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Comparing Sensory Accessibility Needs in Deaf and Low Vision Populations: an Explorative Study

Anna Bruckbauer
University of Wisconsin-Milwaukee

COMPARING SENSORY ACCESSIBILITY NEEDS IN DEAF AND LOW VISION POPULATIONS: AN EXPLORATIVE STUDY

by

Anna Y. Bruckbauer

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ABSTRACT

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by

Anna Y. Bruckbauer

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Under the Supervision of Roger O. Smith

Objective. This study addresses the research question, “How do hard of hearing individuals and individuals with low vision perceive the importance of specific features in the built environment to support engagement and participation?”

Background. The Americans with Disability Act-Architectural Barriers (ABA-ADA) guidelines of 2004 & 2015 help to ensure accessibility for all individuals to federally funded and public buildings. However, these building guidelines often lack functionality, and often neglect to address sensory accessibility needs for those who have sensory disabilities. Other building guidelines have been published, including DeafSpace (Bauman, 2019) and the Design Guidelines for the Visual Environment (National Institute of Building Sciences, 2015), to fill in the gaps of functionality for very specific disability needs. Very little attention has been given to the overlap that resides between these two seemingly different populations. It is hypothesized 1) individuals who are hard of hearing and individuals who have low vision will both perceive Lighting, Openness, and Color/Contrast in the built environment as important to maximize engagement and participation. Secondly, it is hypothesized individuals who are hard of hearing and individuals who have low vision will not perceive Acoustic and

Services/Communications as equally important to maximize participation. This research study focuses on addressing these two hypotheses.

Methods. This study surveyed 103 participants using a between-group design to better understand and compare the importance of various built environment features to address sensory accessibility needs between a group who have visual and a group with auditory disabilities. A Qualtrics on-line survey with an alternative auditory survey was devised and validated through structured interview with six experts to determine the importance of 5 major sensory accessibility features. 35 respondents met the study criteria and were analyzed using crosstabulations and post-hoc Mann-Whitney *U*-testing, with an alpha value of p = .01, 95% CI to determine statistical differences in the distributions of perceived importance in sensory accessibility needs.

Results. Hypothesis 1) The importance of Lighting (U = 82.0, p = .074), Openness (U = 80.0, p = .064), were not statistically significantly different; The importance of Color/Contrast (U = 18.5, p<.001) showed a statistically significant difference between individuals who are hard of hearing and individuals with low vision. Therefore, we accept and reject the null hypothesis. Hypothesis 2) Acoustics (U = 192.5, p<0.001), and Services/communication (U = 86.0, p = .102) showed there was not a statistically significant difference between individuals who are hard of hearing and individuals with low vision; Therefore, we reject the null hypothesis.

Conclusion. Lighting, Openness, Acoustics, and Services/Communication were identified to be important features in the built environment to maximize engagement and participation for both hard of hearing and low vision populations.

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PART 1: THESIS OVERVIEW

Overview

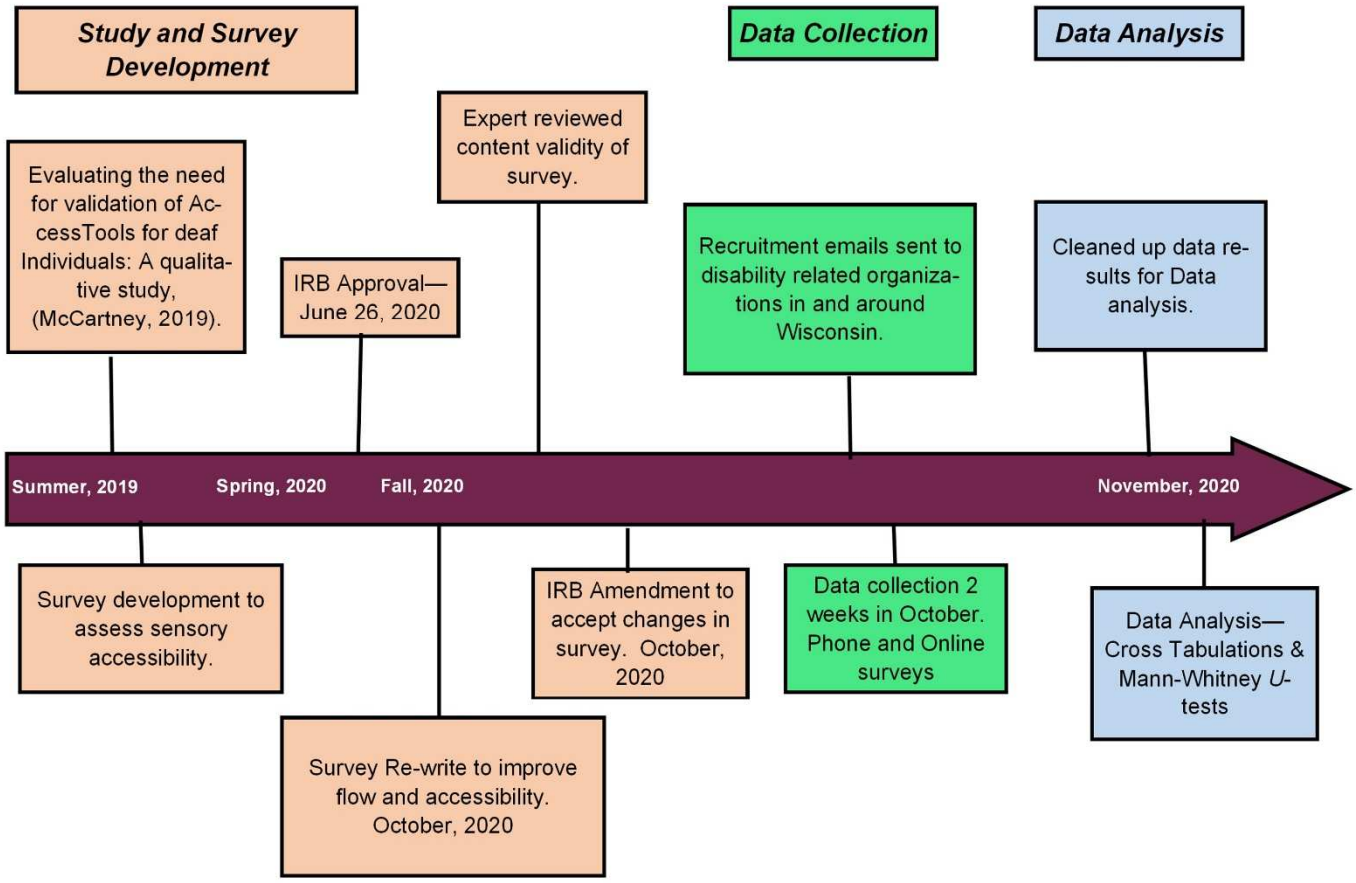
This thesis will consist of three different parts: 1) The thesis overview, 2) the manuscript, and 3) the appendices. Part 1 of this thesis will provide a brief description of the thesis, the timeline of the study, and the significance to occupational science and therapy, as well as the phases of the study from literature review to data analysis. Part 2 of the thesis will be written for a research manuscript in preparation for future submission to a scholarly journal in Universal Design, Accessible Design, deaf/hard of hearing studies, and Low vision studies. Finally, Part 3 will consist of the appendices which will provide in greater details the study survey development and tool, the IRB protocol, specific details from the data set, raw data from each of the survey questions, and the equivalent text descriptions (EqTDs) for the thesis figures.

Timeline of the study

The following section is a chronological summary of the study. In the Spring of 2019, the absence of adequate and sufficient questions related to Deaf and Hard of Hearing individuals for building accessibility was brought to the attention of the primary investigator after analyzing the taxonomy of AccessTools for the AccessRatings for Buildings Project. In March of 2019, a structured interview and qualitative study was written, and an abstract was submitted for the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) 2019 conference. During the Summer of 2020, a noticeable gap in literature was identified relating to the similar accessibility needs individuals who are deaf/hard of hearing, and low vision experience when they are accessing their built environment. On January 20, 2020, the primary researcher proposed a thesis to a committee of advisors. The committee requested some

modifications of the thesis proposal to allow the thesis to be more attainable and achievable by the targeted graduation date of December 2020. Revisions to the thesis proposal were implemented to allow for a more attainable thesis. On February 19, 2020, the thesis committee members approved the design and hypothesis of the thesis. On February 28, 2020, the primary researcher started fieldwork, with the expectation the thesis survey would be created, and IRB approval would be obtained before Summer of 2020. In the Spring of 2020, the COVID-19 pandemic interrupted the fieldwork placement of the primary researcher. On June 8, 2020 documents were submitted to the Institutional Review Board (IRB) for an exempt review. After many iterations, IRB granted approval on June 26, 2020. On July 1, 2020, the primary researcher returned to her first level two fieldwork placement due to the interruption in March of 2020. IRB amendments were submitted in October 2020 for revisions to the survey to improve flow and accessibility of the survey design. Participant recruitment opened and was active from October 6, 2020 to October 20,2020 when an adequate number of participants were recruited. During this time, participants were recruited through snowball sampling, word of mouth, and surveys were provided through both online and through phone call. Recruitment was efficient, effective, and easy as all participants were recruited in a timely manner. Refer to Figure 1. for a visual analysis of the overall thesis timeline. The image depicts of three different phases including Study and survey development, Data collection, and Data analysis over the course of a year and a half.

Figure 1: Thesis Timeline EqTD



Summary of changes

The original research procedure and protocol changed in five ways during the implantation process to improve flow and modify to accommodate for the effect that the COVID-19 pandemic influenced on this research. The first major change was the instrument used. The original proposal proposed to evaluate and code the taxonomy of AccessTools related to the Access Ratings for Building Project. The survey created was supposed to have individuals perform content validity studies on the taxonomy of

access tool. However, a survey was created through comparing building accessibility guidelines for individuals who are deaf/hard of hearing and low vision/blind populations to help fill in the gap in the taxonomy of AccessTools related to lighting, acoustics openness, color/contrast, and person-based services. At the time of creating the survey, July 2020, there were only 2 questions related to lighting and sounds in AccessTools. This was not adequate or sufficient to assess the needs for lighting and sound. The second major change from the original proposal was the expert rating and formal content validity study. To ensure accuracy, flow, and comprehensiveness, 6 different experts were consulted. These experts were two experts who have worked closely with the AccessRatings for Buildings Taxonomy and project, two experts with lived experience who are deaf, and two experts who work for Vision Forward in Milwaukee, Wisconsin. One of these experts are blind herself and provided feedback to the survey. All experts were asked to review the survey, and ensure the wording was accurate, concise, and comprehensive. The third change is related to the data analysis. During the initial proposal, the Fischer Z data analysis was proposed, however through the advice of a statistician and the purpose of data analysis, the Mann Whitney U test was chosen to analyze the data, to determine if the distribution of answers was statistically similar or different. The fourth change was the addition to include participants who are blind in the survey. After a lengthy discussion with a blind/low vision expert, it was discussed the importance of including individuals who are legally blind in the study, and many still have partial sight. Finally, the original proposal proposed a total of 20 participants would be recruited and analyzed. However, due to the excellent support, a

total of 103 participants responded, with 61 surveys considered valid for the inclusion criteria.

Learning process

Over the course of the past year and half of this research study, I have learned many things about both myself and the research process. I have especially learned the challenges and difficulties of the independence in a research process, the appropriate IRB process, and strategies related to participant recruitment. Additionally, I have learned the expectation of a master level thesis is to learn the process of research and can build upon an already established idea, it does not need to be an original idea. However, through all the challenges of my thesis, it has led to a newfound understanding and respect for the research process.

Significance to the Field of Occupational Science and Therapy

Social participation is one of the main occupations defined by the American Occupational Therapy Association Practice Framework (American Occupational Therapy Association (AOTA) Practice Framework, 2014). Occupations are defined as how individuals want and need to occupy their time. Various frameworks explore how persons can explore and engage in various occupations, but also barriers to participation can arise. Individuals with sensory disabilities, such as hearing and vision, face many barriers and challenges in their daily lives in various occupations.

This thesis aims to explore how to improve and increase occupational engagement through increasing social participation in a restaurant environment. Often, the environment is explored in being able to access a building, however, little discussion is related to what allows a person to stay. This concept of staying rather than just

accessing allows to further the discussion of Universal and Accessible design to support the engagement of all persons.

PART 2: RESEARCH MANUSCRIPT

Abstract

Objective. The objective of the study is to compare hypothesized similar sensory accessibility needs of Lighting, Acoustics, Openness, Color/Contrast, and Services/communication for the hard of hearing and low vision population.

Background. The Americans with Disability Act – Architectural Barriers Act Design Guidelines (ADA-ABA, 2004, 2015) provides guidelines to increase accessibility of public buildings for individuals covered by the ADA (1990). However, these guidelines often fall short of providing functional and practical guidelines to be accessible for all. Extant building rating tools fail to attend to the overlap of functional needs for the hard of hearing and/or low vision populations. Thus, there is a need to explore the similarities as they relate to not only accessing the environment but also staying in and engaging with the environment. We hypothesize Lighting, Openness, and Color/Contrast will be important building features to help facilitate engagement in the environment. 2) We hypothesize Acoustics and Services/Communication will have different levels of perceived importance in the facilitation of participation in the environment for hard of hearing and low vision populations.

Methods. An exploratory between-group study was conducted through a survey developed specifically for this research study to compare similar sensory accessibility needs for 35 individuals who self-identify as low vision or hard of hearing. A Mann-Whitney U-test analysis ($p = 0.01$, 95% CI) was run on all the survey questions to analyze the statistical differences of the distributions.

Results. The importance of Lighting ($U = 82.0$, $p = .074$), Acoustics ($U = 192.5$, $p<0.001$), Openness ($U = 80.0$, $p = .064$), and Services/communication ($U = 86.0$, $p = .102$) showed there was not a statistically significant difference between individuals who are hard of hearing and individuals with low vision. The importance of Color/Contrast ($U = 18.5$, $p<.001$) showed a statistically significant difference between individuals who are hard of hearing and individuals with low vision.

Discussion. Implications for future research, and limitations are discussed.

Background

The Person – Environment-Occupation model

The Person-Environment- Occupation (PEO) model (Law et al., 1996) is the guiding framework for this study. The PEO model identifies the relationship between a person, their environment, and occupations, and how they can support and enhance the person's ability (Law et al., 1996). This model illustrates how the environment, when modified correctly to be supportive, can enhance an individual's performance (Park, 2011). Using the PEO model, the fit between the person, environment, and occupation

is analyzed to evaluate the extent to which the building design enables the person versus disabling the person (Baumann, 2014). This theory makes the important point and shifts the focus from a person with a disability to their surrounding environment and how that plays a role in their engagement in social participation.

Person

Sensory Disabilities

A sensory disability is a disability of the senses which affect sight, hearing, smell, touch and taste. As human beings, we perceive 95% of our world through sight and hearing and experiencing a sensory disability can affect how we gather information from the world around us (Dillon et al., 2010). When individuals experience sensory loss at a younger age, the body may heighten the sensitivity of other senses to help support the comprehension of space and movements. As individuals increase in age, sensory disabilities are known to follow closely behind. Thus, the prevalence of sensory impairment will continue to increase as U.S. life expectancy increases. Two major sensory disabilities include hearing and vision.

Hearing Sensory Disabilities

About 20% of individuals, or 48 million people, in the United States have reported some sort of hearing loss (National Institute on Deafness and other Communication Disorders [NIDCD], 2015). Focusing on the audiological model, the term Hard of hearing is used to describe a person with a mild-to-moderate or 20-60 decibel hearing loss across four speech frequencies (NIDCD, 2015). Table 1. provides a quick glimpse of the degree of loss and the type severity of hearing loss. With the power of technology today, several pieces of equipment such as hearing aids, cochlear implants, and amplification devices, are being made to aid hard of hearing users to navigate the

hearing world. However, data has shown, about 70% of older Americans with hearing loss in at least one ear, who could benefit from using hearing aids, do not use one (Dillon et al., 2015).

Table 1. Levels of Hearing Loss EqTD

Levels of Hearing loss (Bance, 2007)	
Type	Decibels (dB) lost
Normal	<20 dB
Mild	20-40 dB
Moderate	41-60 dB
Severe	61-80 dB
Profound/ deafness	>81 dB

Communication and Hearing Sensory Disabilities.

Individuals who are deaf/hard of hearing can communicate in a variety of ways. There is truly no “one-size-fits-all” nor is there a “typical” deaf person (NDC, 2019). Communication styles include Visual such as Sign Language and gestures, Auditory such as cued speech and lip reading, and or tactile such as vibrations and through touch (NDC, 2019). Auditory communication is facilitated through residual hearing and spoken languages received through the ear often supported with hearing aids and cochlear implants to help interpret sound (NDC, 2019).

Visual Sensory Disabilities.

According to the Center for Disease Control, vision disability is one of the top 10 disabilities among adults 18 years and older, and one of the most prevalent disabling conditions among children (Vision Health Initiative, 2020). Similar to hearing, there are several ways to define visual disabilities. There are many different visual impairments that cause low vision, or partial vision loss, the leading age-related eye disorders include cataracts, diabetic retinopathy, glaucoma, and age-related macular

degeneration (Dillon et al., 2015). Legal and total blindness are two very different terms, and do not describe what a person can and cannot see. (American Foundation for the Blind [AFB], 2019). Low vision, on a functional basis, is an uncorrectable vision loss that interferes with daily activities. Individuals with a visual impairment may be able to perceive the difference between light and dark environments. Total blindness is the complete lack of light perception; about 15% of individuals who have eye disorders are totally blind. Refer to Table 2. for the levels of visual impairment and the differentiation between legal and total blindness.

Communication and Visual Sensory Disabilities.

