What factors are necessary for positive perception in healthcare technology?

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I. Introduction

This research proposal is motivated by a desire to understand what factors are necessary for positive perception in healthcare technology. While the literature is rich in aligning positive outcomes in technology investments with executive support, development skill, and input from a wide range of subject matter experts, healthcare IT presents unique challenges not sufficiently described or addressed in the current body of knowledge.

Situating the problem up close, from a technology user's perspective

Cognitive diversity includes a range of differences in thinking, including attention deficit/ADHD, autism spectrum, dyslexia, dyscalculia, and dysgraphia. To six million Americans with a cognitive impairment such as dyslexia or autism, navigating a hospital or clinic website to understand what services are available can be a daunting task. According to the US Centers for Disease Control and Prevention, cognitive impairment describes "when a person has trouble remembering, learning new things, concentrating, or making decisions that affect their everyday life." Cognitive impairment spans a wide range of severity. With mild impairment, an individual will notice changes in cognitive functions, but still be able to perform everyday activities. Severe impairment often leads to losing the ability to comprehend importance or meaning and losing speech and written communication faculties. An inability to live independently is a common result in these cases (cdc.gov). Individuals with learning disabilities or cognitive differences may utilize screen readers or other audio, tactile control, and translation technologies to assist their access to content and often modify content to suit their needs. Individuals with physical or sensory disabilities also face a higher prevalence of cognitive challenges.

Jamie Knight, a speaker, writer, and self-described autistic web developer, describes cognitive accessibility as “just the edge of usability”, “I can’t choose what my body is doing but I can choose the tools. I can make life enjoyable by choosing them carefully and finding the fun in the things I use.”

Jamie’s blog describes his mixed experiences dealing with the systems and interfaces that have evolved over time to serve the average needs of the neurotypical person. Peering just beyond the usability of this world-as-built reveals a great deal of opportunity to gain the expertise of a much wider range of talented individuals just like Jamie.

Situating the problem up close, from an organization’s perspective

From the perspective of information system designers and builders, gathering, organizing, and balancing diverse inputs is not unique to life science and healthcare organizations, but addressing the challenges and requirements across the health care domain are necessary to move the field forward in designing and deploying inclusive medical and life science technology.

For example, Pai and Huang (2011) consider the paramount nature of patient safety and a rapidly growing level of technical sophistication in light of the Technology Acceptance Model (TAM), asserting that providers of health care should “not only focus on these influential forces during the system introduction period, but also continuously improve their service qualities.” The research question requires an exploration of how purpose-driven service quality investments affect stakeholder perceptions in healthcare information systems. If information system usability is driven by service quality, then supporting accessible healthcare technology over the long run will require continuing commitment, through incremental investments in service quality.

Sutcliffe, Sawyer, et al (2020) further describe the experience of gathering requirements from experts in clinical and cognitive neurosciences for dementia detection. An enlightening discussion reveals the wide variety of detection and awareness requirements for IS, “with sensor and intelligent interpreter components that can detect complex changes in several variables.” Explicitly anchoring or tagging some aspects of user experience design as “unknown unknowns” in IS research and design may help healthcare organizations identify areas in which universal system accessibility is at risk. This article also inspires an investigation into how to deploy accessibility-measuring machine learning (ML) for users of healthcare information systems, with an intent to use the ML insights for continuous IS improvement.

Situating the problem from afar

According to the American Community Survey, and annual surveys from the Census Bureau, 68% of people aged 16 to 64 without disabilities work. In contrast, the working percentage of people with cognitive disabilities aged 16 to 64 is only 24%. Cognitive disability is a broad category with people who report difficulties remembering, concentrating, or learning (autismnow.org).

Society is missing out on the talents and contributions of people who could fill tens of thousands of open jobs, and inaccessible information systems hurt the individual with learning style that is different from the average, including, but not limited to, physical sense differences (sound and color perception, sonic and visual acuity) or cognitive impairment.

We are motivated by an interest in extending the view in customer experience (CX), user experience (UX), and marketing, that organizations should move (and are already gradually moving) toward finding and serving an “audience of one”. Operationalizing this idea requires researching, designing, developing, and supporting experience and interaction systems that are inclusive for people who experience, understand, and think about the world differently.

The Utah State University-affiliated Institute for Disability Research, Policy, and Practice outlines three critical considerations that support the research question and bring additional light to the need for research and attention on neurodiversity:

1. “There are many types of cognitive and learning disabilities and an even wider variety of needs and capabilities of users who have these disabilities.”
2. “This population is larger than those with all other physical and sensory disabilities combined.”
3. “Because needs vary across these disabilities, it's difficult to make definitive recommendations that will universally help all users with cognitive and learning disabilities.” (WebAIM.org)

Problem Statement: What factors are necessary for positive perception in healthcare technology? Gathering, organizing, and balancing diverse inputs is not unique to healthcare organizations, but we are addressing the challenges and requirements across the domain to move the field forward--designing and deploying inclusive medical and life science technology for individuals who, because of cognitive processing variability, perceive and interact with the world around them in a way that is different than what is commonly conceived by technology and experience designers as ‘average’.

