Designing Customizable Interfaces for User Cognitive State

how intelligent human-computer interfaces can present unambiguous answers to information-seekers by responding to change in cognitive state

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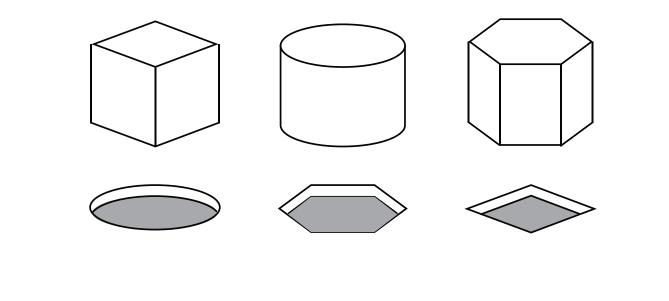
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CONTEXT

INTRODUCTION

There are no one-size-fits-all solutions.

A person faced with a serious diagnosis has an immediate **thirst for knowledge**, even though their **cognitive ability** to find—let alone comprehend—useful information may be **hindered** due to their **traumatized, high-stress mental state**. Most online health information platforms are not designed to consider the cognitive state of this type of user, even though **new technologies**, such as **machine learning**, have the potential to offer **personalized support** for this **special information-seeking circumstance**. Standard search tools and features encountered on the ordinary health information website typically take a **one-size-fits-all approach**. The purpose of this research is to address this interface design problem.
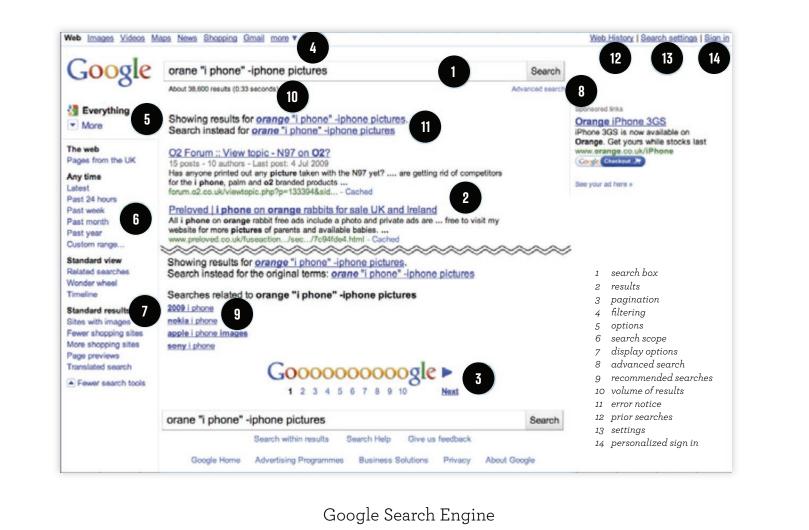
The objective of this study is to determine how intelligent human-computer interfaces can present information in meaningful ways, responding to the health information-seeker's cognitive state—in particular, for someone who is under duress from a recent medical diagnosis.

PROBLEM

It's an interface design problem.
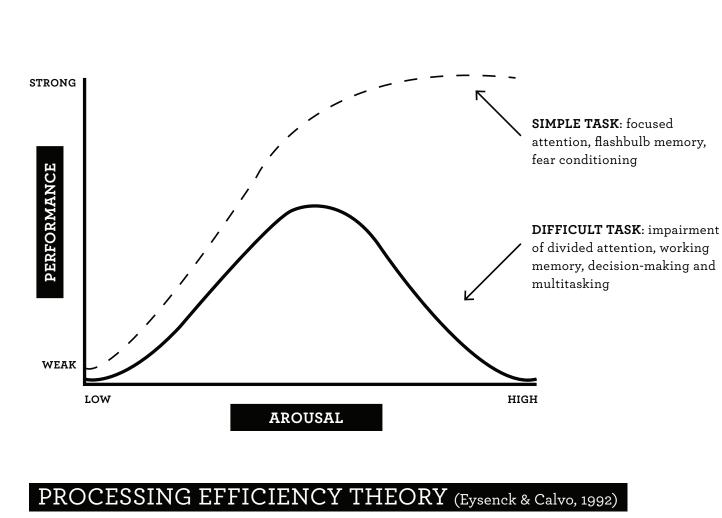
LOTS OF INFO
Users need to understand large quantities of different types of information.