We perceive our world with our brains and not our eyes. Having fight limitations, decreases the visual cues in our environment and defects the interpretation and reduces the ability to understand or safely navigate around the environment. Almost 60% of older persons with vision problems do not use glasses at all or have glasses that do not completely correct their vision (Dillon et al., 2015). With a vision loss, observation with communication partners can decrease with challenges in reading facial cues, hand gestures, turn taking cues, and feedbacks (Myers-Rickard, 2020). However, with the loss of visual acuity in vision may heighten sensitivity in other senses such as auditory and tactile cues (Design Guidelines for the Visual Environment, 2015).

Table 2. Levels of Visual Impairments *EqTD*

Label	Snellen Visual Acuity	Functional Vision Loss
Moderate Visual impairment	20/70 to 20/160	Low vision
Severe visual impairment	20/200 to 20/400 20 degrees or less visual field	Legally blind
Profound Visual Impairment	20/500 to 20/1000 Visual field of 10 degrees or less	Legally blind
Total blindness	Lack of light perception	Legally blind

Environments:

There are several types of environments the physical, social, and psychological environment (Brandt & Pope, 1997). The physical environment can be broken into the natural and the built environment. Even though all the environments can influence a person's engagement, the built environment will be what is focused on for this study (Brandt & Pope, 1997). A brief research study has shown, the physical environment, which is easily modifiable, can have more of an effect [on participation] than the social environment (Foley et al., 2014).

Environment and the deaf population.

Currently, there are few research studies that relate to the accessibility needs of individuals who are deaf to their environment. However, a key and important working draft from Dr. Hansel Bauman, an architect and professor at Gallaudet University offers a 150-item guideline to help architects design spaces that provide the best sensory

experience for individuals who are deaf and hard of hearing (Personal communication, Dr. Hansel Bauman, 2019).

DeafSpace design guidelines (DSDG) is a living document that considers the unique visual and spatial needs for deaf individuals, to create a pattern book of ideas that utilizes basic room sizes, configurations, adjacencies, and strategies for efficient light, color, materials, and acoustics to increase accessibility for the deaf population(Bauman, 2010). DSDG addresses five major points between the deaf experiences and the built environment: space and proximity, sensory reach, mobility and proximity, light and color, and acoustic and electromagnetic interference.

Space and Proximity explores how far apart individuals must be to fully be engaged in conversation, and including the level of intimacy (Bauman, 2010). Due to signed languages being visual, direct eye contact, and a clear visual window is crucial (Bauman, 2010). *Sensory Reach*: Sensory reach is defined by the [person's] interrelated systems of perceptions that are used to understand and orient in space (Bauman, 2010)". It interrelates visual, vibratory, tactile, shared, and social cues to create a 360-degree sensory reach. *Mobility and proximity*: "Signers holding conversation while walking run into risk of tripping, colliding with others, colliding with physical obstructions or drifting into traffic" (Bauman, 2010). The goal is to look at proximity and mobility is pathways, ramps and stairs, thresholds, and rhythm and vertical cues. *Acoustics* The goal of acoustic should help to minimize the background noise for individuals using cochlear implants and hearing aids (Bauman, 2010). Electromagnetic (EM) fields which are used in transmitting radio, television, and cellular phone signals, can interfere with hearing aids. More research needs to be completed in

this section, however mechanical rooms and electrical equipment should be located away from gathering places (Bauman, 2010).*Light and Color:* Light and color is a very important area to assess to help reduce eye strain and increase focus and attention during communication. The color of walls and texture should be basic and help contrast any shade of human skin; recommended colors are blue and green walls. The ability to control daylight, natural lighting, and electric lighting, can help to enhance visual communication, and highlight gathering spaces (Bauman, 2010).

Environment and Low vision:

In 2015, the National Institute of Building Sciences [NIBS] published the 6th *Design Guidelines for the Visual Environment (DSVG)*. These guidelines aim to fill in the gaps where the Americans with Disabilities Act (1990) and the Architectural Barriers Act of 1968 (ABA) fall short in addressing people with low vision needs. The guideline focuses on the exterior spaces, interior space, finishing material, fixed and movable furniture, and the lighting design both used in the daylight and electrical lighting. The guideline emphasizes the importance of balanced lighting and reducing glare.

Comparing Disability Needs

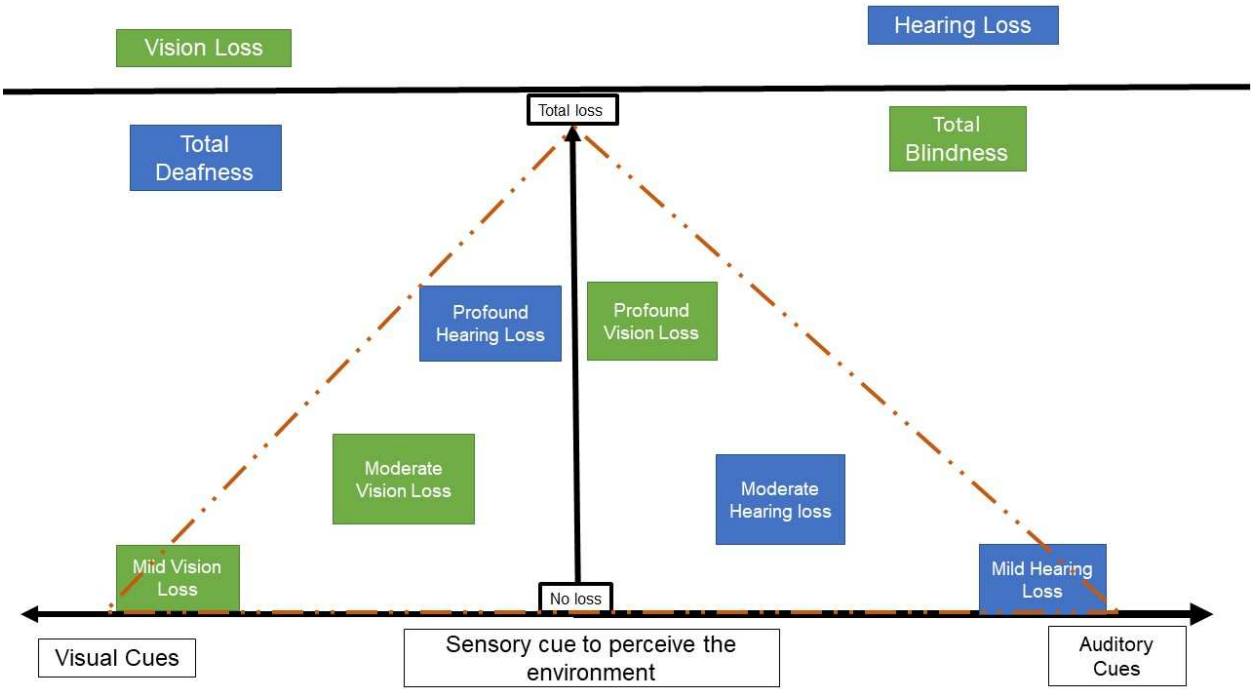
Throughout our literature and medical documents, we categorize sensory disabilities into their own separate, and unique categories. In an attempt to compare similar sensory disability accessibility needs, rather than contrast, an intensive literature search was completed, which resulted in only one article comparing the accessibility needs for individuals with sensory disabilities. In 2010, Camilla Ryhl published, *Accessibility and Sensory experiences: designing dwellings for the visually and hearing impaired,* in the *Nordic Journal of Architectural Research.* Ryhl (2010) introduces a new

design concept, “Sensory Accessibility”, referring to specific design considerations that enable the choice to stay, participate and experience the environment, while accessibility allows physical access to a space. It was concluded acoustics was a primary barrier to sensory accessibility. Acoustics could be accessed through all including people who were deaf. They could access through vibrations through spatial surfaces like walls and floors (Rhyl, 2010). Rhyl notes an interesting discovery which directly relates individuals who are hard of hearing and low vision have similar sensory accessibility needs, both hearing and vision. Both populations rely on both their residual senses and the other as primary senses to help perceive their environments and increase participation. Figure 2. depicts the amount of sensory cues utilized to help perceive their environment to increase participation when sensory loss is experienced. Understanding how each population relies on their senses to perceive their worlds, what similar building features could be explored to make a building more engaging and accessible?

Table 3.Sensory Disability Primary Accessibility Need *EqTD*

Disability	Hearing	Touch	Vision
Blind	x	x	
low Vision	x		x (Varies on residual vision)
deaf		x	x
hard of hearing	x (varies on residual hearing)		x

*Figure 2.*Comparison of sensory disabilities and reliance on sensory cues EqTD



Overlapping Sensory Accessibility needs.

In the literature, several themes of modifiable built environment features came to light and was hypothesized to potentially be important to both those who experience hearing and or visual sensory loss. These five main building features include Lighting, Acoustics, Openness, Color/Contrast, and Services/Communication.

Lighting has been identified as one of the more important building features for individuals who are hard of hearing or have low vision (NIBS 2015). The type of lighting, illumination of people and objects, and the reduction of glare have all been noted as features to consider when creating an accessible design.

Acoustics is another area that is mainly described in guidelines for individuals who are deaf/hard of hearing (Bauman, 2019). However, with the potential heightened

sensitivity of auditory cues for individuals who have low vision, acoustics and background noise is important built environmental features to consider.

Openness is a term used in Rhyl (2010) specific building design article. Openness allows individuals who way find and navigate how large or small a space is. In DSDG, the term space and proximity and spatial awareness are explored (Bauman, 2010). Additionally, in DSVG the need to appropriately negotiate and orient themselves in a new space an environment and the ability to safely navigate without bumping into obstacles are important built features to consider (Knoop, 2013; NIBS, 2015).

Services/communication is an all-encompassing term that addresses visual and auditory communication systems to increase understanding of their current environment, as well as wayfinding information (NIBS,2015.

Color/Contrast are additional overlapping building features discussed in both the DSVG (NIBS, 2015) and DSDG (Bauman 2010). Contrast is discussed heavily in the DSVG relating to patterns on walls and floors, and contrast of features to assist with wayfinding (NIBS, 2015). Additionally, DSDG discusses the importance of neutral colors, and usage of blues and greens to contrast all skin tones to reduce eye strain when perceiving visual information.

Occupation:
Participation:

Social participation is one of the occupations humans wish to engage in as defined by the American Occupational Therapy Association (AOTA, 2014). Participation can be defined as self-care, domestic life, interpersonal interactions and relationships, community, and social and civic life (Carey, 2012). However, to fully participate in

society one must feel they 'belong' (Wilcock, 1999). Belonging is strongly identified as people's interpersonal relationships, which can reflect social interactions, mutual support, friendship, and a sense of inclusion and affirmations from others (Hitch, 2014). Research has shown that several adults and older adults with disabilities experience social isolation and engage in more passive activities (Law, 2002; Carey, 2012). Minimizing environmental barriers as older adults age is important to maintain independent living, health, and quality of life (Dillon et al., 2010).

Restaurant Environment and Participation.

One location people with and without disabilities engage socially is at restaurants. A restaurant can be defined as "A place you can buy and eat a meal" (Srivastava, 2015) or "A business establishment where meals or refreshment… usually inside a building where you go to eat food. Which, most of the time you pay for" (Srivastava, 2015). The why of dining out can be variable depending on situations and the individuals. Research has shown there are three main reasons why; 1) Meet physiological needs, 2) Meet social and sense of belonging needs, 3) Meet intellectual needs (Anderson, 2004; Scitovsky,1986). Depending on the time of day, patrons often search to meet various needs, for example lunch is usually aiming to meet Physiological needs, while supper time is usually to meet social needs (Anderson, 2004).

Restaurants and people with Disabilities.

Previous research has explored how accessibility information impacts consumer decision-making for people with disabilities, as well as factors that influence selecting a restaurant to meet accessibility needs (Mendonca & Smith, 2009; Baumann, 2014; Park, 2011). Accessibility had more participants who had disabilities rate it as important

versus those who did not have a disability. As previously mentioned, the ADA (1990) often lacks addressing accessibility needs of various disabilities including attitudes and knowledge of service personnel, noise level, sense of safety, level of crowding, dietary restrictions, and even menus with Braille or Large print (Baumann, 2014). These accessibility barriers prevent individuals from being able to access the restaurant environment. Baumann (2014) notes that people with disabilities eat at restaurants half as frequently as the average population. This disparity is important to address as restaurants can serve as an important place for physiological and social needs to be met.

Public Building Assessments

Tools and Checklists

To try and close the gap of functionality, a variety of tools and checklists have been developed to help assess accessibility of a public building, on a more functional level than the ADA (1990) and ABA (1968) standards, to allow consumers to be more informed prior to visiting the building. The various tools found include the Community Health and Environmental Checklist (CHEC), Measure of Accessibility to Urban infrastructures for adults with physical disabilities (MAUAP), Ability App, Sound Print, and AccessTools. In Table 4, each assessment was analyzed to determine if they addressed the sensory accessibility need of lighting, acoustics, openness, services/communication, and color/ contrast to increase engagement and participations for individuals who are deaf or have low vision.

Table 4. Tools and checklist comparison EqTD

	Lighting	Acoustics	openness	Services	Color/ contrast	Data presented to consumer
Access Tools	x (Access Light)	x (access sounds)	x		x	App
CHEC-HOH	x (lip reading)	x (decibels)		x	x	Web page
CHEC-LV	x					Web page
MAUAP	x	x (decibels)	x	x	x	?
Sound print App		x (decibels)				App
Deaf Space Guidelines	x	x	x		x	Textbook
Design Guidelines for the Visual Environment	x	x			x	PDF Document

Research question

The purpose of this study is to explore and compare functional needs for two seemingly different populations according to the self-rated importance of sensory accessibility needs for individuals who are deaf/hard of hearing and individuals with visual impairments. By exploring the overlap in sensory accessibility needs for these seemingly different populations, we can ensure that buildings are universally designed to encourage more than just access but also engagement and participation throughout the lifespan.

Research-based building design guidelines (e.g., Design Guidelines for the Visual Environment, 2015) recommend certain building features (e.g., lighting sources,

color/contrast, or acoustics) that similarly serve the functional needs of deaf individuals and individuals with low vision. Therefore, this study seeks to explore the overlapping recommendations. Three central questions guide this study: 1) How do hard of hearing individuals perceive the importance of the impact of various building features on sensory accessibility in the restaurant environment? 2) How do individuals with low vision perceive the importance of the impact of various building features on sensory accessibility in the restaurant environment? 3) How do the perception ratings compare between individuals who identify as hard of hearing or low vision?

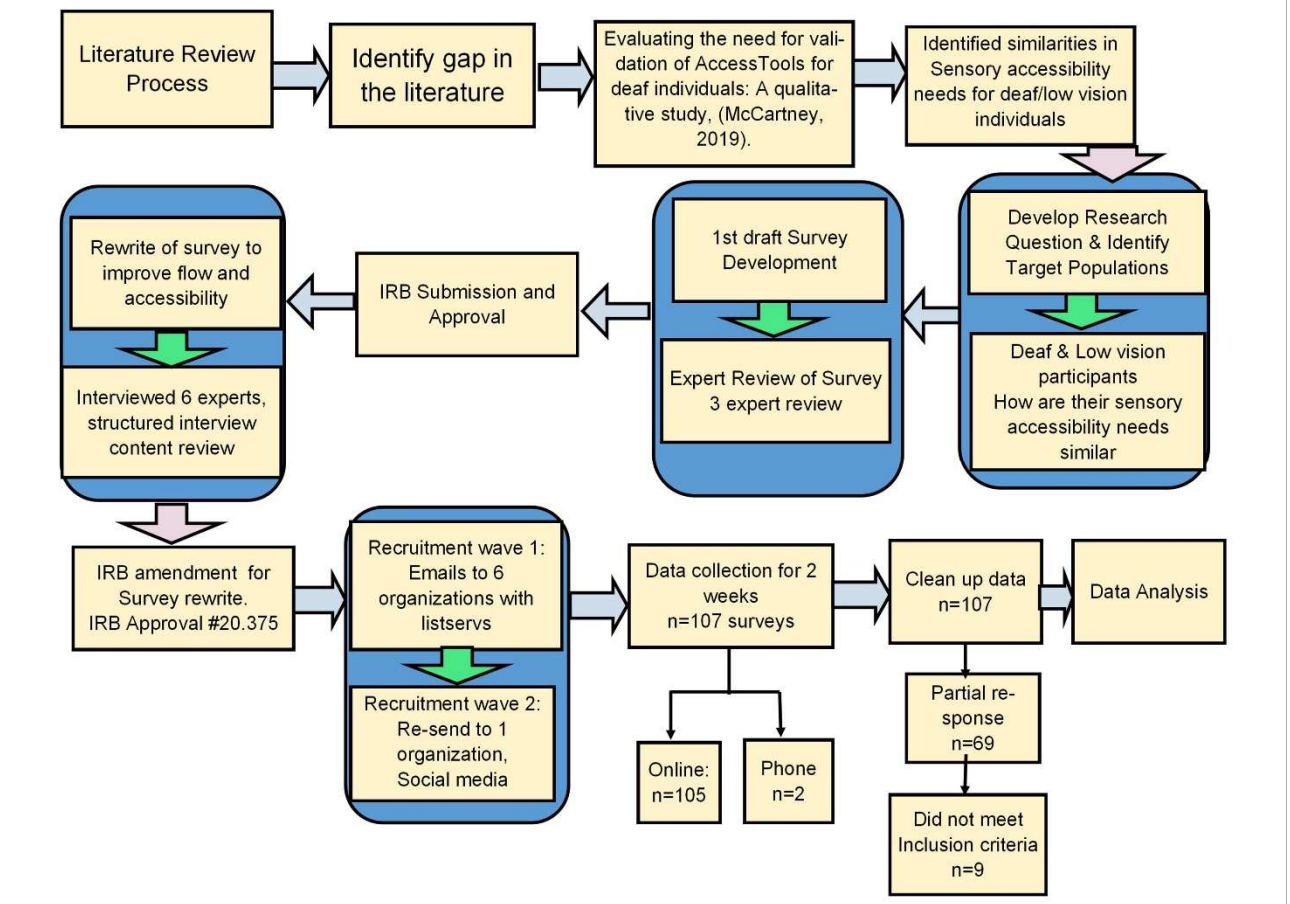
The researchers pose two specific hypotheses: 1) Lighting, Openness, and Color/Contrast sensory accessibility needs will not have a statistically significant difference between individuals who self-identify as hard of hearing or low vision. 2) Acoustics and Services/Communication sensory accessibility needs will have a statistically significant difference between individuals who identify as hard of hearing or low vision.