Defining Positive Perception

Approach	Mode	Positive Perception…
Semantic	by affirmation	is the degree to which an information system is easy to understand given an individual's unique combination of sensory perception and mental faculties.
Semantic	by negation	is not merely usability or slickness of the user interface and is not achievable through adopting the principles of 'universal design' in user interface development.
Constitutive	as a concept	consists of all the scaffolding of meaning and style in an information system.
Constitutive	as a construct	consists of simple language, clear hierarchy in information architecture, straight-line navigation, alternate ways to approach the information presented to understand it, and meaningful contrasts in text and image placement.
Constitutive	as a variable	is a typology consisting of seven measurable components: consistency, transformability, multi-modality, focus, language, error recovery, and assistive technology compatibility.

Contribution to Business

We are motivated by an interest in extending the view in customer experience (CX), user experience (UX), and marketing, that organizations should move (and are already gradually moving) toward finding and serving an 'audience of one'. In a concrete sense, this research is intended to push at the boundaries of how we understand information system usability.

II. Literature Review

Theoretical and Practical Foundations for this Research

A literature review examines peer-reviewed sources after parsing the research question into three elements:

1) Defining ‘positive perception’
2) Exploring methods for finding ‘factors that are necessary’
3) Highlighting the distinguishing aspects of ‘healthcare technology’.

Foundation 1: Defining positive perception

Designing and deploying experiences that are open to people who think differently develops an environment in which individual talents can be shared to the betterment of humanity. Blanck (2014) provides a definition of accessibility as the enjoyment of knowledge and social interaction from a human rights perspective. The author brings explanatory depth to the ideals attached to equality under law and electronic equality, to signify the “meaningful and objective opportunity for the comparable use of web content by persons with cognitive disabilities.” This contribution sets the goal for cognitive accessibility to be full societal participation and supports the idea that cognitive accessibility is simply the edge of usability.

Positive social outcomes and feelings of self-efficacy by individuals who think differently may be heightened or lowered by interactions with information systems and other work processes in a healthcare context, where the stakes for human well-being are higher than in many other domains. The research question at hand should be adequately informed by research on how diversity, inclusion, and equity are developed in the work environment. Bernstein, Bulger, Salipante, and Weisinger (2020) develop a practice-based Theory of Generative Interactions based on frameworks and published study results from sociology, communication, social psychology, and organizational development. To direct resources toward a shared organizational purpose, it is necessary to incorporate or mix different members into and out of important task groups frequently over time, to enable diverse groups to have equal standing. Positive outcomes include “collaborative interdependence, interpersonal comfort, and self-efficacy.”

Educating healthcare technology researchers and designers on the variety of accessibility priorities across a wide range of individuals who think differently is imperative. Fenton and Krahn (2007) summarize neurodiversity and introduce “neuro-equality” as an attempt to challenge express or inadvertent “social hierarchy” faced by individuals with cognitive differences indicated by Autism Spectrum Disorder (ASD). The authors describe the need for an enlightened social perspective because “there is little doubt that both higher and lower functioning autistics can be functional … and this should impact how neuro-typicals perceive ASD,” emphasizing the need for education beyond discovering accessibility-building techniques, rather entailing a knowledge transfer to IS researchers and designers that will reframe “normal” design goals.

Foundation 2: Exploring methods for identifying the independent variables

The impact of curriculum development and delivery to system developers is central to developing effective life science and healthcare IT. Information system designers and builders must develop an awareness of the need for cognitive accessibility and should further be prepared to apply a robust set of practices and tools to create accessible experiences. Leite, Scatalon, Freire, and Eler (2021) describe an accessibility design and development training gap that should be improved by a coherent educational curriculum, since knowledge and proper training “can be decisive on the influence of team members and managers to include accessibility into the development process.” The authors’ critical areas of concern include detecting gaps in usability and designing for a fuller range of thinking styles and cognitive ability at the beginning of the mobile application design process.

Pai and Huang (2011) consider the paramount nature of patient safety and a rapidly growing level of technical sophistication in light of the Technology Acceptance Model (TAM), asserting that providers of health care should “not only focus on these influential forces during the system introduction period, but also continuously improve their service qualities.” The research question requires an exploration of how purpose-driven service quality investments affect stakeholder perceptions in healthcare information systems. In the ongoing improvement of healthcare technology, if information system usability is driven by service quality, then supporting accessible healthcare technology over the long run will require continuing commitment, through incremental investments in service quality.

Sutcliffe, Sawyer, et al (2020) describe the experience of gathering requirements from experts in clinical and cognitive neurosciences for dementia detection. An enlightening discussion reveals the wide variety of detection and awareness requirements for IS, “with sensor and intelligent interpreter components that can detect complex changes in several variables.” Explicitly anchoring or tagging some aspects of user experience design as “unknown unknowns” in IS research and design may help healthcare organizations identify areas in which universal system accessibility is at risk. This article also inspires an investigation into how to deploy accessibility-measuring machine learning (ML) for users of healthcare information systems, with an intent to use the ML insights for continuous IS improvement.

The interface through which data from bodily implants and wearables are gathered is critical to ensuring the usefulness and effectiveness of a high-tech healthcare intervention. Ethical considerations around the interpretability of the data by the subject wearing the device is an important yet under-developed area of concern. Senbekov, Saliev, and Bukeyeva (2020) analyze recent progress on the application of big data, artificial intelligence, telemedicine, block-chain platforms, smart devices, and medical education across 152 scholarly articles. Noting a lack of official regulations and recommendations, stakeholders confront a problem with evaluating novel digital health technologies and highly recommend “proper scientific research … before a digital product is deployed for the healthcare sector.”