MENTAL NOISE
Stress and mental noise can reduce the ability to process information by up to 80%.
(Covello, 2010)

COGNITIVE STATE
Traditional online search platforms are not designed to consider the cognitive state of the user.

ONE-SIZE-FITS-ALL
Search sites take a 'one-size-fits-all' approach to standard features and tools.

Our everyday experience of search...

Google Search Engine

NORD Website / rarediseases.org

Cognition and stress

An understanding of how stress affects information processing will help guide the development of information delivery tools.

STRESS RELATED COGNITIVE AFFECT
>> attention + focus
>> learning + recall
>> short-term memory
>> word finding

PROCESSING EFFICIENCY THEORY (Eysenck & Calvo, 1992)
Anxiety affects task performance through pre-empting some of the processing and storage capacity of the working memory system.

MENTAL NOISE THEORY (Covello, 2010)
Stress and mental noise can reduce the ability to process information by up to 80%.

RESEARCH QUESTION

How can the design of a **responsive interface** for an online data repository **adapt** to the different **cognitive states** of primary caregivers engaged in **help-seeking + knowledge acquisition processes** as they learn about a dependent's medical condition?

METHODOLOGY

METHODS

Qualitative Research Methods

This study employs **QUALITATIVE RESEARCH METHODS** by collecting **DATA** from **20 PATIENT ADVOCATES** from the **NC RARE DISEASE ADVISORY COUNCIL** through **SEMI-STRUCTURED INTERVIEWS**, which will inform subsequent prototype testing.

PROTOTYPING
"Prototyping is the tangible creation of artifacts at various levels of resolution, for development and testing of ideas within design teams and with clients and users."
(Martin & Hanington, 2012)

SCENARIOS
"A scenario is a narrative that explores the future use of a product from a user's point of view, helping design teams reason about its place in a person's day-to-day life."
(Martin & Hanington, 2012)
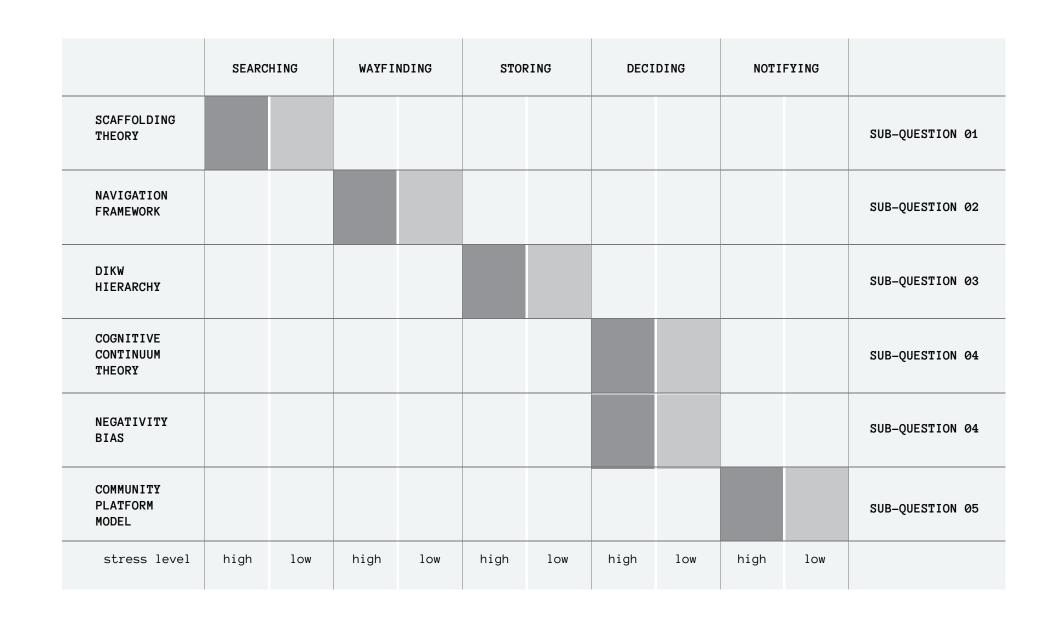
PERSONA
"Personas consolidate archetypal descriptions of user behavior patterns into representative profiles, to humanize design focus, test scenarios, and aid design communication."
(Martin & Hanington, 2012)