Methods

Research Design

This exploratory study used an experimental between-groups design. Participants were placed into four separate groups (deaf, hard of hearing, low vision, and blind) and responded to a research-developed survey focused on sensory accessibility needs (Lighting, Acoustics, Openness, Color/Contrast, and Services/Communication). The anonymous questionnaire included 76 nominal, trichotomous items and one open-ended item (see Appendix A). Refer to Figure 3. for an overview of the study design. The study design went through 13 phases, with 4 phases having subtasks to ensure an effective data collection instrument was used.

Figure 3. Overview of the study design. EqTD



The researcher-developed questionnaire was based on a building accessibility checklist discussed in the Tools and Checklists section in the introduction. The survey went through informal content validation through individual structured interviews with six experts in the areas of Occupational Therapy, Deaf/Hard of Hearing, and Low vision. Each expert reviewed the survey and provided feedback related to the flow, content, and conciseness.

The methodologies used for sampling and recruitment were specific to this study. When recruiting for this study, convenience sampling and snowball sampling was used

using email, word of mouth, and social media in hopes to recruit enough participants for this study.

Data analysis included frequency calculations and crosstabulations to explore the relationships between the various relationships of disabilities and their accessibility needs. A Mann-Whitney *U*-Test was run as indicated by the data in order to compare population differences.

Recruitment

To answer the central research questions on how individuals who identify as hard of hearing or low vision perceive their built environment, participants were recruited for this study in a variety means. First, to increase the likelihood of response, convenience and snowball sampling methods were used to recruit all participants who self-identified as hard of hearing or low vision. Second, emails were sent to various organizations in Wisconsin that serve adults who are deaf/hard of hearing and blind/visually impaired. Third, the survey was disseminated through 1) the Accessibility Resource Center at the University of Wisconsin – Milwaukee; 2) six qualifying individuals at Independence First in Milwaukee, WI; 3) Vision Forward; 4) Wisconsin Lions Camp; and 5) the Wisconsin Center for the Blind and Visually Impaired. Finally, social media was used to recruit additional participants. The recruitment message was specifically shared to the principal investigator's personal social media page, requesting help from individuals to share the survey to those who may be eligible to complete it. All participants were encouraged to share this survey with individuals they felt could qualify, additionally, if the researcher received a phone call from a participant, they were encouraged to share names of individuals that could qualify as well. Refer to Appendix D for recruitment materials.

The recruitment period spanned the first 2 weeks in October 2020 to ensure adequate time to collect sufficient data. Two waves of emails within those 2 weeks were sent out to generate enough interest and participants in the study.

Participants

A total of 103 participants clicked on the survey link; the completion rate varied from reading the consent form (100%) to submitting a completed survey (66%). Inclusion criteria were applied as follows: between ages 18-40 years old; either Deaf/ hard of hearing or visually impaired (not both); able to read and or comprehend written English; and does not have any other disabilities that impact accessibility needs.

A total of 60 participants completed surveys for this study. This included individuals who identified as follows: Deaf (n = 18), Hard of hearing (n = 25), Low vision (n = 10), and Blind (n = 7) participants. The self-reported gender identity of respondents reflected a wide range, including men, women, and genderqueer/non-binary individuals. A variety of ethnicities, education level, and marital status were reported among respondents. A diversity of participants was surveyed to try and better represent the variety in the population of individuals with disabilities.

Instrumentation

To evaluate the perceived importance of sensory accessibility needs, the survey instrument featured 76 items rated on a 3-point scale and one open-ended item. Refer to Appendix A for the full list of questions. The survey was constructed through Qualtrics, an online research suite survey platform. To increase accessibility and participation, respondents were provided the option to complete the survey over the phone with the primary researcher reading the online survey verbatim.

Survey development

To explore perceived importance for features in the built environment, this survey went through two phases of review. First, the demographic portion of the survey was developed to create a profile of participants. Additionally, information regarding their restaurant-going frequency was added to evaluate the opportunities for decision-making individuals had in picking where they go in their community.

To develop an instrument to investigate hypotheses 1 and 2, building feature guidelines for people who are deaf/hard of hearing (DeafSpace, Hansel, 2019) and visually impaired (Low Vision Building Guideline, Knoop, 2013) were analyzed to identify overlapping themes of Lighting, Acoustics, Openness, Color/Contrast, and Services/Communication. Next, questions were modified from several building accessibility tools and checklists in order to focus on sensory accessibility. The first survey draft included 104 questions (see Appendix B). Items were collapsed or rewritten to improve flow and efficiency for participants.

The final survey distributed 76 questions across five sensory accessibility categories. All responses were collected in a trichotomous manner, in which participants could choose *Important, Somewhat Important,* or *Not important*. In each of the five sensory accessibility categories, participants were asked a general question (e.g., Is the Lighting important to your overall engagement in a social restaurant setting?). Logic was built into the survey so that further questions could be presented. If respondents selected *Not important*, the survey would skip to the next section, addressing the next sensory accessibility category. When respondents selected *Important* or *Somewhat important*, they were brought sub questions that probed into the variability of

accessibility features in that category. An open-ended comments section was provided at the end of the survey to capture any additional thoughts that items may not have addressed.

Survey content was validated through structured interviews and discussion with six experts, two individuals who have worked closely with the taxonomy of AccessTools, two who are Deaf, and one individual who is blind, and one Occupational Therapist who serves individuals with visual impairments.

Data collection & Administration process

All participants received the survey through an online link. The option of completing the survey over the phone was provided to ensure full accessibility of the survey. Participants were provided with the consent page on the first page of the survey. Participants selected “next” to advance to confirm consent and advance to the next survey page. Participants were informed the survey was expected to take between 10 to 20 min to complete and could contact the researcher with any question at any time. All surveys were completed on personal devices in various locations. The survey was open for 2 weeks to allow for enough participants to respond. No external incentives for participation in this study were provided.

Data Analysis

Data were compiled into SPSS version 27 (IBM Corp, 2020), a software for statistical analysis, and cleaned up prior to data analysis. Clean-up of results entailed removing the following data: ratings from participants over the age of 40, partial responses, or ratings from individuals who identified that they did not go to restaurants.

In addition, data was removed for one participant who did not state their disability. Data were retained for 60 respondents.

Descriptive analyses were then conducted on the demographic information to explore the characteristics of the 60 respondents, which included only participants who identified as hard of hearing or low vision.

Hypothesis 1: A cross tabulation was completed to calculate the distribution on the three summary questions related to Lighting, Openness, and Color and contrast for respondents. To determine if there was not a statistically significant difference, a Mann-Whitney *U* test was performed, using an alpha of .01 and a 95% Confidence interval.

Hypothesis 2: A cross tabulation was completed to calculate the distribution of answers for Acoustics and Services/Communication. To determine if there was a statistically significant difference, a Mann-Whitney *U* test, with an alpha .01 and a 95% confidence interval was performed.

Along with the five main summary questions, cross tabulations and Mann-Whitney *U* tests were performed on each sub question to investigate specific features important to each population's needs. See Appendix C for raw data and tables.

Results

Description of the Sample (Participant Characteristics)

Data for 60 individuals were retained for analysis in this study. Table 5 includes a summary of the respondents' demographics, as reflected by disability category, age, sex, ethnicity, education level, and marital status. Additionally, Table 6 shows a list of the assistive devices used by hard of hearing respondents. Respondents' forms of

communication is listed in Table 7. The assistive devices used by respondents with low vision are presented in Table 8.

Hypothesis 1:

A Mann-Whitney *U* test at an alpha level of $p<.01$ indicated that the importance of Lighting ($U = 82.0$, $p = .074$), and Openness ($U = 80.0$, $p = .064$) was not different in a statistically significant way for the two groups.

Figure 4. Sensory accessibility: Lighting EqTD

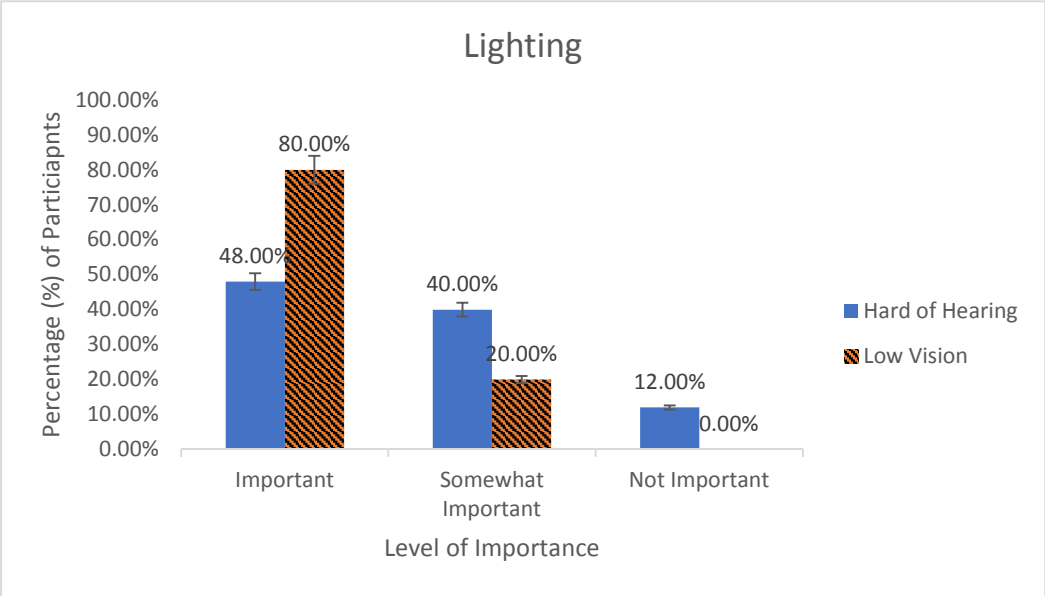


Table 5. Statistics for Lighting EqTD

Independent-Samples Mann-Whitney U Test Summary

Total N	35
Mann-Whitney U	82.000
Wilcoxon W	137.000
Test Statistic	82.000
Standard Error	24.080
Standardized Test Statistic	-1.786
Asymptotic Sig.(2-sided test)	.074
Exact Sig.(2-sided test)	.122

Figure 5. Sensory Accessibility: Openness EqTD

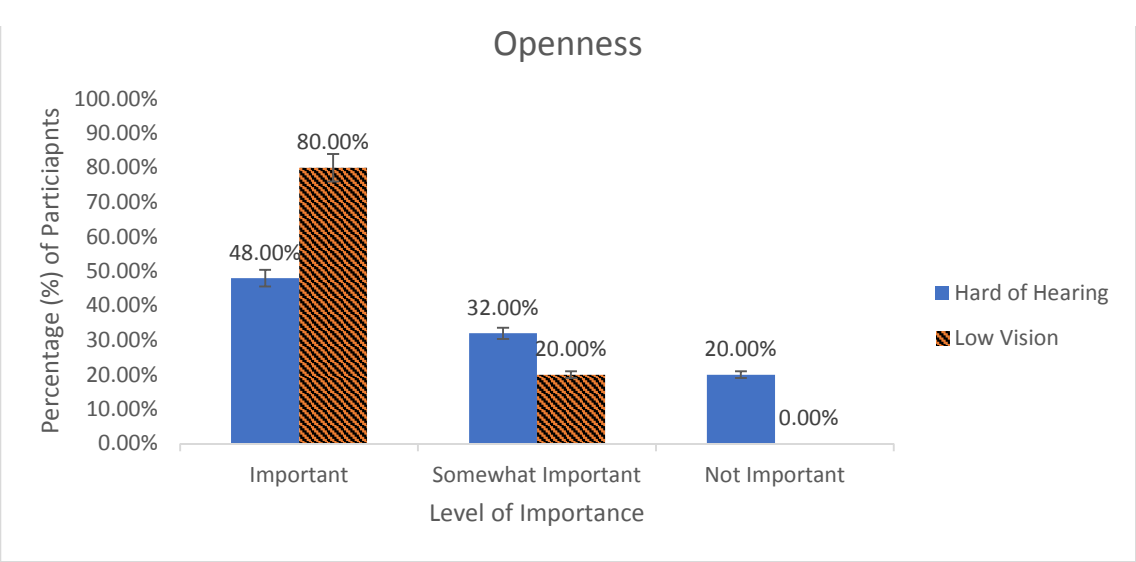


Table 6. Statistics for Openness EqTD

Independent-Samples Mann-Whitney U Test Summary

Total N	35
Mann-Whitney U	80.000
Wilcoxon W	135.000
Test Statistic	80.000
Standard Error	24.308
Standardized Test Statistic	-1.851
Asymptotic Sig.(2-sided test)	.064
Exact Sig.(2-sided test)	.105

Additionally, a Mann-Whitney *U* test showed a statistically significant difference in the importance of Color/Contrast for individuals who are hard of hearing and individuals who experience low vision, (U=18.5, p<.001).

Figure 6. Sensory Accessibility: Color / Contrast EqTD

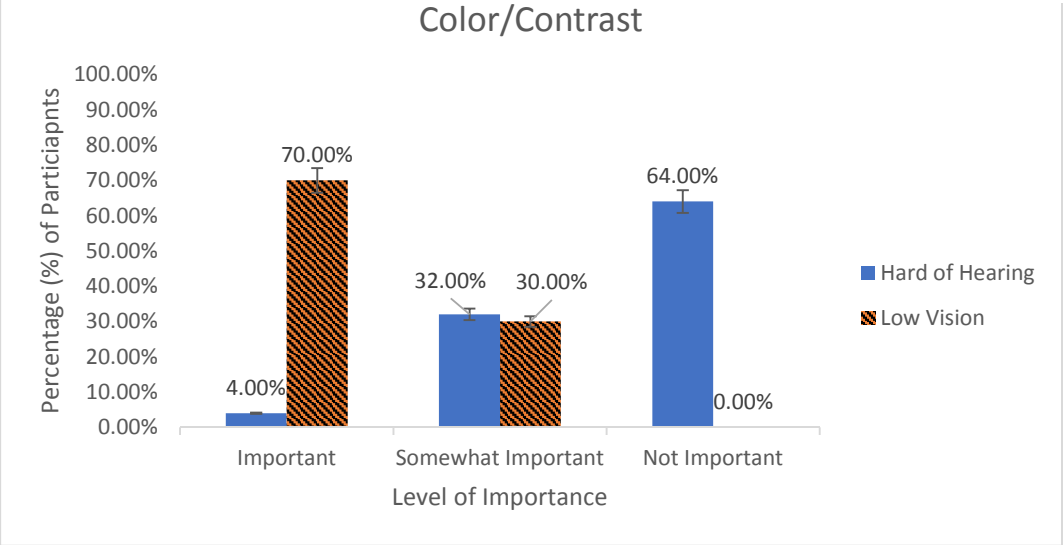


Table 7. Statistics for Color / Contrast EqTD

Independent-Samples Mann-Whitney U Test Summary

Total N	35
Mann-Whitney U	18.500
Wilcoxon W	73.500
Test Statistic	18.500
Standard Error	25.429
Standardized Test Statistic	-4.188
Asymptotic Sig.(2-sided test)	.000
Exact Sig.(2-sided test)	.000

Hypothesis 2.

A Mann-Whitney *U*-test with an alpha level of p<0.01, showed no significant difference in the importance of Acoustics (*U* = 192.5, p<0.001) and Communication/Services (*U* = 86.0, p =.102) for individuals who are hard of hearing and individual who experience low vision.