Foundation 3: Highlighting the distinguishing aspects of healthcare technology

Due to the significant ethical and legal obligations involved in managing EPRs, it is necessary to explore end-user acceptance factors in the healthcare domain. Accessibility research is likely to be more effective if informed by the massive amount of research already available on usability privacy models, regulatory guardrails in healthcare technology, and ethical considerations from theory and practice.

The spectrum of Maturity Models applied to the healthcare domain reinforces the belief that the maturity of IS can contribute to the quality of information and knowledge management. The research question that motivated this review requires knowledge of how organizations in this space may be assessed and characterized along a spectrum of process capability and technology deployment. Gomes and Romão (2018) turn a critical eye toward healthcare IS and the potential to improve individuals’ health and providers’ performance by delivering better quality at lower cost with greater patient involvement and self-monitoring. Maillet, Mathieub, and Sicottec

(2015) investigate the Electronic Patient Record (EPR) and delve into end-user acceptance and satisfaction factors for successful implementation. The authors explain the practical implementation and lessons learned from the use of an EPR and nurses' satisfaction by testing a theoretical model adapted from the Unified Theory of Acceptance and Use of Technology (UTAUT). The authors develop a maturity model for healthcare IS and assert that at the higher levels of IS maturity, "gamification contributes to actual healthcare execution."

Understanding how healthcare delivery IS leaders responsible for design, development, and support perceive and respond to change may be a critical input for modeling the factors that drive positive accessibility outcomes. Yelton and Schoener (2020) share the results of an extensive descriptive study that examined adaptation to advances in technology by healthcare technology management departments in U.S.-based healthcare delivery organizations (HDOs). The authors examine change drivers, responses, strategy evolution and innovative paths forward for the firms surveyed, including a useful summary of IS expenditures for major HDOs in the U.S.

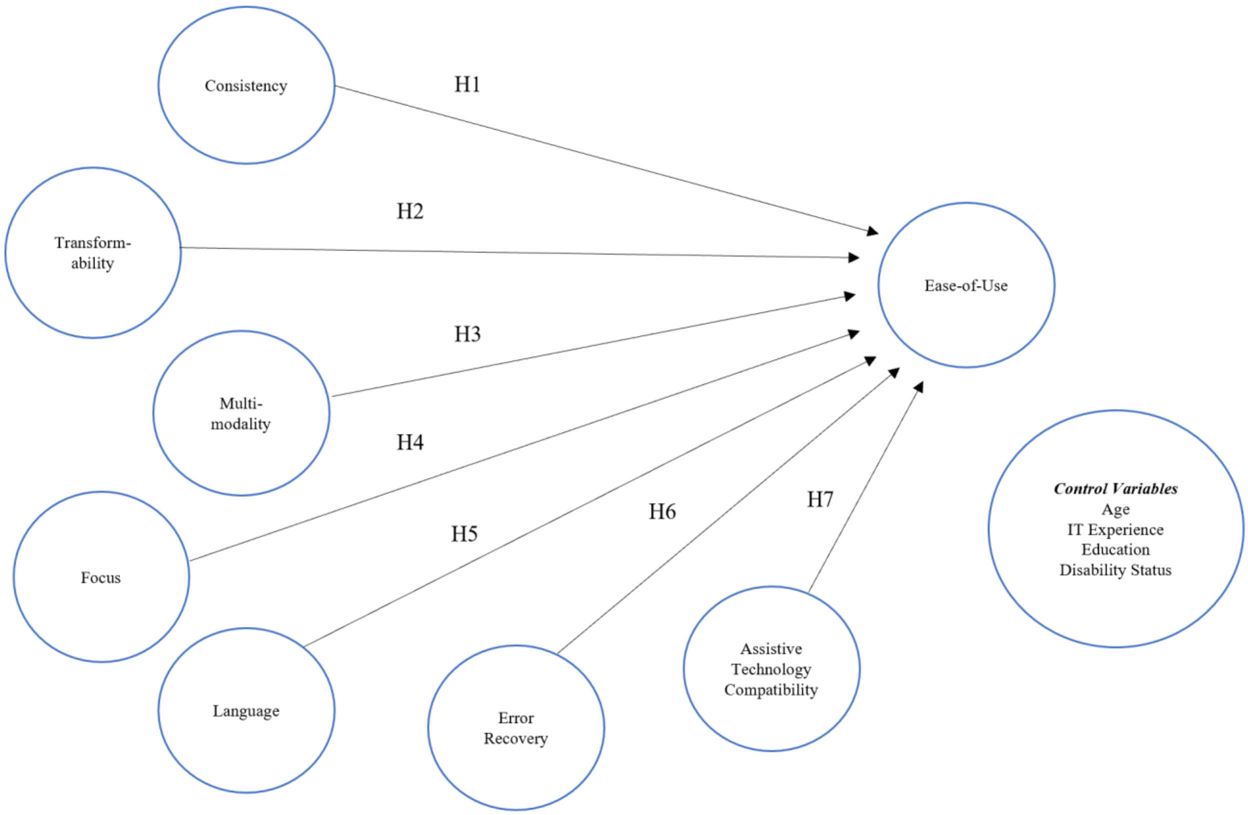
Medical IS investments depend on executive support, development skill, and just as critically, input from a wide range of subject matter experts with knowledge about patient psychology, cognition, treatment options, insurance coverage, office procedures, and so on. Gathering, organizing, and balancing diverse inputs is not unique to healthcare organizations, but understanding the challenges and requirements across the domain are necessary for this assessment. Waldmüller, Spreckelsen, Rudat et al (2020) assert that healthcare information systems "modify communication habits, alter clinical processes and may have serious ethical implications." Given these weighty considerations, it is incumbent upon organizational leaders to gather experts from multiple disciplines together in successive rounds of ethical, technical, and process discussions in a panel and craft the best multi-disciplinary approach to address these sociotechnical challenges.