RESEARCH THROUGH DESIGN
"Research through design recognizes the design process as a legitimate research activity, examining the tools and processes of design thinking and making within the project, briding theory and building knowledge to enhance design practice."
(Martin & Hanington, 2012)

FRAMEWORK CREATION

By combining the following four axes of information, I developed my own conceptual framework to inform the design of my prototypes: Researched Theories, Tools and Features, Stress Level, and Sub-Questions.
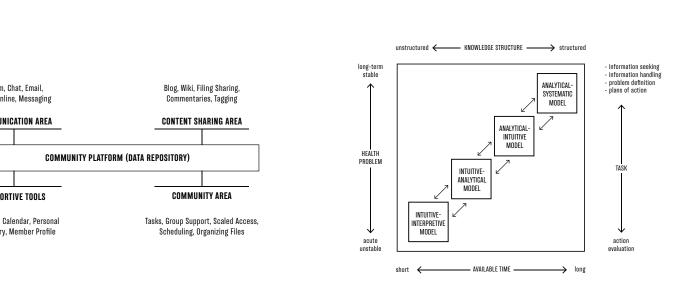
Sub-questions
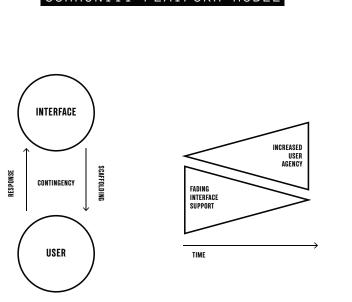
How can the design of search tools that interpret + learn from user search behavior allow for adaptive + personalized ways of delivering + consuming information?

How can a suite of information navigation aids respond to a caregiver's shifting cognitive state as s/he acquires and archives information?

How can the design of interface search features track knowledge acquisition progress to serve as an ongoing personal reference tool?
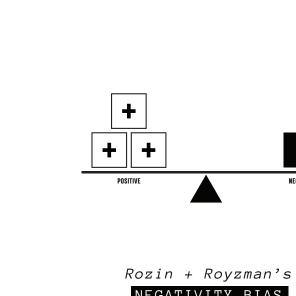
How can the design of a response interface assist non-experts in developing expert research behaviors that aid in effective + autonomous decision making?

How can a data-aware notification system alert users to changes in information + knowledge in both just-in-time and over-time delivery approaches?

DESIGN PRINCIPLES

GESTALT PRINCIPLES

The gestalt principles of similarity, proximity, and connection are used to develop the information presentation strategies of organizing, filtering, and chunking
(Moore & Fitz, 1993)

PROXIMITY
Most people see rows on the left and columns on the right.

SIMILARITY
Most people see a larger group containing a sub-group.

CONNECTION
Most people see the connected elements as being related to each other.

PICTORIAL DEPTH CUES

The pictorial depth cues of linear perspective, texture gradient, and relative height are being used to represent time-based information whereas shadow, interposition, clarity, and relative size are being used for urgency-based information.
(Schwartz, 2015)

LINEAR PERSPECTIVE
Most people see where the parallel lines get closer together as farther away.

TEXTURE GRADIENT
Most people see the texture pattern becoming more fine as an indication of increased distance.

RELATIVE HEIGHT
Most people see the objects crossing the "horizon" line as farther away.

LIGHTING + SHADOW
Most people see the box on the right as being closest.

INTERPOSITION
Most people see the overlapping object as being closest.

AERIEL PERSPECTIVE + CLARITY
Most people see the box on the left as being closest.

RELATIVE SIZE
Most people see the box on the left as closest and the box on the right as farthest away.

PROTOTYPES

FINDINGS

Information presentation strategies

Data collection suggests that people under duress prefer to have information delivered in a minimal fashion using different delivery strategies such as **chunking, withholding, seeking, gathering, and tiered presentation.**

GATHERING
The interface will be constantly working behind the scenes, searching all the pertinent information databases to collect information for the user in one place.

CONVERSING
The interface will serve as a digital facilitator, conversing with the user in a humanized tone of voice.

PRIORITIZING
The information gathered will be organized and presented to the user in an urgency and/or time-based fashion, allowing the user to focus on what tasks need to be addressed today and what can be postponed for the future.