Figure 7. Sensory Accessibility Graph: Acoustics EqTD

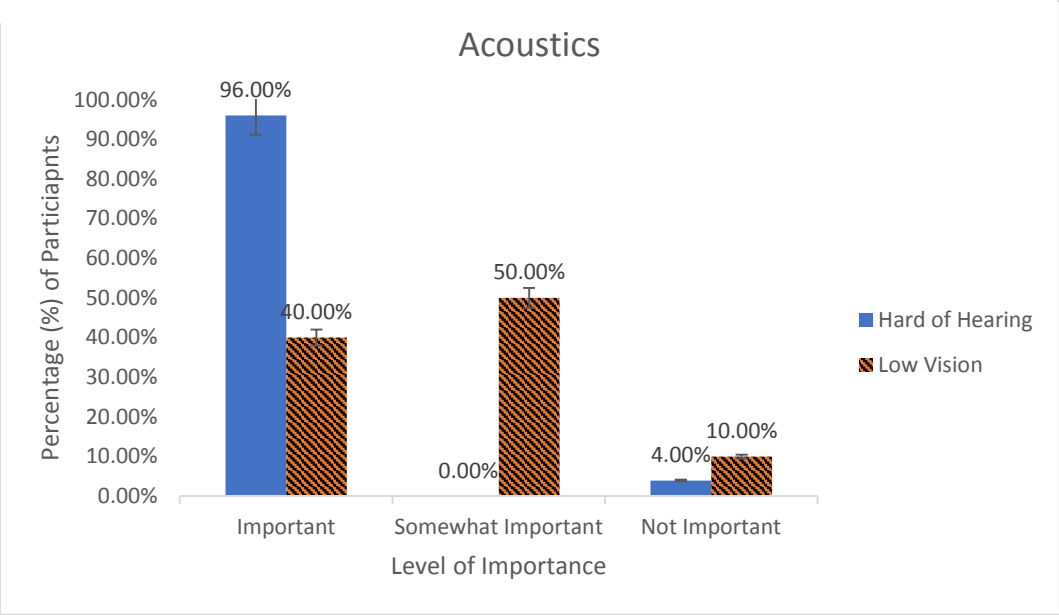


Table 8. Statistics for Acoustics EqTD

Independent-Samples Mann-Whitney U Test Summary

Total N	35
Mann-Whitney U	192.500
Wilcoxon W	247.500
Test Statistic	192.500
Standard Error	19.078
Standardized Test Statistic	3.538
Asymptotic Sig.(2-sided test)	.000
Exact Sig.(2-sided test)	.012

Figure 8. Sensory Accessibility Graph: Services/ Communication EqTD

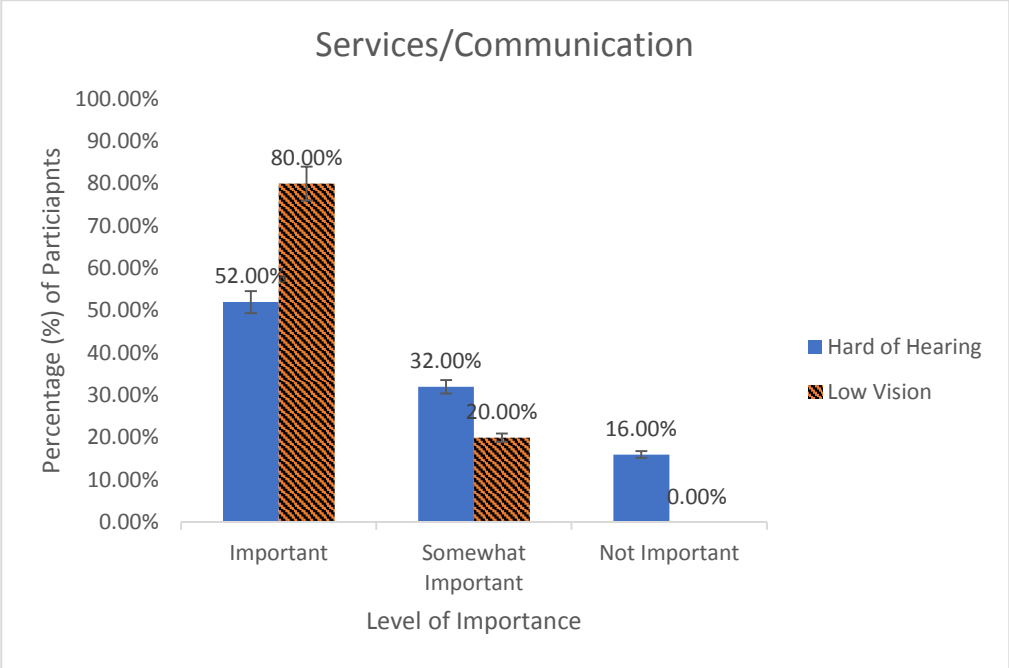


Table 9. Statistics for Services/Communication *EqTD*

Independent-Samples Mann-Whitney U Test Summary

Total N	35
Mann-Whitney U	86.000
Wilcoxon W	141.000
Test Statistic	86.000
Standard Error	23.872
Standardized Test Statistic	-1.634
Asymptotic Sig.(2-sided test)	.102
Exact Sig.(2-sided test)	.162

Table 10. Demographic Information EqTD

Identified Disability	Deaf	Hard of Hearing	Low Vision	Blind	Total
Claims-based Variables					
Age, Years					
18-21	6	5	2	0	13
22-24	2	6	3	1	12
25-30	3	9	2	3	17
31-35	3	4	2	2	11
36-40	4	1	1	1	7
Total	18	25	10	7	60
Gender					
Man	5	5	1	3	14
Woman	13	18	7	4	42
Genderqueer/Non-binary	0	2	2	0	4
Ethnicity:					
White/ Caucasian	17	17	8	5	47
Black or African American	0	1	0	0	1
Latino or Hispanic	0	3	1	1	5
Asian/ Pacific Islander	1	2	0	0	3
Two or more	0	1	0	0	1
Other/Unknown	0	1	1	0	2
Prefer not to say	0	0	0	1	1
Total	18	25	10	7	60
Education level:					
Some High School	1	0	0	0	1
High School graduate, diploma, or the equivalent (ex. GED)	3	5	4	3	15
Associates Degree	4	0	3	2	9
Bachelor's Degree	5	13	1	2	21
Master's Degree	4	3	2	0	9
Ph.D. or higher	1	2	0	0	3
Prefer not to say	0	2	0	0	2
Total	18	25	10	7	60
Are you married?					
Yes	6	5	2	0	13
No	12	20	8	6	46
Prefer not to say	0	0	0	1	1
Total	18	25	10	7	60

***TABLE 11*. Deaf/Hard of Hearing Assistive Devices** EqTD

	Deaf	Hard of hearing	Total
Hearing aids	8	16	24
Cochlear implants	9	3	12
I do not wear assistive devices	4	7	11
Total	21	26	47

***TABLE 12*. Sign Language as a Main Form of Communication** EqTD

					Total	
Disability	Deaf		Hard of hearing			
	N	%	N	%	N	%
Yes	3	16.70%	0	0.00%	3	7.00%
No	9	50.00%	19	76.00%	28	65.10%
I use a mix of sign and voice	6	33.30%	6	24.00%	12	27.90%
Total	18	100.00%	25	100.00%	43	100.00%

***TABLE 13*.Blind/Low Vision Assistive Devices** EqTD

	Blind	**Low Vision**	**Total**
Glasses/contacts	0	6	6
Magnifier/low vision device	1	4	5
Other	5	2	7
Total	6	12	18

. Blind/Low vision Assistive Devices

Discussion

To address the first research question, our analyses show that the sensory accessibility categories of Acoustics, Lighting, and Openness were rated as most important by hard of hearing respondents. These results are consistent with findings in DeafSpace Guidelines (Bauman, 2014). The importance of Lighting and Openness allows for increased access through visual communication. Additionally, an emphasis on lighting decreases potential strain on the eyes.

In addressing the second research question, the results indicated that respondents who experience low vision rated the sensory accessibility categories of Services/Communication, Color/Contrast, Lighting, and Openness as most important. Lighting and Color were key guiding features consistent with the *Design Guidelines for the Visual Environment* (NIBS, 2015). These two elements allow for better access to communication and overall engagement in the environment.

For the third research question, comparisons of the ratings between the two groups showed a statistically significant difference in the category of Color/Contrast. Further, no statistically significant difference was found in the areas of Acoustics, Lighting, Openness, and Services/Communication. Thus, the analyses support the first hypothesis regarding the perceived importance of Lighting and Openness for individuals who are hard of hearing compared to those who experience low vision. The two groups perceived Lighting and Openness to be important features to their overall experience in engaging and staying within an environment. However, the results did not support the first hypothesis regarding the perceived importance of Color and Contrast for individuals

who are hard of hearing compared to those who experience low vision. Individuals who experience low vision perceived Color and Contrast to be more important than did individuals who are hard of hearing.

The DeafSpace guidelines established by Bauman (2014), indicated that individuals who are deaf/hard of hearing perceive Color and Contrast important to their environmental space in order to engage fully in their built environment; yet, findings in this study do not support this. This might be due to the inclusion of 25 hard of hearing respondents who self-reported that Sign Language was not their main or only form of communication (e.g., six reported using a mix of sign and voice as a main form of communication). The DeafSpace guidelines (Bauman, 2014) was created for individuals who rely on signed communication to access their daily communication and engagement. Thus, future research should investigate is more important for individuals who use Sign Language as their only form or main form of communication.

The results from the current study did not support the second hypothesis regarding the perceived importance of Acoustics and Communication/Services for individuals who are hard of hearing compared to those who experience low vision. Thus, we must reject our hypothesis that there is a statistical difference in importance for Acoustic and Communication/Services for individuals who are hard of hearing compared to individuals who experience low vision. However, with a Mann-Whitney *U*-test, we cannot state the ratings of the two populations are the same, rather they are not statistically different. Both populations found Acoustics and Communication/Services to be *Important* or *Somewhat Important*. The perceived importance of acoustics is consistent with Rhyl's (2010) work related to sensory accessibility. She found

individuals who were hard of hearing and who experience low vision rely on their residual senses their non-affected senses, which include vision and hearing. To understand the importance of Communication and Services, a deeper dive into extra sources of information will have to be conducted in future research. Refer to Appendix C for the raw data, as well as the analysis on whether to retain or reject the null hypothesis.

Comment Section

At the end of the survey, a space was provided for participants to include any additional comments regarding sensory accessibility features that may be missing. Many participants opted out of providing feedback; however, a few mentioned specific aspects of the environment that affected access and engagement. One important note was several participants commented on the loudness of the background music in various restaurants. Often it can be frustrating when individuals go to a restaurant for the purpose of socialization, and the music or other noise is too loud to adequately hear their communication partner. Another important comment noted that it depends on the type of situation they are in for socialization. The respondent provided the example that occasionally they visited a restaurant for work events with people they did not know well, opposed to visiting with close friends and family members who they could communicate with easily. Finally, several comments related to the quality of the service staff members. Due to the nature of the variability of service staff members, this was not included in the survey as a point to touch on. Service staff members, who continually change, were not considered a building feature; however, services (e.g., a self-ordering kiosk) were included. See Appendix E. for a table of all the additional comments made.

Limitations

There were several limitations to this study. One of the first limitations was the hypotheses to help guide this study. In statistics, it is impossible to demonstrate that two group are the same; rather analysis allow for demonstrating that ratings between groups are different in a statistically significant way. The inability to prove that two groups would be significantly different does not mean they are statistically the same. This was a challenge for the researcher to understand in this learning process. Additionally, the original hypothesis was created for a Fischer Z test; and, later the researcher used a Mann-Whitney *U*-test for significance. Additionally, the sample used to tabulate the data for this study only represents a small fraction of individuals who are hard of hearing and who experience vision loss.

A second limitation was, only individuals who identified as hard of hearing and low vision were analyzed. Participants who identified as Deaf were not included in this data analysis but would have added value to this study. A third limitation included a time constraint. Data was only collected for 2 weeks with the potential of more participants being recruited. A fourth limitation revolved around the data analysis portion. When collecting and analyzing the data, the instrument could have been designed to support an overall score to be calculated of the building feature assessments, rather than exploring the distribution of percentages of participants. Lastly, the survey did not have a formal content validity study performed prior to distribution to participants. Some of the language was intentionally vague in hopes for participants to answer specific questions about various building features, however, this may have led participants to not have answered as accurately or honestly.

An additional limitation that might be important to discuss is the American dining culture. In the United States, we have a culture where quick-service restaurants are an important factor, and many restaurants choose to fill tables and turn them over as quickly as possible. In some Asian cultures, such as Chinese, it is common to find your dining experience to be a much slower pace. Typically, your table is yours for the evening, and a round table is used to allow for conversation between everyone. These cultural differences might influence the restaurant environment we experience in our everyday lives (Saksena et al., 2018).

Implications for practice

Further investigation is needed before making broader assertions; however, the data suggests there may be some agreeance in the building sensory accessibility needs for individuals who are hard of hearing and low vision. This research offers a preliminary suggestion that both groups find Lighting, Acoustics, Openness, and Communication/Services to be important to their overall experience. Additionally, this study's preliminary findings may help to influence building assessment tools that evaluate the environment of public buildings for functional accessibility. This allows for the conversation starter of universal design comparing two seemingly different disabilities.

Further research

There are several areas this work could explore regarding further research. One of the biggest areas is comparing Deaf and Blind individuals, or deaf and low vision individuals allows for a greater discussion of two maybe different sensory accessibility needs. It will also be important to continue this research study and explore individuals

who use sign language as their main form of communication, as there may be some similar sensory accessibility needs of individuals who have low vision and deaf individuals who predominantly use signs.

A second area of research includes extending this study to further investigate the needs of the aging population. This study did not explore individuals who experience both low vision and are hard of hearing, but at some point, in life, everyone will experience both a vision and hearing loss due to age. Understanding the sensory accessibility needs will allow for better aging in place, and a more fulfilling and happier end of life.

A third area of research that needs to be explored is the ability for parents of children with sensory disabilities to accurately identify their child's sensory accessibility needs. It is imperative for parents with children with sensory disabilities to foster independence and advocacy through providing children with a sensory accessible environment.

Finally, In 2020, the global Corona Virus Pandemic impacted the function of society and the restaurant industry as we knew it. Further research could also explore the effects the new social distancing guidelines have perhaps supported or hindered various sensory accessibility needs of individuals with disabilities. The concept of universal design has several opportunities for growth. This research is just the beginning of comparing two seemingly different disabilities, and further research should start to compare other hidden disabilities that are not so often discussed in the literature.

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PART 3: APPENDICES

Appendix A: Data Collection Form

DEMOGRAPHIC/BACKGROUND INFORMATION

1. What is your age?
    - 18-21
    - 22-24
    - 25-30
    - 31-35
    - 36-40
    - 40+
2. I am currently employed:
    - Full Time
    - Part time
    - Unemployed
    - Other
3. I identify as:
    - Man
    - Woman
    - Genderqueer/ Non-binary
    - Other:
    - Prefer not to say
4. Ethnicity:
    - Caucasian
    - African American
    - Latino or Hispanic
    - Asian
    - Native American
    - Native Hawaiian or Pacific Islander
    - Two or more
    - Other/unknown
    - Prefer not to say
5. Education level:
    - Some High School
    - High School
    - Bachelor's Degree
    - Master's Degree
    - Ph.D. or higher
    - Trade school
    - Prefer not to say
6. Are you married?

Yes
No
Prefer not to say

TELL US ABOUT YOUR DISABILITY

7. What is your disability?
   Deaf (If selected, will go to question 8)
   Hard of hearing (If selected, will go to question 8)
   Low Vision (If selected, will go to question 10)
   Blind (If selected, will go to question 10)
8. If deaf/hard of hearing do you wear any assistive devices? (Select all that may apply):
   Hearing aids
   Cochlear Implants
   Bone Anchored hearing aids
   I do not wear any assistive device
   Other_____
9. If deaf/hard of hearing, do you use any form of sign language as a main form of communication?
   Yes
   No
   I am not deaf/hard of hearing

10. If you have a vision impairment, what corrective options have you taken? (Select all that may apply):
    Glasses/Contacts
    I Magnifier/ Low vision device
    Other_____

<u>QUESTIONS ABOUT YOU AND RESTAURANT FREQUENCIES (please answer about your experiences prior to COVID-19 and safer at home orders:</u>

11. I go to restaurants: Select all that apply
    Daily
    Weekly
    Once a month
    Once every three months
    Once or twice a year

12. Most of the time, I go to _____ type of restaurants: Select all that apply
    - Fast-Food (McDonalds, Burger King, Taco Bell…)
    - Coffee Shops (local or chain)
    - Sit down restaurant (Local or chain)
    - At home delivery (Uber Eats, door dash, Grub Hub, Postmates)
    - Drive-in restaurants (Sonic Drive-In, A&W…)
    - I do not go to restaurants.
13. I go to restaurants to meet my_____ needs: Select all that apply
    - Physiological: (hunger)
    - Social (Dates, socialize, celebrations and special occasions)
    - Intellectual (studying, Tasting unique food)
    - Special occasions: (Anniversaries, birthdays, celebrations)
    - Other _____
    - I do not go to restaurants
14. When going to a restaurant, I decide where to go ____% of the time:
    - 0-25%
    - 26-50%
    - 51-75%
    - 76-100%
15. I have a voice in picking new restaurants to try:
    - All the time
    - Sometimes
    - None of the times
16. I pick new restaurants using: (Select all that apply)
    - Internet reviews (Google review, yelp)
    - Friends/family recommendations
    - Advertisement (Television, Radio, online, newspaper…)
    - In-Person discovery (driving, walking…)
    - I do not pick new restaurants to try.
17. I pick new restaurants based on: (Select all that apply)
    - Affordability
    - Ratings
    - Accessibility
    - Food type
    - Location/Proximity
    - I do not pick new restaurants.
18. My disability needs can affect my experience when I go to a restaurant:
    - Agree
    - Neither Agree nor Disagree
    - Disagree

Not applicable

19. My disability needs affect others around me when I got to a restaurant:
    Agree
    Neither Agree nor Disagree
    Disagree
    Not applicable.
20. I believe restaurant environments are accommodating:
    All the time
    Some of the time
    Rarely
    Never

SENSORY ACCESSIBILITY NEEDS:

For this next section, please think about a time you went to a restaurant for the purpose of socializing with friends, family members, co-workers, or anyone in your life you would have a conversation with. While answering these questions, rate how important that feature is to maximize your engagement in your dining and social experience. Think about what makes you want to stay in an environment with your sensory accessibility needs.

Throughout the survey, you will be asked to rate various features of a restaurant as Important, Somewhat important, or Not important.

Please try to answer all questions as honestly as possible. If the feature is only sometimes important, depending on the situation and type of place, please answer the question as somewhat important.

At the end of this survey, a comment section will be provided if you have any additional information to share.