Ease-of-use as a reflective construct

Freeze and Raschke (2007) offer helpful guidance on our measurement model. The authors distinguish scale items or measurements that are influenced by latent variables (reflective) in contrast with those that influence a latent variable (formative). The measurement instrument consists of eight reflective constructs, seven of which are independent, and one dependent. In this context, reflective constructs have several relevant properties:

1. indicators are realized in the direction from construct to indicators,
2. we measure error terms at the indicator (also known as item) level,
3. items within the eight constructs are expected to exhibit high correlation with one another, and
4. removing a scale item does not change the effect on the construct being measured.

III. Research Model and Hypotheses



Defining the Response to Measure

In this research context, "positive perception" denotes healthcare technology or information system effectiveness, measured by a usability typology constructed from seven scales identified below, for people who think differently. We will propose that seven scales form a Cognitive Accessibility typology, illustrated by a prototype scale component for each (WebAIM.org)

Consistent navigation throughout a site,

Disabling images or styles to support Transformability,

Pairing icons or graphics with text to provide Multi-modality, some contextual cues that help with content comprehension, Avoiding pop-up windows to enhance Focus and Structure, avoiding blinking or moving elements,

Using Language that is as simple as is appropriate for the content,

Giving users control over time sensitive content changes that support Orientation and Error Prevention/Recovery, and

Alternative text to support Assistive Technology Compatibility, with an intuitive and logical navigation order.

Deductive conditional propositions following Van de Ven (2016)

Within a healthcare website:

IF Consistency is high

AND Transformability is high

AND Multi-modality is present

AND Focus is targeted

AND Language is simple

AND Error Recovery is high

AND Assistive Technology Compatibility is high

THEN a healthcare website will be perceived as easy-to-use.

These deductive conditional propositions lead to the following relationships, our measurement variables, between the independent and dependent constructs, with relationship and mode of measurement indicated.

Measurement Variables

ID	Independent Construct	Hypothesis	Hypothesized Relationship	Dependent Construct	Measurement
H1	Consistency	When navigation is consistent throughout a site then ease-of-use is higher.	Direct, Positive	Ease of Use	5-point Likert scale
H2	Transformability	When a site supports disabling images and/or styles then ease-of-use is higher.	Direct, Positive	Ease of Use	5-point Likert scale
H3	Multi-modality	When a site contains contextual cues and help with content comprehension then ease-of-use is higher.	Direct, Positive	Ease of Use	5-point Likert scale
H4	Focus	When a site avoids pop-up windows and blinking or moving elements then ease-of-use is higher.	Direct, Positive	Ease of Use	5-point Likert scale
H5	Language	When a site uses language that is as simple as is appropriate for the content then ease-of-use is higher.	Direct, Positive	Ease of Use	5-point Likert scale
H6	Error Recovery	When a site gives users control over time sensitive content changes then ease-of-use is higher.	Direct, Positive	Ease of Use	5-point Likert scale
H7	Assistive Technology Compatibility	When a site offers alternative text and a logical, intuitive reading and navigation order then ease-of-use is higher.	Direct, Positive	Ease of Use	5-point Likert scale

Control Variables

ID	Construct	Hypothesized Relationship	Dependent Construct	Measurement
C1	Age	None	Ease of Use	Categorical, range of years
C2	IT Experience	None	Ease of Use	Categorical, range of years working in the information technology field
C3	Education	None	Ease of Use	Categorical, range of years beyond high school diploma or GED
C4	Disability Status	None	Ease of Use	Boolean, whether the respondent has a disability

IV. Methodology

Sampling

English-literate adults (aged 18 and older) residing in the United States and participating on Amazon's Mechanical Turk platform:

- Surveying 7 hypotheses with between 3 and 5 questions apiece yields a minimum 21 questions, following the 'rule of 3' from Freeze and Raschke (2007),
- Sample approximately 100 healthcare website users to validate the instrument.

Threats to Validity

Two threats to construct validity stemming from our sampling and survey procedure worry us the most, from Van de Ven (2016) #3 Hypothesis guessing—participants guess the hypothesis, and #4 Evaluation apprehension—participants present positive impression.

Our concern is that the survey questions will lead the respondents into wanting to pick the socially acceptable answer since we will be seeking respondents responsible for funding, designing, and building information systems. We would describe all of the product owners, designers, and developers we know as relatively sophisticated and it may be a challenge to word the questions in a way that isn't leading. We will attempt to address this risk through a two-fold approach: 1. include a control variable in the survey, to indicating the number of years of IT experience, and 2. ask respondents about the dependent variable, usability, at the top of the survey to minimize the risk inherent in the survey instrument.