FILTERING
While the interface is constantly making decisions in terms of priority and organization, filtering options will be clearly communicated and opportunities will be presented to the user to override default decisions.
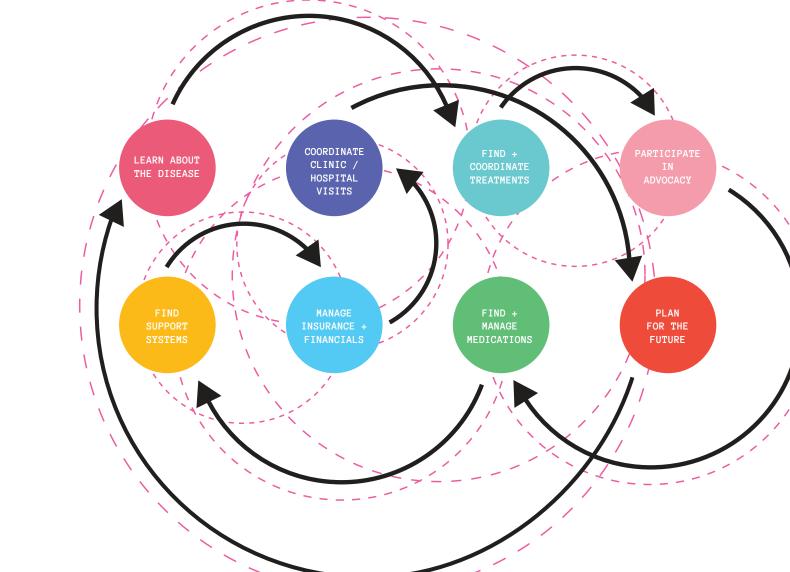
CHUNKING
The interface will break text and multimedia content into smaller chunks to help users process, understand, and remember it better.
(Dance, 2016)

WITHHOLDING
In contrast with traditional online medical forums which flood the user with all information up front, weighty content will be presented in a scaffolded manner, allowing the user to self-time delivery.

STORING
When a user comes across a new term or concept, they can request the interface "remember" that information for them, storing it in their personal dashboard.

NOTIFYING
When a user is away from the interface, they can rest assured that the searching will continue and the interface will notify them when new information becomes available.