1. ***Is Lighting important to your overall experience? (Brightness, type of lighting, focus of lighting)***
    Important
    Somewhat important
    Not important

a. Is the brightness of lighting important to your overall experience? (Dim lighting or bright lighting)
    i. Is dim lighting important
        1. Important

2. Somewhat important
3. Not important

ii. Is bright, non-blinding light important?
1. Important
2. Somewhat important
3. Not important

b. Is the type of lighting important? (artificial or natural lighting)
1. Important
2. Somewhat important
3. Not important

ii. Is artificial light important
1. Important
2. Somewhat important
3. Not important

iii. Is natural lighting important
1. Important
2. Somewhat important
3. Not important

c. Is the focus of lighting important? (task lighting, ambient room lighting)
1. Important
2. Somewhat important
3. Not important

ii. Are tasks lighting important
1. Important
2. Somewhat important
3. Not important

iii. Is ambient room lighting important?
1. Important
2. Somewhat important
3. Not important

d. Is having a non-glare finish surface important to your overall experience? (tables and floors)
1. Important
2. Somewhat important
3. Not important

ii. Table
1. Important
2. Somewhat important
3. Not important

iii. Floor
1. Important

2. Somewhat important
3. Not important

2. Is the acoustics of an environment (background noise, music, conversation) important to your overall experience?

Important

Somewhat important

Not important

a. Is loudness of background noise important to you overall experience? (whisper, normal conversation tone, 2 or fewer noise sources):
    1. Important
    2. Somewhat important
    3. Not important

ii. Being able to hear a whisper with someone at my table is.
    1. Important
    2. Somewhat important
    3. Not important

iii. Being able to hear someone with normal conversation tone and loudness is.
    1. Important
    2. Somewhat important
    3. Not important

iv. Having two or fewer sources of noise in the background is:
    1. Important
    2. Somewhat important
    3. Not important

b. Having sound absorbing material is: (on walls, on flooring):
    1. Important
    2. Somewhat important
    3. Not important

ii. Sound-absorbing materials on at least one wall in at least one room?
    1. Important
    2. Somewhat important
    3. Not important

iii. Floor is covered with a sound-absorbing material or carpeting where conversations are more likely to occur?
    1. Important
    2. Somewhat important
    3. Not important

3. Is the openness of the environment important to your overall experience? (Variety of seating, tables, comfortable navigation)

a. Important
b. Somewhat important
c. Not important

a. Is having a variety of seating important to your experience? (booths or chairs)
    1. Important
    2. Somewhat important
    3. Not important

ii. Having the option for low back booth
    1. Important
    2. Somewhat important
    3. Not important

iii. Having the option for high back booth
    1. Important
    2. Somewhat important
    3. Not important

iv. Having the option for chair without arms
    1. Important
    2. Somewhat important
    3. Not important

v. Having the options for chair with arms.
    1. Important
    2. Somewhat important
    3. Not important

b. The amount of stuff in the center of your table? (centerpieces, condiments, specials menu)
    1. Important
    2. Somewhat important
    3. Not important

ii. Centerpieces on your table
    1. Important
    2. Somewhat important
    3. Not important

iii. Condiments/napkins/silver ware
    1. Important
    2. Somewhat important
    3. Not important

iv. Special/drink specials menu
    1. Important
    2. Somewhat important

3. Not important

c. Is being able to express where your table is located important? (near wall, center of room, private room)
    1. Important
    2. Somewhat important
    3. Not important

ii. Placed with one wall near me
    1. Important
    2. Somewhat important
    3. Not important

iii. Placed with 2 or more walls surrounding me
    1. Important
    2. Somewhat important
    3. Not important

iv. Placed in the center of the room
    1. Important
    2. Somewhat important
    3. Not important

v. Private room
    1. Important
    2. Somewhat important
    3. Not important

d. Is being able to express the type of table you'd like to sit at important? (round, square, small, large)
    1. Important
    2. Somewhat important
    3. Not important

ii. Round table
    1. Important
    2. Somewhat important
    3. Not important

iii. Square table
    1. Important
    2. Somewhat important
    3. Not important

iv. Small table
    1. Important
    2. Somewhat important
    3. Not important

v. Large table
    1. Important

2. Somewhat important
3. Not important

e. Being able to comfortably navigate around the restaurant is: (avoid tables, chairs, obstructions)
    1. Important
    2. Somewhat important
    3. Not important

4. Is color/contrast of your environment important to your overall experience? (walls, floors)

Important

Somewhat Important

Not Important

a. Is the colors and pattern of the wall important to your overall experience? (neutral or bright; patterned or plain)
    1. Important
    2. Somewhat important
    3. Not important

ii. Walls should be a neutral color
    1. Important
    2. Somewhat important
    3. Not important

iii. Walls should be a bright color
    1. Important
    2. Somewhat important
    3. Not important

iv. Walls should have patterns
    1. Important
    2. Somewhat important
    3. Not important

v. Wall should be plain
    1. Important
    2. Somewhat important
    3. Not important

b. Is the color of the floor important to your overall experience? (neutral color or bright, patterned or plain)
    1. Important
    2. Somewhat important
    3. Not important

ii. Floors should be a neutral color

1. Important
2. Somewhat important
3. Not important

iii. Floors should be a bright color
1. Important
2. Somewhat important
3. Not important

iv. Floors should have patterns
1. Important
2. Somewhat important
3. Not important

v. Floors should be plain
1. Important
2. Somewhat important
3. Not important

5. ***Is services/communication important to your overall experience? (Reservation/paging system, menu, self-serve kiosk)***

Important

Somewhat important

Not important

a. Is the way you use the reservation system (phone, online, in-person)
1. Important
2. Somewhat important
3. Not important

ii. Phone
1. Important
2. Somewhat important
3. Not important

iii. Online
1. Important
2. Somewhat important
3. Not important

iv. In-person
1. Important
2. Somewhat important
3. Not important

b. Understanding how seating works (Sign or person present stating; please wait to be seated, please sit anywhere):
1. Important

2. Somewhat important
3. Not important

ii. Clear through visual sign
1. Important
2. Somewhat important
3. Not important

iii. Person informs you
1. Important
2. Somewhat important
3. Not important

c. How you find your table and seat is (Finding your own seat, Table assigned):
1. Important
2. Somewhat important
3. Not important

ii. Finding my own seat
1. Important
2. Somewhat important
3. Not important

iii. Being guided to my table
1. Important
2. Somewhat important
3. Not important

d. Clear communication on when it is your turn to be seated regardless of pager or person: (Auditory, visual, or tactile cues)
1. Important
2. Somewhat important
3. Not important

ii. Auditory cues
1. Important
2. Somewhat important
3. Not important

iii. Visual cues
1. Important
2. Somewhat important
3. Not important

iv. Tactile cues
1. Important
2. Somewhat important
3. Not important

e. Is the way the menu presented important to your overall experience? (online, physical copy, menu board, pictures on menu, numbers corresponding to menu items)
    1. Important
    2. Somewhat important
    3. Not important
    ii. Online menu available
        1. Important
        2. Somewhat important
        3. Not important
    iii. Physical copy available
        1. Important
        2. Somewhat important
        3. Not important
    iv. Menu on a screen
        1. Important
        2. Somewhat important
        3. Not important
    v. Pictures/ pictograms on the menu
        1. Important
        2. Somewhat important
        3. Not important
    vi. Number corresponding to items on the menu
        1. Important
        2. Somewhat important
        3. Not important
f. Is how you order food important to your overall experience? (server, self-serve kiosk)
    1. Important
    2. Somewhat important
    3. Not important
    ii. Having a server is.
        1. Important
        2. Somewhat important
        3. Not important
    iii. Having a self-serve kiosk is:
        1. Important
        2. Somewhat important
        3. Not important
g. Easy to understand when food is ready to pick up: (Visual cue or auditory cue)

1. Important
2. Somewhat important
3. Not important

ii. Order is ready, visual cue is given
1. Important
2. Somewhat important
3. Not important

iii. Order is ready, auditory cue is given
1. Important
2. Somewhat important
3. Not important

iv. Order is ready, tactile cue is given
1. Important
2. Somewhat important
3. Not important

h. How I receive my food is: (get it myself, server brings it me)
1. Important
2. Somewhat important
3. Not important

ii. Having food brought to me is:
1. Important
2. Somewhat important
3. Not important

6. ***Comment section****:*
Thank you for taking the time to complete the survey. Please feel free to add any additional comments.

Appendix B: Survey draft 1

DEMOGRAPHIC/BACKGROUND INFORMATION

21. What is your age?
    - 18-21
    - 22-24
    - 25-30
    - 31-35
    - 36-40
    - 40+
22. What is your current employment level?
    - Full Time
    - Part time
    - Unemployed
    - Other
23. I identify my gender as:
    - Man
    - woman
    - Genderqueer/ Non-binary
    - Other:
    - Prefer not to say.
24. Please specify your ethnicity:
    - Caucasian
    - African American
    - Latino or Hispanic
    - Asian
    - Native American
    - Native Hawaiian or Pacific Islander
    - Two or more
    - Other/unknown
    - Prefer not to say
25. What is the state you live in?
    - ____ (Will have drop down) ____
26. Education level:
    - Some High School
    - High School
    - Bachelor's Degree
    - Master's Degree
    - Ph.D. or higher
    - Trade school

Prefer not to say

27. Are you married?
    Yes
    No
    Prefer not to say

QUESTIONS ABOUT YOU AND YOUR DISABILITY

28. What is your disability?
    deaf
    Hard of hearing
    Low Vision
    Blind
29. If deaf/hard of hearing do you wear any assistive devices? Select all that may apply.
    Hearing aids
    Cochlear Implants
    Bone Anchored hearing aids
    I do not wear any assistive device
    Other_____
    I am not deaf/hard of hearing
30. If you have a vision impairment, what corrective options have you taken? Select all that may apply.
    Single focal lens glasses
    Bi-focal lens glasses
    Tri-focal lens glasses
    Contacts
    Surgery
    I do not have any corrective devices/measures
    Other_____
    I do not have a vision impairment

31. If deaf/hard of hearing, do you use any form of sign language as a main form of communication?
    Yes
    No
    I am not deaf/hard of hearing

QUESTIONS ABOUT YOU AND RESTAURANT FREQUENCIES

32. I go to restaurants: Select the one that applies the most
    - Daily
    - Weekly
    - Once a month
    - Once every three months
    - Once or twice a year
33. Most of the time, I go to _____ type of restaurants: Select all that apply
    - Fast-Food (McDonalds, Burger King, Taco Bell…)
    - Coffee Shops (local or chain)
    - Sit down restaurant (Local or chain)
    - At home delivery (Uber Eats, door dash, Grub Hub, Postmates)
    - Drive-in restaurants (Sonic Drive-In, A&W…)
    - I do not go to restaurants.
34. I go to restaurants to meet my_____ needs: Select all that apply
    - Physiological: (hunger)
    - Social (Dates, socialize, celebrations and special occasions)
    - Intellectual (studying, Tasting unique food)
    - Special occasions: (Anniversaries, birthdays, celebrations)
    - Other _____
    - I do not go to restaurants
35. When going to a restaurant I decide where to go ____% of the time
    - 0-25%
    - 26-50%
    - 51-75%
    - 76-100%
36. I have a voice in picking new restaurants to try:
    - All the time
    - Sometimes
    - None of the times
37. I pick new restaurants using: (Select all that apply)
    - Internet reviews (Google review, yelp)
    - Friends/family recommendations
    - Advertisement (Television, Radio, online, newspaper…)
    - In-Person discovery (driving, walking…)
    - I do not pick new restaurants to try.
38. I pick new restaurants based on: (Select all that apply)
    - Affordability
    - Ratings
    - Accessibility
    - Food type

Location/Proximity
I do not pick new restaurants.

39. My disability needs can affect my experience when I go to a restaurant.
    Agree
    Neither Agree nor Disagree
    Disagree
    Not applicable
40. My disability needs affect the experience other people I am with have when we go to restaurants.
    Agree
    Neither Agree nor Disagree
    Disagree
    Not applicable.
41. I believe all restaurants should be accessible
    Agree
    Neither agree nor disagree
    Disagree
    Not Applicable
42. I believe ___% of restaurants are accessible:
    0-25%
    25-50%
    50-75%
    75-100%
43. I believe restaurant environments are accommodating to my accessibility needs.
    All the time
    Some of the time
    Rarely
    Never

“Think about your favorite restaurant to go to when you want to socialize with persons” Please answer these questions rating how important a building feature is to maximize your engagement in your dining experience. Think about what makes you not only access an environment but choose to stay in the environment. A comment section will be provided at the end. Please provide the question number (#) and follow up with your comment.

The Restaurant I am thinking of:

QUESTIONS ABOUT RESTAURANT ACCESSIBILITY

44. When approaching the entrance door of the restaurant, being able to see the other side of the door is.
    - Important
    - Somewhat important
    - Not important
45. When approaching the restaurant, changes in levels (such as curbs, steps) need to very noticeable:
    - Important
    - Somewhat important
    - Not important
46. When walking in a parking garage, having visuals of when a car is coming around the corner is:
    - Important
    - Somewhat important
    - Not important
47. When walking in a parking garage having adequate, continuous, and non-blinding lighting is:
    - Important
    - Somewhat important
    - Not Important

48. The built environment surrounding the outdoor and indoor waiting area is:
    - Important
    - Somewhat important
    - Not important
49. Outdoor and indoor waiting area should have a sufficient variety of seating.
    - Important
    - Somewhat important
    - Not important
50. Outdoor and indoor waiting area should have uniform, continuous, and non-blinding lighting.
    - Important
    - Somewhat important
    - Not important
51. Outdoor and indoor waiting area should have background music:
    - Important
    - Somewhat important

Not important

52. Indoor waiting area: surrounding walls should be a bright color.
    Important
    Somewhat important
    Not important
53. Indoor waiting area surrounding walls should be neutral colors
    Important
    Somewhat important
    Not important

54. Indoor waiting area should have material to help decrease echoing and sounds bouncing off flat surfaces (such as padding, carpeting…)
    Important
    Somewhat important
    Not important

55. The accessibility of navigating around the restaurant is:
    Important
    Somewhat important
    Not important
56. A sign indicating seating (please wait to be seated or please sit anywhere) is:
    Important
    Somewhat important
    Not important
57. Host/hostess stand should have non-blinding lighting directed at the host/hostess:
    Important
    Somewhat important
    Not important
58. When putting your name on a waiting list, visual and or written instructions should be provided.
    Important
    Somewhat important
    Not important
59. When putting your name on a waiting list, verbal instructions should be provided
    Important
    Somewhat important
    Not important
60. When your name is called, visual cues are:
    Important

Somewhat important
Not important

61. When your name is called, verbal cues are:
    Important
    Somewhat important
    Not important
62. When your name is called, tactile cues are:
    Important
    Somewhat important
    Not important

63. The type of seating in a restaurant is:
    Important
    Somewhat important
    Not important
64. When seated, being placed in low back booth is:
    Important
    Somewhat important
    Not important
65. When seated, being placed in a high back booth is:
    Important
    Somewhat important
    Not important
66. When seated, being placed in a chair is:
    Important
    Somewhat important
    Not important
67. Your table should have a mix of booth and chairs:
    Important
    Somewhat important
    Not important

68. Location and direction of my table in a restaurant is:
    Important
    Somewhat important
    Not important
69. When seated, expressing your option for seating choice is:
    Important
    Somewhat important

Not important

70. My table should be placed by the kitchen:
    Important
    Somewhat important
    Not important
71. My table should be in a corner:
    Important
    Somewhat important
    Not important
72. My table should be in the middle of the room:
    Important
    Somewhat important
    Not important
73. My table should be along a wall:
    Important
    Somewhat important
    Not important
74. My table should be facing a window:
    Important
    Somewhat important
    Not important
75. My table should be placed near an exit:
    Important
    Somewhat important
    Not important
76. My table should be placed near a bathroom:
    Important
    Somewhat important
    Not important
77. My table should be placed by the kitchen:
    Important
    Somewhat important
    Not important

78. The floor, the walls, and the lighting around your table are:
    Important
    Somewhat important
    Not important
79. The wall near your table needs to be bright and colorful:
    Important

Somewhat important
Not important

80. The wall near your table needs to have a lot of patterns:
    Important
    Somewhat important
    Not important
81. The wall near your table should be neutral in color:
    Important
    Somewhat important
    Not important
82. **The type of lighting at my table is**
    Important
    Somewhat important
    Not important
83. Your table should have dim lighting:
    Important
    Somewhat important
    Not important
84. Your table should have bright lighting, non-blinding lighting.
    Important
    Somewhat important
    Not important
85. Your table should have candle lighting:
    Important
    Somewhat important
    Not important
86. The flooring around your table should be matte:
    Important
    Somewhat important
    Not important
87. The flooring around your table should be shiny:
    Important
    Somewhat important
    Not important
88. The flooring around your table should have a complex pattern.
    Important
    Somewhat important
    Not important
89. The flooring around your table should have a simple pattern.
    Important

Somewhat important
Not important

90. The flooring around your table should have carpet:
    Important
    Somewhat important
    Not important

The table surface and table set up is:

Important
Somewhat important
Not important

91. Your table surface should be matte:
    Important
    Somewhat important
    Not important
92. Your table surface should be shiny:
    Important
    Somewhat important
    Not important
93. Your table should have centerpieces in the middle:
    Important
    Somewhat important
    Not important
94. Your table should have centerpieces to the side:
    Important
    Somewhat important
    Not important
95. Your table should have decorations and essentials (saltshaker, pepper shaker, napkin holder….) at your table:
    Important
    Somewhat important
    Not important
96. Your table should just have essentials:
    Important
    Somewhat important
    Not important

The next set of questions will ask more specifically about fast food service such as McDonalds, Burger King, Wendy's, Subway, Panera Bread.