V. Proposed Data Analysis

Coding and Analysis

We will measure the dependent and independent variables on a 5-point Likert scale, and analyze the data by conforming to a stepwise process, at a minimum, to include four critical components:

1. Exploratory Factor Analysis,
2. Scale reliabilities for the retained items measuring each of the constructs,
3. Descriptive statistics for the aggregates measuring each of the constructs (created by averaging the retained items), including normality tests and plots, and
4. A hierarchical regression analysis which examines both the main effects and the interactions depicted in the measurement model.

VI. Timeline

Candidate questions drafted for review (refer to Appendix A for survey items)	April 1, 2022
IRB submitted	April 18
Survey instrument refined	April 29
IRB re-submitted	April 29
Informed pilot	May 10
Survey instrument refined	May 13
IRB re-submitted	May 17
IRB re-submitted	May 20
IRB approved	June 16
Main pilot	June 17

Data Analysis and Write-Up	July 15
Final Submission	July 28

VII. Analysis and Discussion

Informed Pilot

Prior to IRB submission, we conducted an informed pilot with six of our FIU DBA colleagues to 1. Gain insights on the content and structure of the survey instrument, 2. Validate the expected amount of time required from each respondent, and 3. Ensure the proper functioning of the survey instrument configuration on the Qualtrics platform.

There were two main points by the participants in the informed pilot panel. First, several questions were identified as 'double-barreled', that is, asking the subject for a single response to a multi-part question, indicated by the use of 'and' in the item's predicate. We split the items accordingly. Second, there were several important interface enhancements suggested and implemented, and we appreciate the thoughtful time and effort invested by the informed pilot participants.

Main Pilot – Exploratory Factor Analysis

After visually checking and importing the main pilot responses from Qualtrics into SPSS in CSV file format, a principal axis factor analysis was conducted on the 93 items with oblique rotation (direct oblimin), n=100. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis, KMO = .78 ('middling' according to Kaiser and Rice, 1974), and all KMO values for individual items were greater than .59, which above the acceptable limit of .50. An initial analysis was run to obtain eigenvalues for each factor in the data.

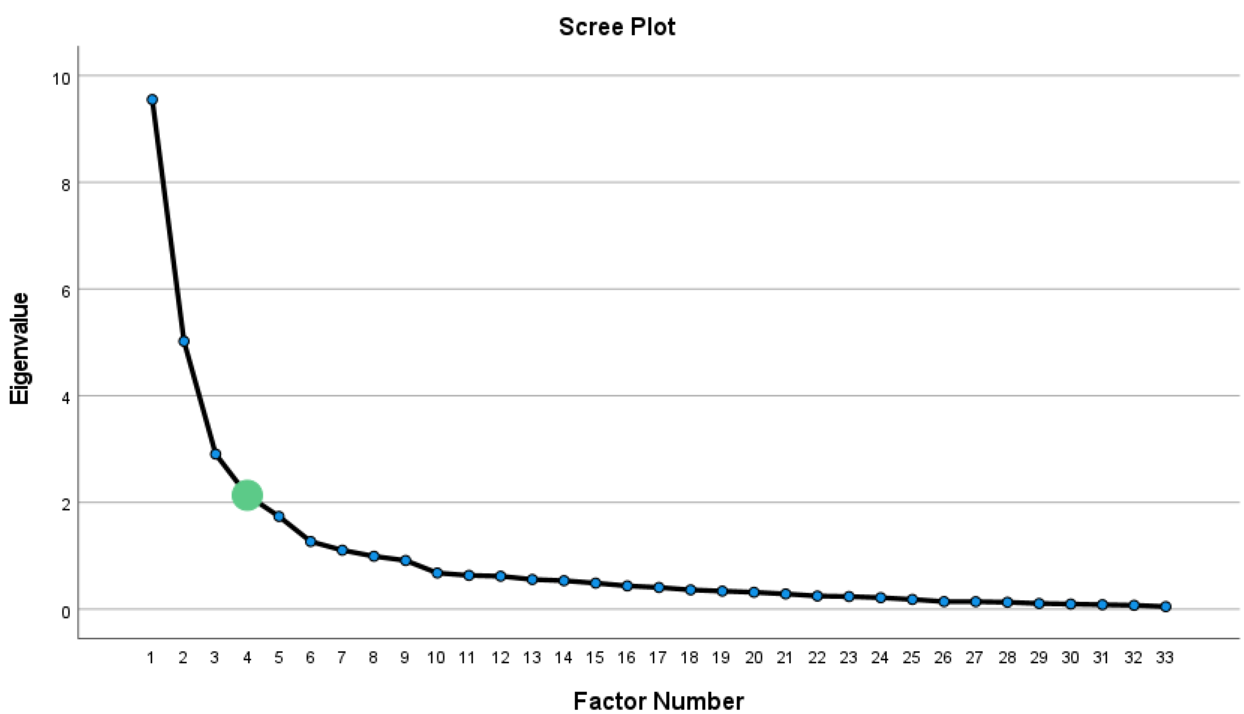
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.788
Bartlett's Test of Sphericity	Approx. Chi-Square	2412.511
	df	528
	Sig.	.000

We retained four factors because of the model specification and the convergence of the scree plot on this value. The four factors together explain 54% of the variance in the data.