User interactions

The interactions the user will make in the system will fall into eight broad categories. Although these interactions can be seen in timeline form, the process of learning under these circumstances will not occur in a linear fashion. Instead, the system will be designed as a **looping navigation of experiences to promote discovery**.
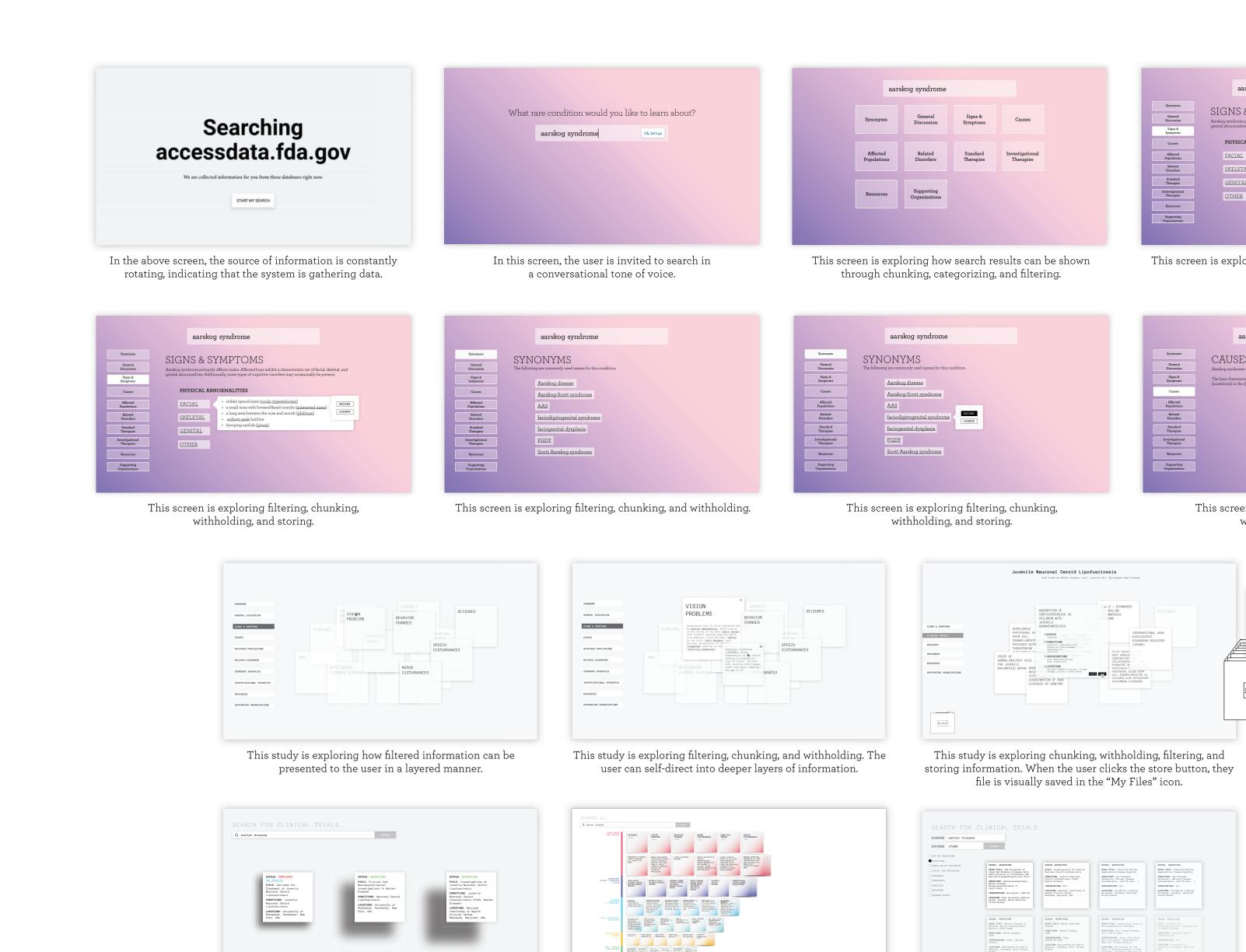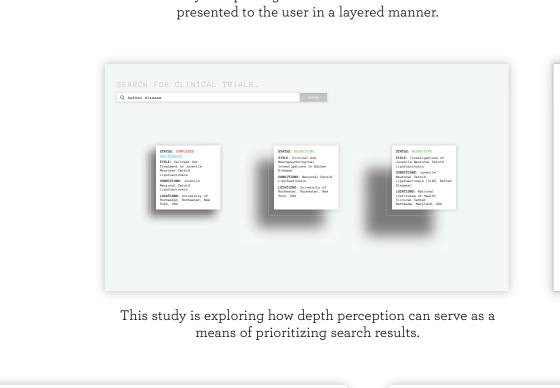
LEARN ABOUT THE DISEASE · FIND SUPPORT SYSTEMS · COORDINATE CLINIC / HOSPITAL VISITS · MANAGE INSURANCE + FINANCIALS · FIND + COORDINATE TREATMENTS · FIND + MANAGE MEDICATIONS · PARTICIPATE IN ADVOCACY · PLAN FOR THE FUTURE

PROTOTYPES IN PROGRESS

Searching accessdata.fda.gov

In the above screen, the source of information is constantly rotating, indicating that the system is gathering data.

In this screen, the user is invited to search in a conversational tone of voice.

This screen is exploring how search results can be shown through chunking, categorizing, and filtering.

This screen is exploring filtering, chunking and withholding.

This screen is exploring filtering, chunking, and withholding.

This screen is exploring filtering, chunking, and withholding.

This screen is exploring filtering, chunking, and withholding.

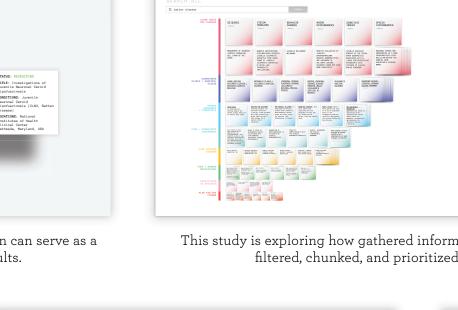This screen is exploring filtering, chunking, withholding, and storing.

This study is exploring how filtered information can be presented to the user in a layered manner.

This study is exploring filtering, chunking, and withholding. The user can add/detract into deeper layers of information.

This study is exploring how depth perception can serve as a means of prioritizing search results.

This study is exploring how gathered information can be filtered, chunked, and prioritized.