A variety of ways to order food is:

Important

Somewhat important
Not important

Fast-Food:

97. An online menu should be available before coming to the restaurant.
    Important
    Somewhat important
    Not important
98. The menu board should have numbers corresponding to the items.
    Important
    Somewhat important
    Not important
99. The menu board should have pictures or pictograms indicating food selection:
    Important
    Somewhat important
    Not important
100. A self-serve kiosk should be present.
    Important
    Somewhat important
    Not important
101. If a self-serve kiosk is present: Instructions for the self-serve kiosk should have visual/written instructions.
    Important
    Somewhat important
    Not important
102. If a self-serve kiosk is present: Instructions for the self-serve kiosk should have verbal instructions.
    Important
    Somewhat important
    Not important
103. If a self-serve kiosk is present: the kiosk should make a noise when touched:
    Important
    Somewhat important
    Not important
104. If a self-serve kiosk is present: The kiosk should provide vibration when touched
    Important
    Somewhat important
    Not important

105. If a self-serve kiosk is present: The surface of the self-serve kiosk should be adjustable.
Important
Somewhat important
Not important

106. The lighting surrounding the self-serve kiosk should be uniform, continuous, and non-blinding
Important
Somewhat important
Not important

If a menu is presented:

107. The menu should not have a reflective/glare on the surface:
Important
Somewhat important
Not important

108. There should be pictures or pictograms in the menu:
Important
Somewhat important
Not important

109. There should be corresponding numbers with the items on the menu.
Important
Somewhat important
Not important

110. The menu's font should be large and easy to read.
Important
Somewhat important
Not important

111. The special of the day should be easy to identify visually:
Important
Somewhat important
Not important

Sit-down:

112. The server wearing a name tag is:
Important
Somewhat important
Not important

113. The menu having pictograms and visual of food is:
Important
Somewhat important

Not important

114. The menu having a non-glare surface is:

Important
Somewhat important
Not important

The ambient noise of the restaurant is:

Important
Somewhat important
Not important

115. The volume of music in a restaurant should be loud enough to hear.

Important
Somewhat important
Not important

116. The openness of a restaurant is:

Important
Somewhat important
Not important

If food is obtained through an order number:

117. At a fast-food restaurant, my number should be called with an auditory cue:

Important
Somewhat important
Not important

118. When my order is ready; my number should be called with a visual cue

Important
Somewhat important
Not important

119. How I am able to pay for my food is:

Important
Somewhat important
Not important

120. Paying with credit card is:

Important
Somewhat important
Not important

121. Paying with cash is:

Important
Somewhat important

Not important

122. An itemized bill being presented is:

Important

Somewhat important

Not important

Appendix. C. Graphs and Mann-Whitney *U*-Tests

Lighting Graphs & Mann-Whitney U Test

Figure 9. Brightness of Lighting (Dim Vs. Bright) EqTD

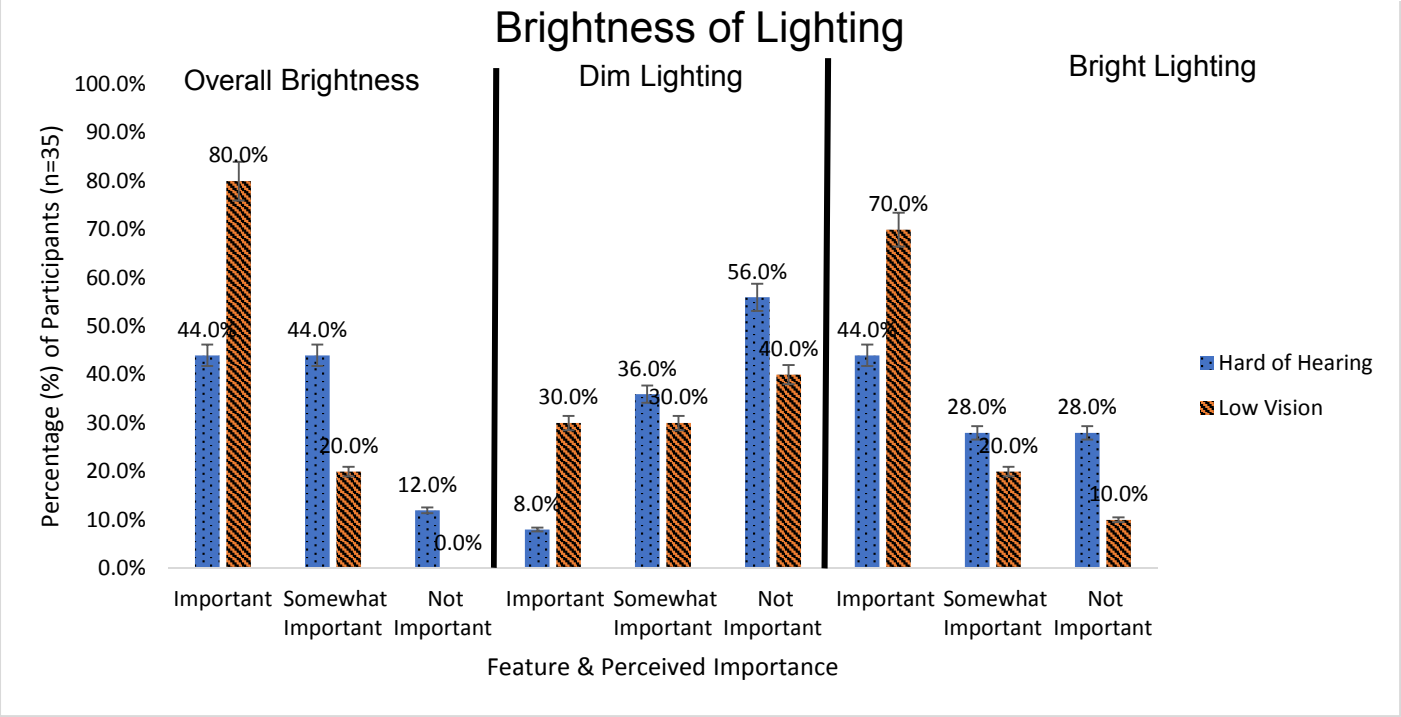


*Figure 10.*Type of Lighting (Artificial Vs. Natural) EqTD

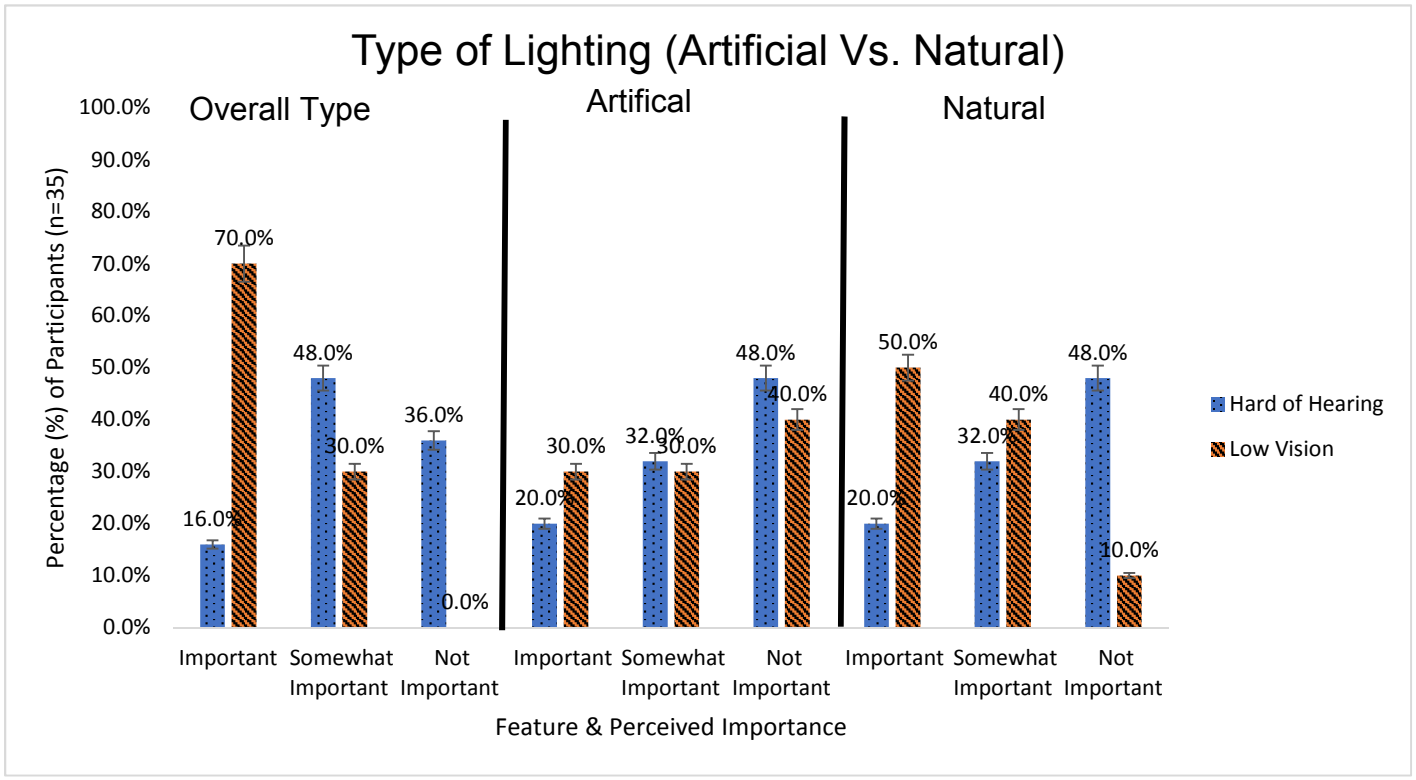


Table 14.Lighting Hypothesis Test Summary *EqTD*

	Null Hypothesis	Test	Sig.[a, b]	Decision
1	The distribution of Is lighting important to your overall experiences. (i.e. brightness, type of lighting, focus of lighting) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.122[c]	Retain the null hypothesis.
2	The distribution of Is the brightness of lighting important to your overall experience? (i.e. dim or bright lighting) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.083[c]	Retain the null hypothesis.
3	The distribution of Which type of brightness lighting is important to your overall experience? - Dim Lighting is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.270[c]	Retain the null hypothesis.
4	The distribution of Which type of brightness lighting is important to your overall experience? - Bright, Non-blinding lighting is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.198[c]	Retain the null hypothesis.
5	The distribution of Is the type of lighting important to your overall experience (i.e. artificial lighting, natural lighting) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.002[c]	Reject the null hypothesis.
6	The distribution of Which type of lighting is important to your overall experience? - Artificial Lighting is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.602[c]	Retain the null hypothesis.
7	The distribution of Which type of lighting is important to your overall experience? - Natural Lighting is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.034[c]	Retain the null hypothesis.
8	The distribution of Is the focus of lighting important to you overall experience? (i.e. task lighting, ambient lighting) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.003[c]	Reject the null hypothesis.
9	The distribution of Which type of focus lighting is important to your overall experience? - Task Lighting is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.013[c]	Retain the null hypothesis.

10	The distribution of Which type of focus lighting is important to your overall experience? - Ambient Room Lighting is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.011[c]	Retain the null hypothesis.
11	The distribution of Is having a non-glare finish surface surrounding you important to your overall experience. (i.e. Tables and Floor) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.113[c]	Retain the null hypothesis.
12	The distribution of Where is non-glare finish important to your overall experience. - Table is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.070[c]	Retain the null hypothesis.
13	The distribution of Where is non-glare finish important to your overall experience. - Floor is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.162[c]	Retain the null hypothesis.
a. The significance level is .010.				
b. Asymptotic significance is displayed.				
c. Exact significance is displayed for this test.				

Table 15. Lighting Mann-Whitney U-Test

Figure 12. Focus of Light (Task Vs. Ambient) EqTD

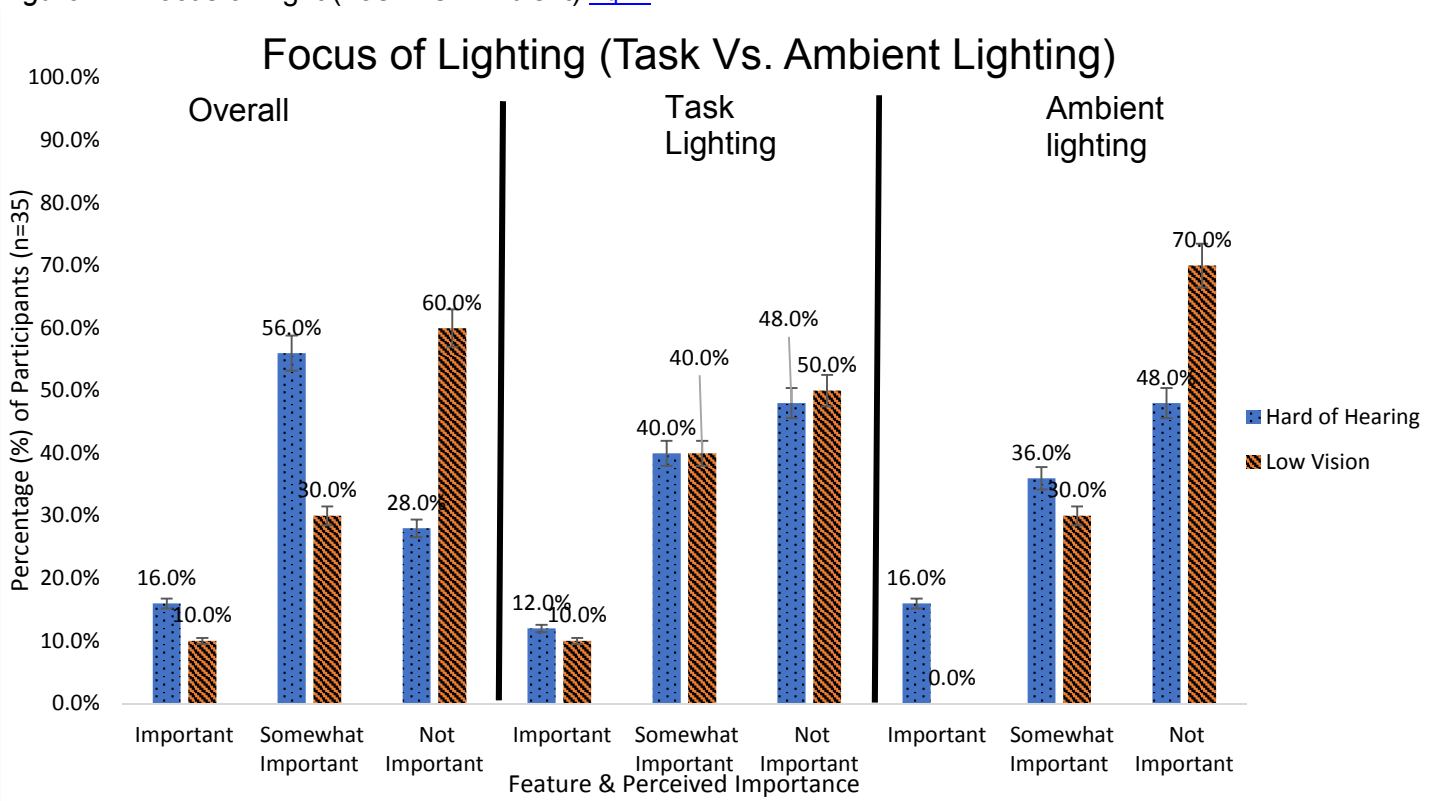
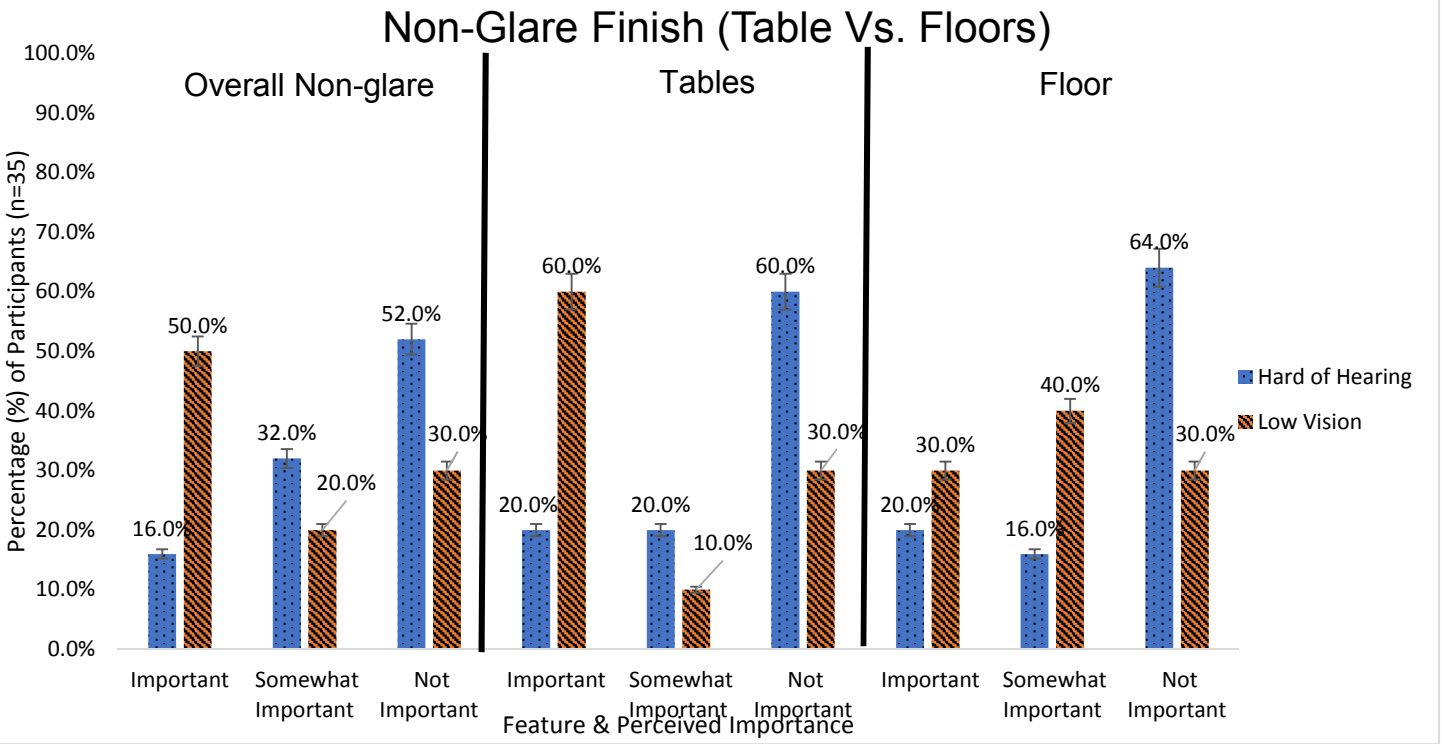