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	9.551	28.941	28.941	9.146	27.714	27.714	8.339
2	5.021	15.217	44.158	4.597	13.930	41.644	4.030
3	2.907	8.809	52.967	2.467	7.477	49.121	5.364
4	2.135	6.468	59.436	1.605	4.865	53.985	2.800
5	1.739	5.268	64.704				
6	1.269	3.844	68.548				
7	1.106	3.351	71.899				
8	.992	3.006	74.906				



Structure Matrix

	Factor			
	1	2	3	4
EASE03	.879			
EASE01	.865			
EASE10	.841			
EASE09	.840			
EASE14	.830			
EASE02	.798			
EASE11	.786			
EASE05	.767			
EASE07	.760			
EASE12	.730			
EASE08	.632			
EASE04	.620			
MLMD08		.841		
MLMD07		.797		
MLMD05		.778		
MLMD06		.756		
MLMD04		.561		
MLMD02		.537		
ERRC10			-.760	
ERRC12		.420	-.711	
ERRC11			-.686	
ERRC08			-.669	
ERRC09			-.644	
ERRC01			-.637	
ERRC16			-.629	
ERRC02			-.627	
ERRC03			-.544	
ERRC26			-.491	
FOCS13				-.762
FOCS02				-.571
FOCS01				-.564
FOCS12				-.527
FOCS03				-.409

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

Factor Correlation Matrix

Factor	1	2	3	4
1	1.000	.034	-.267	-.194
2	.034	1.000	-.261	-.129
3	-.267	-.261	1.000	.120
4	-.194	-.129	.120	1.000

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

Scale reliabilities for the retained items measuring each of the constructs

The items that cluster on the same factor suggest that factor 1 represents support for multi-modality in healthcare websites, factor 2 represents support for focus, factor 3 support for error recovery and factor 4 ease of use. The subscales exhibited high reliabilities, with all Cronbach's alphas >= .78.

Multi-modality (Cronbach's alpha = .84)

Focus (Cronbach's alpha = .78)

Error Recovery (Cronbach's alpha = .87)

Ease of Use (Cronbach's alpha = .94)

Descriptive statistics for aggregate measures

Zero-centered means for the four factors were calculated on each record and evaluated for normality using the Kolmogorov-Smirnov test, and three were found to exhibit normality (p < .001), and Q-Q Plots provided visual evidence in support of this result. Error Recovery was found to have a left skew thereby failing to conform to the normal distribution assumption (extreme values on the lower end), Multi-modality and Focus exhibiting three extreme values at the bottom of the range, and Ease of use exhibiting four extreme values at the bottom of the range.

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Zero-centered mean for Multi-modality	.125	100	.001	.930	100	.000
Zero-centered mean for Focus	.123	100	.001	.961	100	.004
Zero-centered mean for Error Recovery	.081	100	.099	.968	100	.016
Zero-centered mean for Ease of Use	.198	100	.000	.802	100	.000

a. Lilliefors Significance Correction

Pearson's test for correlation was conducted to roughly evaluate the degree to which the factor means moved in the same direction as an indicator that the model had theorized the direction of the relationships accurately. Factor correlations were mixed. Error Recovery positively correlated with Multi-modality and Focus, and Ease of Use positively correlated with Focus and Error Recovery ($p < .001$), ranging from a low of .22 to a high of .37.

Correlations

		Zero-centered mean for Multi-modality	Zero-centered mean for Focus	Zero-centered mean for Error Recovery	Zero-centered mean for Ease of Use
Zero-centered mean for Multi-modality	Pearson Correlation	1	.063	.243*	.012
	Sig. (2-tailed)		.530	.015	.909
	N	100	100	100	100
Zero-centered mean for Focus	Pearson Correlation	.063	1	.227*	.370**
	Sig. (2-tailed)	.530		.023	.000
	N	100	100	100	100
Zero-centered mean for Error Recovery	Pearson Correlation	.243*	.227*	1	.248*
	Sig. (2-tailed)	.015	.023		.013
	N	100	100	100	100
Zero-centered mean for Ease of Use	Pearson Correlation	.012	.370**	.248*	1
	Sig. (2-tailed)	.909	.000	.013	
	N	100	100	100	100

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Future Data Collection and Analysis Opportunities

Given an opportunity to collect more data ($n > 400$, or ten times the number of retained items in the survey), we believe there is an opportunity to use the factors under investigation in a further analysis to examines the main effects between the four factors. Specifically, a hierarchical multiple regression analysis may be conducted to examine the relationship between Multi-modality, Focus, Error Recovery, and Ease of Use, while controlling for IT experience, education, disability status, and age of the respondent.

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Appendix A – Survey Questions

Control Variables

Model -Ref.	Name	Question
C1	CRTL01	What is your age? (Categorical, range of years)
C2	CTRL02	How many years of experience do you have using information technology? (Categorical, range of years)
C3	CTRL03	How many years of education do you have since finishing high school or equivalent (like a GED)? (Categorical, range of years)
C4	CTRL04	Do you have a disability? (Boolean)

Note that the "accessibility best practices" published by W3C and WebAIM have not been empirically validated and this research will help create a reliable instrument.

We will measure responses to ninety-three (93) questions on a five-point Likert scale unless noted otherwise: 1-strongly disagree, 2-disagree, 3-not sure, 4-agree, 5-strongly agree.

