Haasteren A, Fille F, Fadda M, Vayena E. Development of the mHealth app trustworthiness checklist. *Digit Health* 2019; 5: 1-21. doi: 10.1177/2055207619886463

¹¹Baptista S, Tawley S, Pouwer F, Oldenburg B, Wadley, Speight J. What do adults with type 2 diabetes want from the "perfect" app? Results from the second diabetes MILES Australia (MILLES-2) study. *Diabetes Technol Ther* 2019; 21(7): 393-299. doi: 0.1089/dia.2019.0086

Questions/Comments?

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