*Figure 11.*Non-Glare Finish (Table Vs. Floor) EqTD



Acoustic Graphs & Mann-Whitney *U*-Test

Figure 13. Background Noise Loudness (Whisper, Conversation tone, 2 or fewer noise sources). EqTD

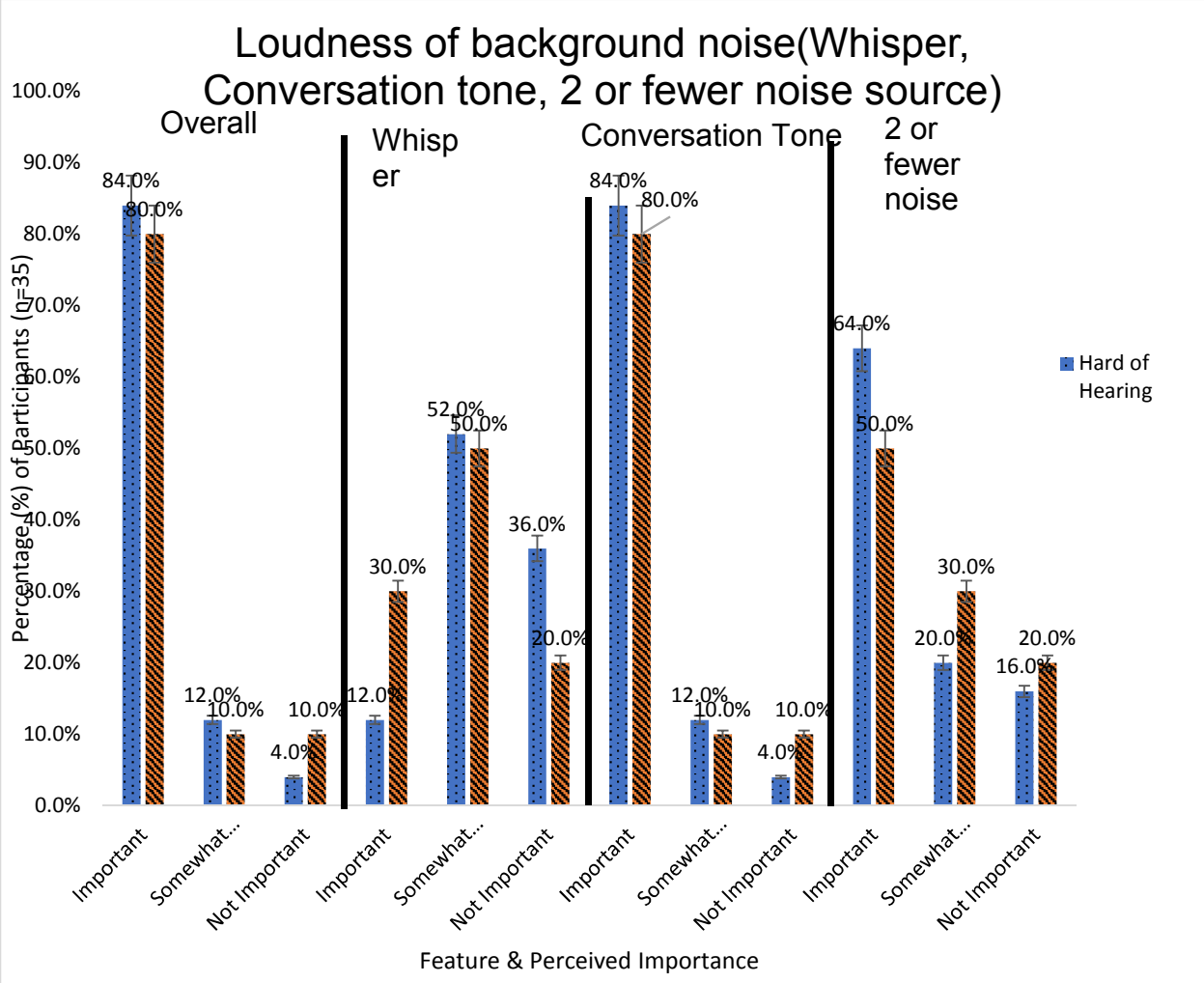


Figure 14. Sound Absorbing Materials (Walls Vs. Flooring) EqTD

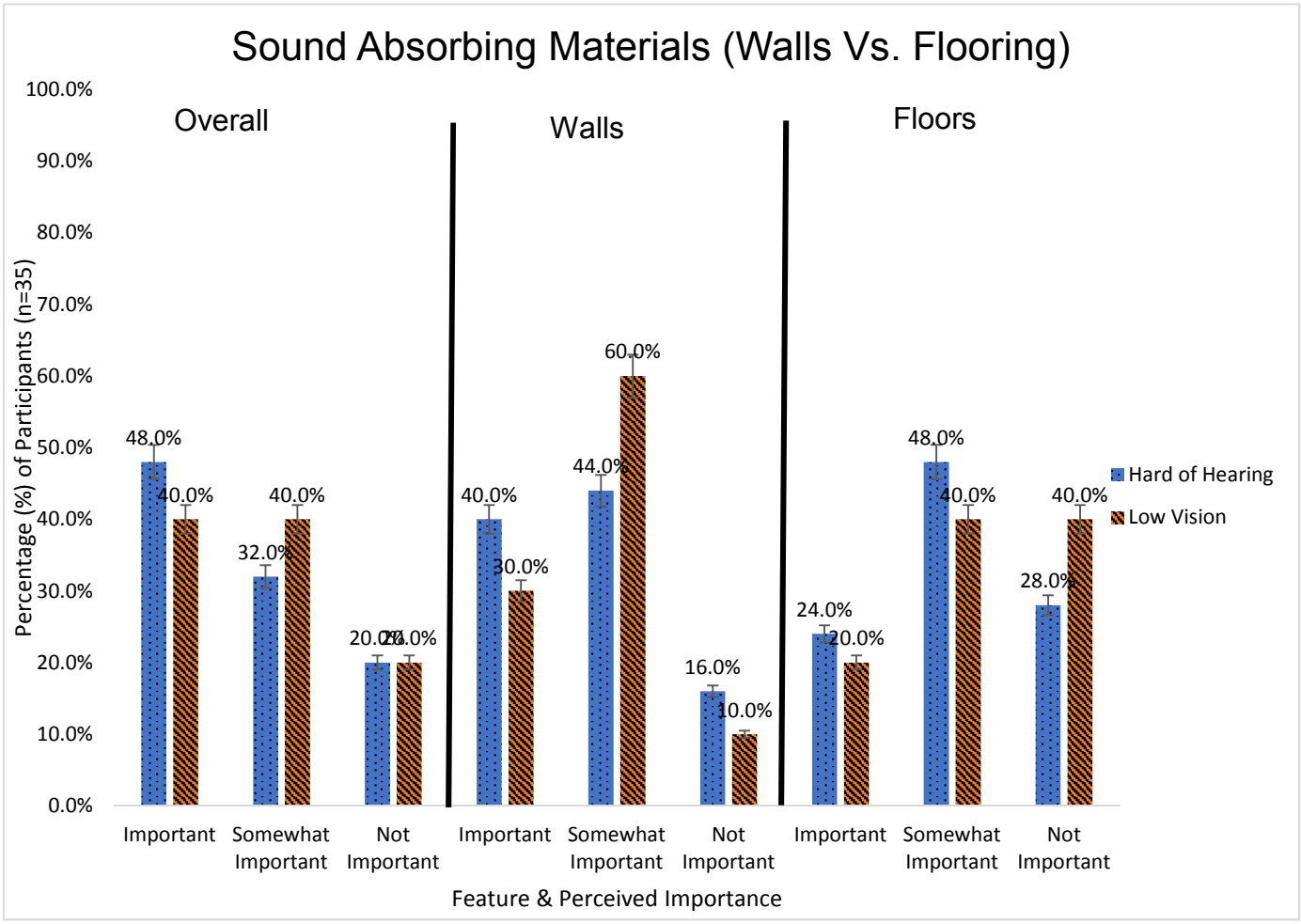


Table 16. Acoustics *Mann-Whitney U-Test* EqTD

Acoustics Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a, b]	Decision
1	The distribution of Is the acoustics of an environment (background noise, music, conversation level) important to your overall experience? is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.012[c]	Retain the null hypothesis.
2	The distribution of Is loudness of background noise important to you overall experience? (i.e. whisper, normal conversation tone, 2 or fewer noise sources): is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.843[c]	Retain the null hypothesis.
3	The distribution of Which type of noise level is important to your overall experience? - Hearing a whisper is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.255[c]	Retain the null hypothesis.
4	The distribution of Which type of noise level is important to your overall experience? - Hearing normal conversation tone is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.843[c]	Retain the null hypothesis.
5	The distribution of Which type of noise level is important to your overall experience? - Having two or fewer sources of background noise is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.553[c]	Retain the null hypothesis.

6	The distribution of Is having sound absorbing material important to your overall experience. (i.e. walls or flooring) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.788[c]	Retain the null hypothesis.
7	The distribution of Which location is sound absorbing material important to your overall experience? - Wall is covered with sound absorbing material is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.843[c]	Retain the null hypothesis.
8	The distribution of Which location is sound absorbing material important to your overall experience? - Floor is covered with sound absorbing material is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.602[c]	Retain the null hypothesis.

a. The significance level is .010.

b. Asymptotic significance is displayed.

c. Exact significance is displayed for this test.