Pilot Survey Instructions: Please think about your last interaction with a health care website. It could have been a clinic, hospital, doctor's office, pharmacy, or insurance provider, and keep that experience in mind as you answer the following questions about your experience.

Dependent Variable: Ease-of-use

From Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, Vol. 13 No. 3 pp. 319-340.

D1	EASE01	I often became confused the last time I used the health care website. (reverse)
D2	EASE02	I made errors frequently when using the health care website. (reverse)
D3	EASE03	Interacting with the health care website was often frustrating. (reverse)
D4	EASE04	I needed to consult the site help links often when using the health care website. (reverse)
D5	EASE05	Interacting with the health care website required a lot of my mental effort. (reverse)
D6	EASE06	I found it easy to recover from errors encountered while using the health care website.

D7	EASE07	The health care website was rigid and inflexible to interact with. (reverse)
D8	EASE08	I found it easy to get the health care website to do what I want them to do.
D9	EASE09	The health care website often behaved in unexpected ways. (reverse)
D10	EASE10	I found it cumbersome to used the health care website. (reverse)
D11	EASE11	My interaction with the health care website was easy for me to understand.
D12	EASE12	It was easy for me to remember how to perform tasks using the health care website.
D13	EASE13	The health care website provided helpful guidance in performing tasks.
D14	EASE14	Overall, I found the health care website easy to use.

Note that factor loadings are not available for the scale items we developed for the independent variables (measuring H1, H2, …, H7). Exploratory factor analysis results are not available from the organization that publishes the *Evaluating Cognitive Web Accessibility* recommendations, and to our knowledge, are not available in publication. We are therefore relying on colleague input during an informed pilot. Participants are our fellow students in the FIU DBA program, are familiar with the research question, with the intention of helping us decide how to reduce the number of items proposed for each scale before the Summer pilot study begins.

Independent Variable: Consistency (H1)

From WebAIM.org, the Institute for Disability Research, Policy, and Practice at Utah State University *Evaluating Cognitive Web Accessibility.* Retrieved September 3, 2021 from https://webaim.org/articles/evaluatingcognitive/#consistency

H1.1	CNST01	The health care website had consistent navigation.
H1.2	CNST02	I found that the health care website displayed information in a predictable way.
H1.3	CNST03	Functionality in the health care website did not change from page to page.
H1.4	CNST04	The health care website used similar interface elements.

H1.5	CNST05	Similar interactions in the health care website produced predictably similar results.

Independent Variable: Transformability (H2)

From WebAIM.org, the Institute for Disability Research, Policy, and Practice at Utah State University *Evaluating Cognitive Web Accessibility.* Retrieved September 3, 2021 from https://webaim.org/articles/evaluatingcognitive/#transformability

H2.1	TRNF01	I found that health care website pages remained readable and functional when text size is increased.
H2.2	TRNF02	Images were readable and comprehensible when enlarged on the health care website.
H2.3	TRNF03	I prefer when color alone is not used to convey content on the health care website.
H2.4	TRNF04	I prefer when images can be disabled on the health care website.
H2.5	TRNF05	I prefer when page styles can be disabled on the health care website.

Independent Variable: Multi-modality (H3)

From WebAIM.org, the Institute for Disability Research, Policy, and Practice at Utah State University *Evaluating Cognitive Web Accessibility.* Retrieved September 3, 2021 from https://webaim.org/articles/evaluatingcognitive/#multimodality

H3.1	MLMD01	Content was available in multiple media on the health care website.
H3.2	MLMD02	Video or audio alternatives provided an additional method of perceiving content on the health care website.
H3.3	MLMD03	The health care website provided a text alternative (captions and/or a transcript) for video and audio content.
H3.4	MLMD04	Closed captioning, which gives me the option to turn on video captions, is available on the health care website.
H3.5	MLMD05	Images were used to convey or enhance content on the health care website.
H3.6	MLMD06	Illustration, diagrams, icons, and animations conveyed complex information on the health care website.
H3.7	MLMD07	Icons or graphics was paired with text to provided contextual cues on the health care website.
H3.8	MLMD08	Icons or graphics helped with content comprehension on the health care website.

Independent Variable: Focus (H4)

From WebAIM.org, the Institute for Disability Research, Policy, and Practice at Utah State University *Evaluating Cognitive Web Accessibility.* Retrieved September 3, 2021 from https://webaim.org/articles/evaluatingcognitive/#focus

H4.1	FOCS01	Empty space and visual design elements on the page focused my attention on the health care website.
H4.2	FOCS02	The design of the page (empty space, color, images, etc.) focused on what is most important on the health care website.
H4.3	FOCS03	The layout of the page helped me avoided distractions on the health care website.
H4.4	FOCS04	The health care website avoided animation, varying or unusual font faces, contrasting color or images, or other distracters that pull my attention away from content.
H4.5	FOCS05	The health care website avoided complex or "busy" background images that can draw my attention away from the content.
H4.6	FOCS06	The health care website avoided pop-up windows and blinking or moving elements.
H4.7	FOCS07	The health care website avoided italics or bold on long sections of text.
H4.8	FOCS08	The health care website avoided ALL CAPS.
H4.9	FOCS09	The health care website organized content into well-defined groups or chunks, using headings, lists, and other visual mechanisms
H4.10	FOCS10	The health care website broke long pages into shorter sections with appropriate headings (used true and visually significant headings rather than simply big bold text).
H4.11	FOCS11	The health care website used shorter, multi-step forms for complex interactions, rather than lengthy, all-in-one forms.
H4.12	FOCS12	The health care website pages used plenty of empty space for separation.
H4.13	FOCS13	Empty space separated navigation from main body, body text from side elements and footer, main content from supplementary items (floating boxes, for example) and separated headings, paragraphs, and other body text on the health care website.
H4.14	FOCS14	The health care website avoided background sounds.
H4.15	FOCS15	The health care website gave me control over playing audio content within the page.
H4.16	FOCS16	The health care website gave me control to stop all background sounds.