This study is exploring how depth perception can serve as a means of prioritizing search results according to selected filters.
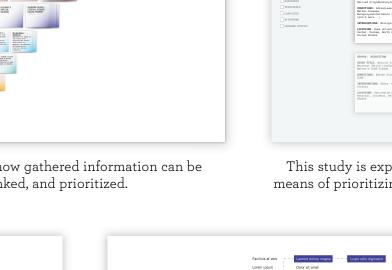
Faded information helps user maintain focus on key information within large body of copy.

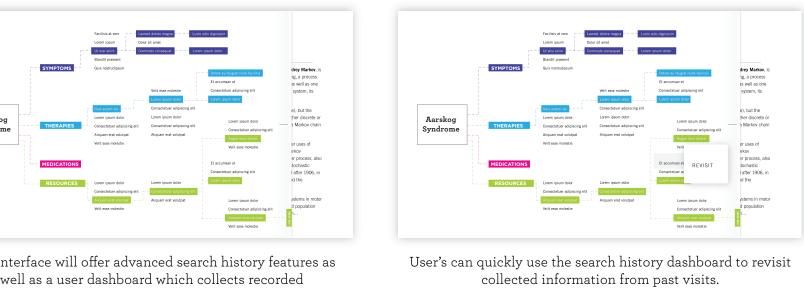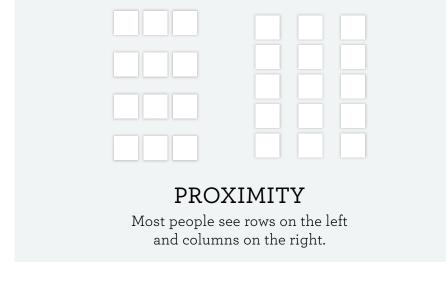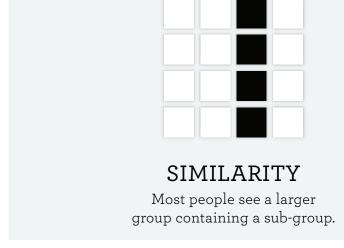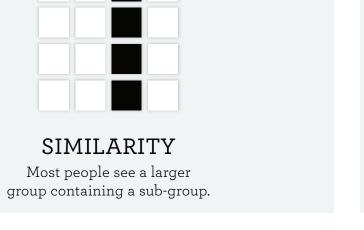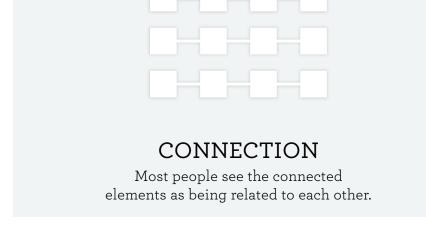User's have the opportunity to ask the interface to remember key terms of interest to look them up.

The interface will offer advanced search history features as well as a user dashboard which collects recorded terminology and information.

User's can quickly view the search history dashboard to revisit collected information from past visits.

Lang, C. (2018). Enabling Representation of rare information in the census framework. Journal of Digital Information, 5(3). Retrieved from https://journals.tdl.org/jodi/index.php/jodi/article/view/7278. Spence, R. (1999). A framework for navigation. Int. J. Human-Computer Studies, 51. Retrieved from http://www.dformtasmdesign.com/portfolio/PDF/331/3268/5/c25-Spence.pdf. Anxiety and Performance: The Processing Efficiency Theory. Michael W. Eysenck & Manuel G. Calvo. Cognition and Emotion Vol. 6. Iss. 6 1992. Duke, J. Pierik, A. A framework (2008). A novel visualization tool for evaluating confidence-risk effects in multi-drug regimens. In Human-Computer Interaction. (pp. 418-488). Covello, V.T. (2010). Center for Risk Communication. http://www.centerforriskcommunication.org/risk-communication-coordinated. Reduce of Orphanet (Journal of Rare Diseases) (2017) 12:65. DOI: 10.1186/s13023-017-0618-0. Robert Gagne: Conditions of Learning. http://www.instructionaldesign.org/theories/conditions-learning.html. The Scientific World Journal. Volume 2012 (2012). Article ID 196836 10 pages. http://dx.doi.org/10.1155/2012/196836. Nix, Monroe. "Designing for situations of elevated stress" (2018). 2015 Rochester Institute of Technology.