Independent Variable: Language (H5)

From WebAIM.org, the Institute for Disability Research, Policy, and Practice at Utah State University *Evaluating Cognitive Web Accessibility.* Retrieved September 3, 2021 from https://webaim.org/articles/evaluatingcognitive/#readability

H5.1	LANG01	Language was as simple as appropriate for the content on the health care website.
H5.2	LANG02	The health care website avoided tangential, extraneous, or non-relevant information.
H5.3	LANG03	The health care website stuck to the content at hand.
H5.4	LANG04	The health care website used correct grammar and spelling.
H5.5	LANG05	The health care website was written in clear and simple language.
H5.6	LANG06	The health care website avoided colloquialisms, non-literal text, and jargon.
H5.7	LANG07	The health care website expanded abbreviations and acronyms.
H5.8	LANG08	The health care website provided summaries, introductions, or a table of contents for complex or lengthy content.
H5.9	LANG09	The health care website avoided long lines of text (more than around 80 characters per line).
H5.10	LANG10	The health care website required no horizontal scrolling.

Independent Variable: Error Recovery (H6)

From WebAIM.org, the Institute for Disability Research, Policy, and Practice at Utah State University *Evaluating Cognitive Web Accessibility.* Retrieved September 3, 2021 from https://webaim.org/articles/evaluatingcognitive/#orientation

H6.1	ERRC01	The health care website gave me control over time sensitive content changes.
H6.2	ERRC02	The health care website gave me control over page content updates or changes.
H6.3	ERRC03	The health care website allowed me to request more time to complete an action.
H6.4	ERRC04	The health care website provided instructions and cues for forms.
H6.5	ERRC05	The health care website identified required elements.
H6.6	ERRC06	The health care website provided associated and descriptive form labels and legends.
H6.7	ERRC07	The health care website gave me clear and accessible form error messages.

H6.8	ERRC08	The health care website provided a way to resolve form errors and resubmit the form.
H6.9	ERRC09	The health care website gave feedback on my actions.
H6.10	ERRC10	The health care website confirmed correct choices.
H6.11	ERRC11	The health care website alerted me to errors or possible errors.
H6.12	ERRC12	The health care website provided instructions for unfamiliar or complex interfaces.
H6.13	ERRC13	The health care website used breadcrumbs, indicators, or cues to indicate location or progress.
H6.14	ERRC14	The health care website allowed me to quickly determine where they was at in the structure of a web site (e.g., a currently active "tab" or Home > Products > Widget, for example) or within a sequence (Step 2 of 4).
H6.15	ERRC15	The health care website gave me Next/Previous options for sequential tasks.
H6.16	ERRC16	The health care website allowed critical functions to be confirmed and/or canceled/reversed.
H6.17	ERRC17	The health care website provided adequately-sized clickable targets and ensured functional elements appear clickable.
H6.18	ERRC18	The health care website used labels for form elements, particularly small checkboxes and radio buttons.
H6.19	ERRC19	The health care website ensured all clickable elements appear clickable and do not require exactness in how the pointer is positioned (plenty of space in which to click).
H6.20	ERRC20	The health care website used underline for links only.
H6.21	ERRC21	The health care website provided multiple methods for founding content.
H6.22	ERRC22	The health care website featured a logical navigation.
H6.23	ERRC23	The health care website provided search functionality.
H6.24	ERRC24	The health care website provided an index.
H6.25	ERRC25	The health care website provided a site map.
H6.26	ERRC26	The health care website provided a table of contents.
H6.27	ERRC27	The health care website provided links within body text.
H6.28	ERRC28	The health care website provided a supplementary or related links section.
H6.29	ERRC29	The health care website provided multiple ways for me to found content.

Independent Variable: Assistive Technology Compatibility (H7)

From WebAIM.org, the Institute for Disability Research, Policy, and Practice at Utah State University *Evaluating Cognitive Web Accessibility.* Retrieved September 3, 2021 from https://webaim.org/articles/evaluatingcognitive/#atcompatibility

H7.1	ATC01	I used a screen reader so I could hear all of the page content when using the health care website.
H7.2	ATC02	I used a screen magnifier so that the content was visible when using the health care website.
H7.3	ATC03	I used a keyboard when using the health care website.
H7.4	ATC04	I used a mouse when using the health care website.
H7.5	ATC05	I used a trackpad when using the health care website.
H7.6	ATC06	I used a touchscreen when using the health care website.

Attention check questions

Z1	Z1	Please select 'strongly agree'
Z2	Z2	Please select 'strongly agree'
Z3	Z3	Please select 'strongly agree'