Openness Graphs & Mann-Whitney *U*-Test

Figure 15. Variety of Seating (Booths Vs. Chairs) EqTD

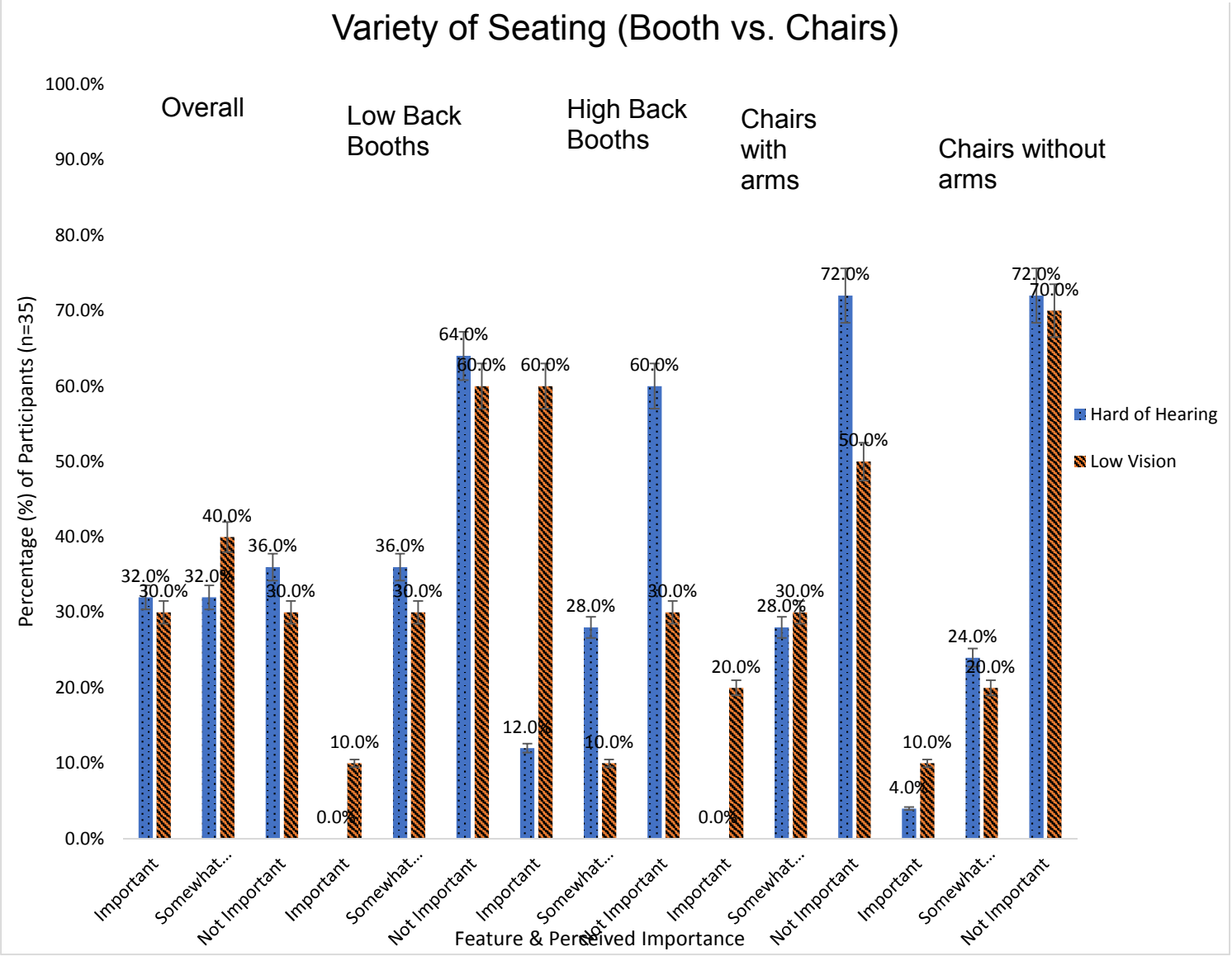


Figure 16. Center of table (Centerpieces, Condiments, Food/Drink Menu) EqTD

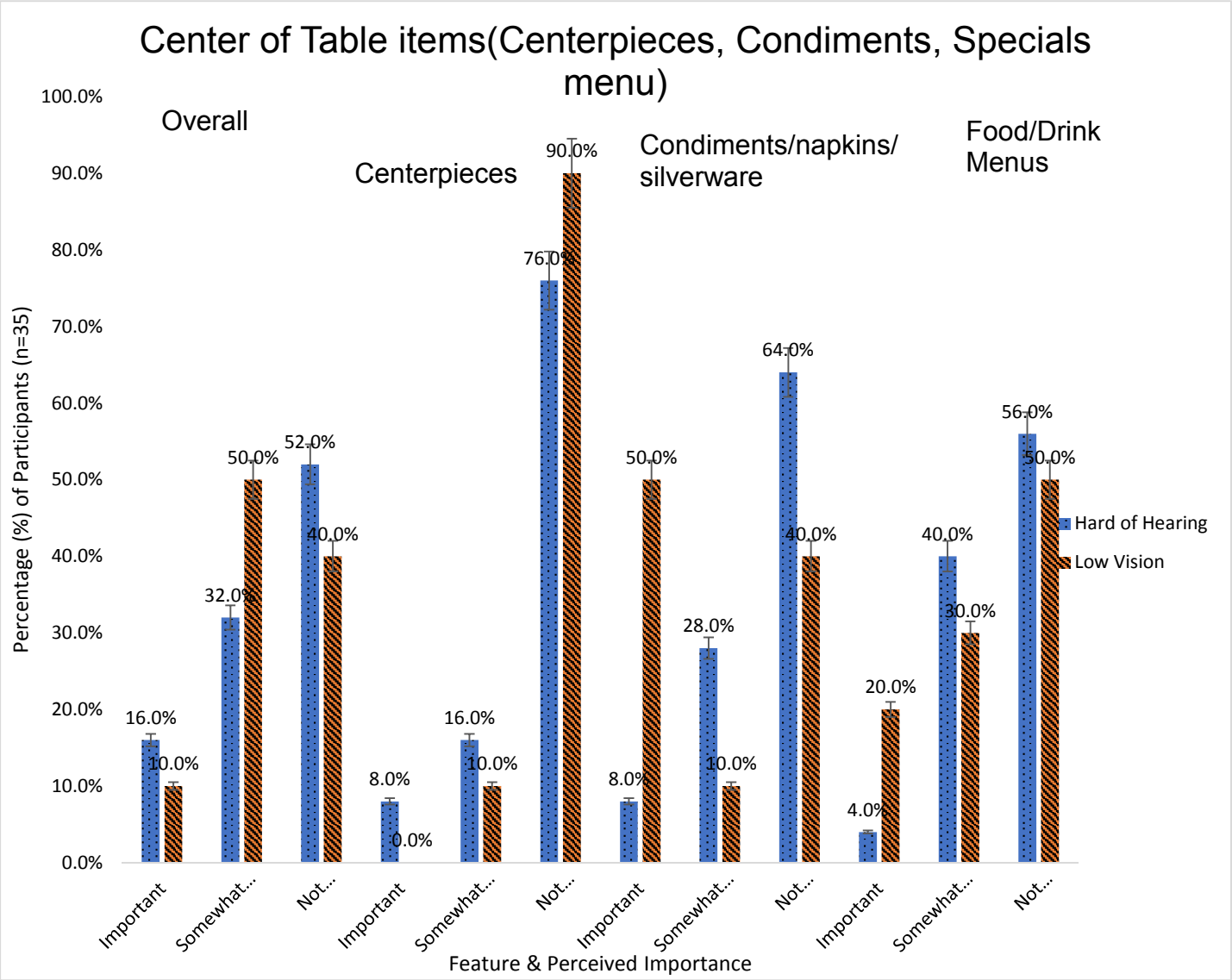


Figure 17. Location of Table (1 Wall Vs. Corner) EqTD

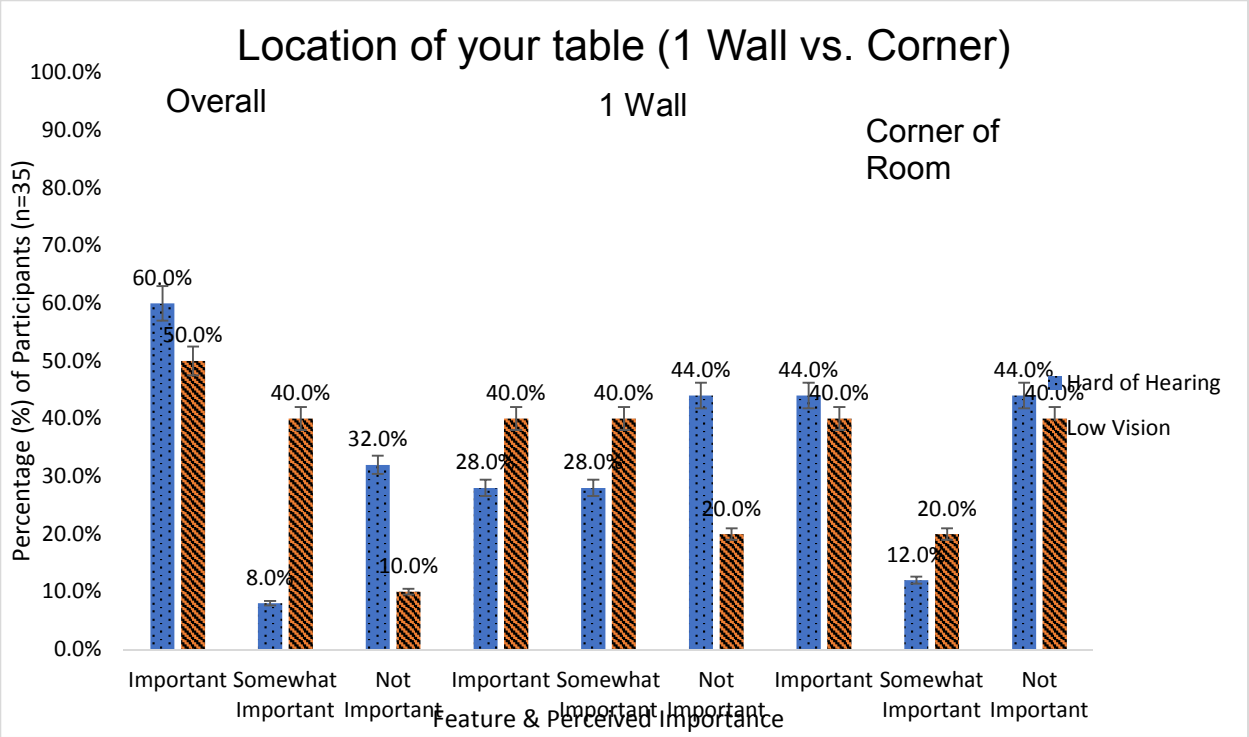


Figure 18. Location of Table (Center of Room, Near vs. Away from Win*dow,* Private Room*)* EqTD

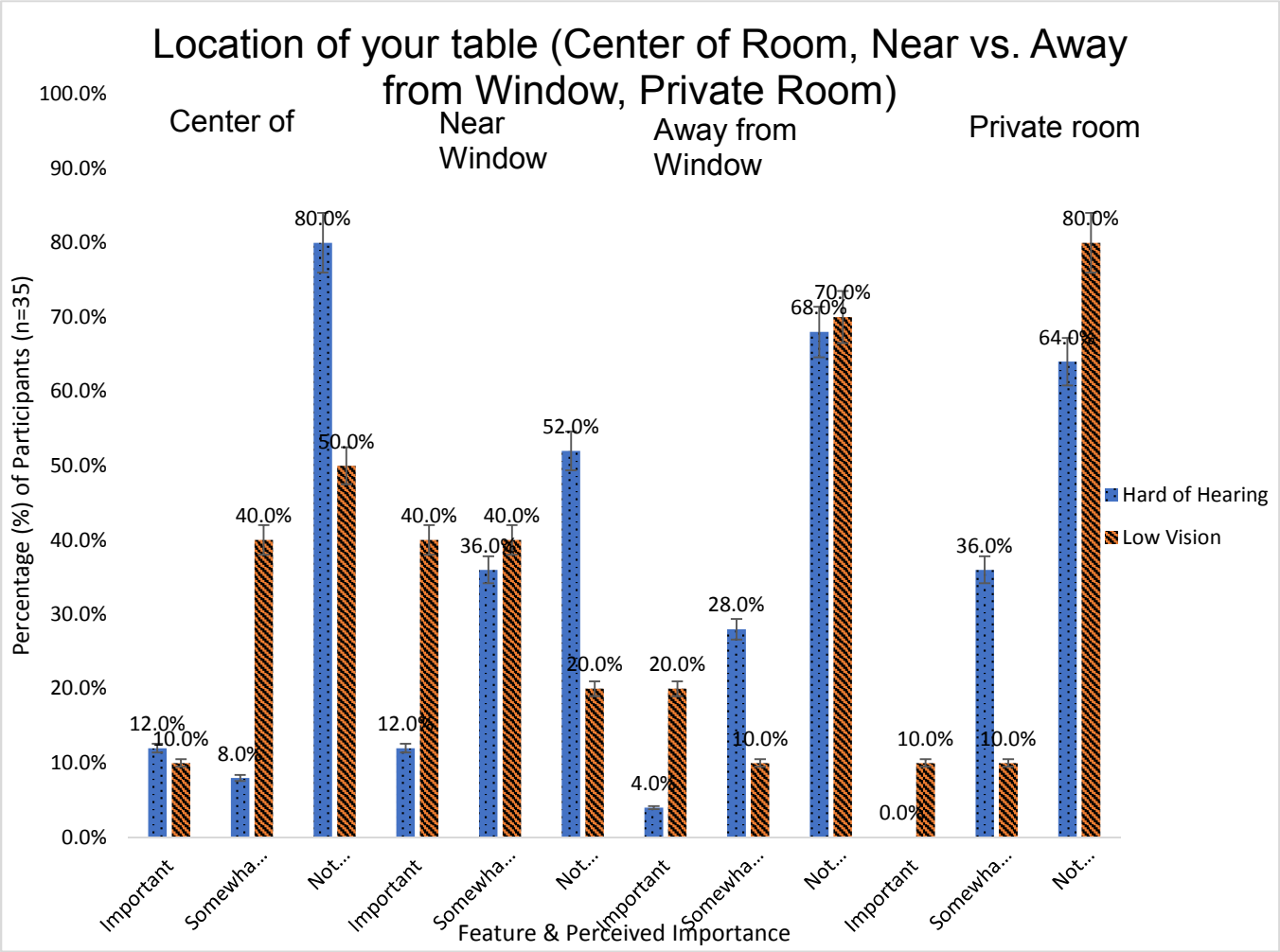


Figure 19. Types of Tables (Round Vs. Square, Small Vs. Large) EqTD

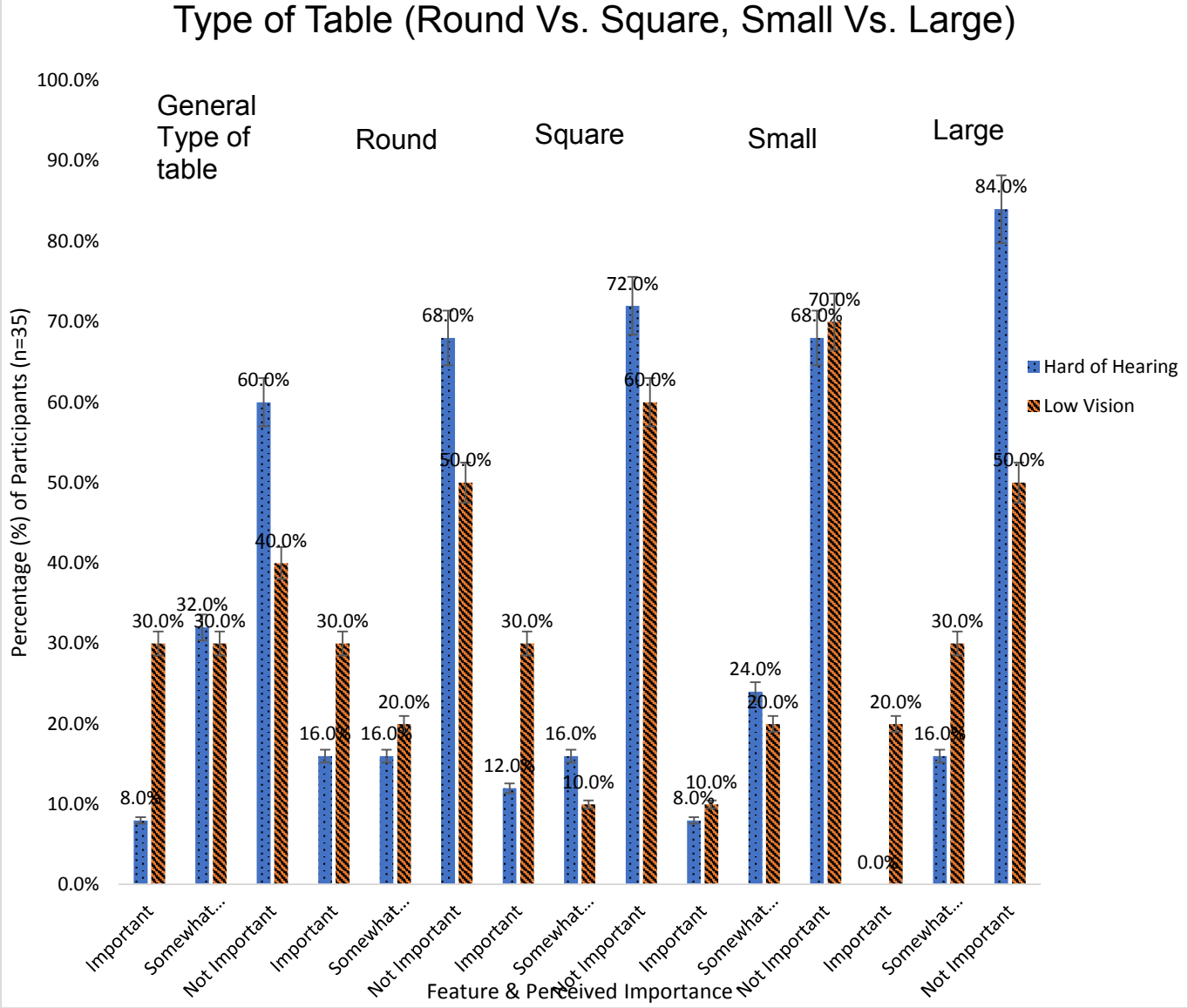


Figure 20. Comfortably Navigate Around the Restaurant EqTD

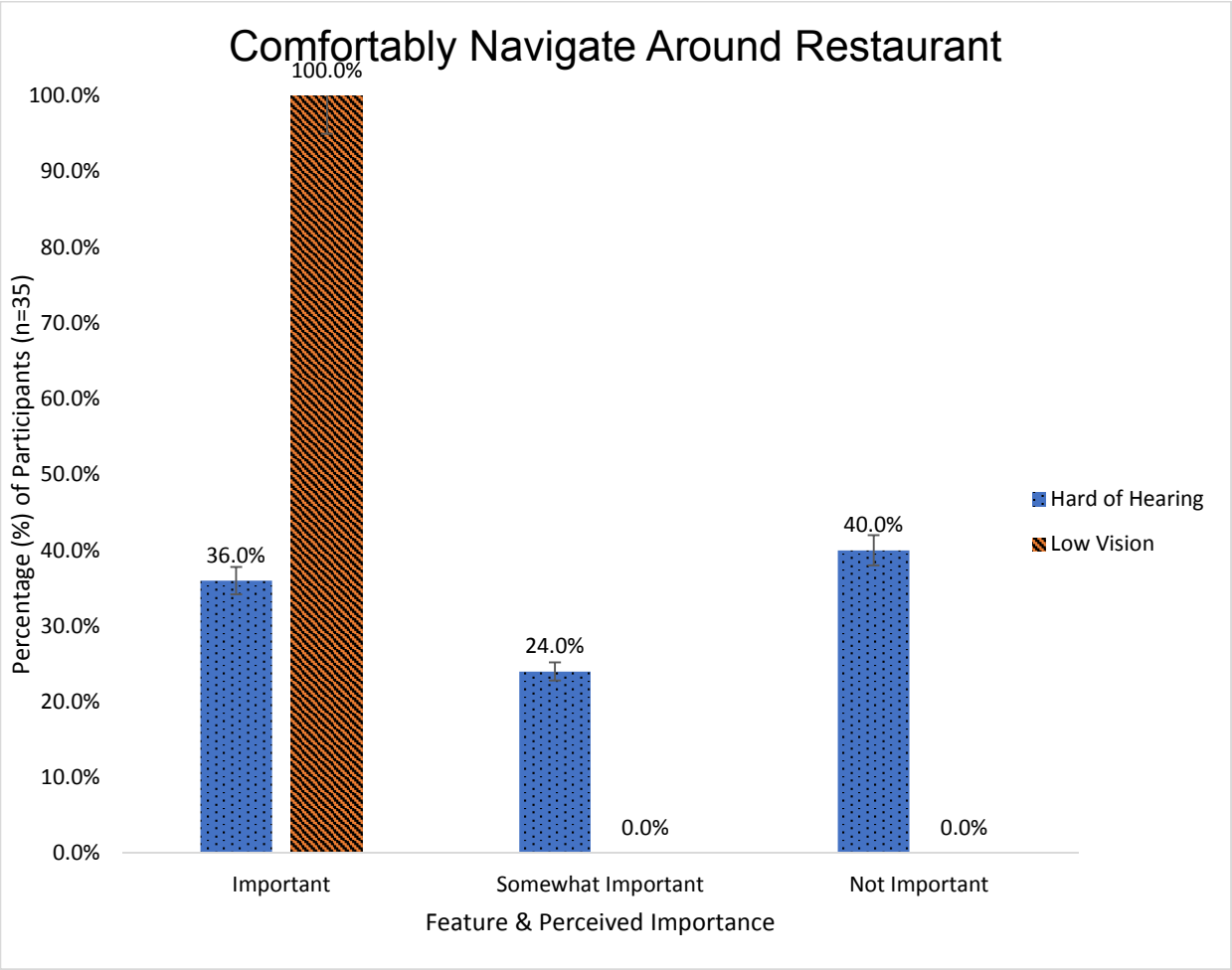


*Table 17.*Openness Mann-Whitney *U*-Test EqTD

Openness Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a, b]	Decision
1	The distribution of Is the openness of the environment important to your overall experience? (Variety of seating, tables, comfortable navigation): is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.105[c]	Retain the null hypothesis.
2	The distribution of Is having a variety of seating important to your experience? (i.e. booths or chairs) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.900[c]	Retain the null hypothesis.
3	The distribution of Which variety of seating is important to your overall experience? - Low Back Booth is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.733[c]	Retain the null hypothesis.
4	The distribution of Which variety of seating is important to your overall experience? - High Back Booth is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.038[c]	Retain the null hypothesis.
5	The distribution of Which variety of seating is important to your overall experience? - Chair with Arms is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.212[c]	Retain the null hypothesis.
6	The distribution of Which variety of seating is important to your overall experience? - Chair Without Arms is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.872[c]	Retain the null hypothesis.
7	The distribution of Is the number of items in the center of your table important to your overall experience? (i.e. centerpieces, condiments, specials menu) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.760[c]	Retain the null hypothesis.

8	The distribution of Which items at the center of your table is important to your overall experience? - Centerpieces is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.506[c]	Retain the null hypothesis.
9	The distribution of Which items at the center of your table is important to your overall experience? - Condiments/ napkins/ silverware is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.090[c]	Retain the null hypothesis.
10	The distribution of Which items at the center of your table is important to your overall experience? - Food and Drink Specials menu is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.577[c]	Retain the null hypothesis.
11	The distribution of Is the location of your table important to your overall experience? (i.e. near a wall, center of the room, private room, near a window) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.928[c]	Retain the null hypothesis.
12	The distribution of Which location of your table is important to your overall experience? - Placed near 1 wall is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.287[c]	Retain the null hypothesis.
13	The distribution of Which location of your table is important to your overall experience? - Placed in a corner is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	1.000[c]	Retain the null hypothesis.
14	The distribution of Which location of your table is important to your overall experience? - Placed in the center of the room is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.240[c]	Retain the null hypothesis.

15	The distribution of Which location of your table is important to your overall experience? - Near a window is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.059[c]	Retain the null hypothesis.
16	The distribution of Which location of your table is important to your overall experience? - Away from a window is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.900[c]	Retain the null hypothesis.
17	The distribution of Which location of your table is important to your overall experience? - Private Room is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.577[c]	Retain the null hypothesis.
18	The distribution of Is the type of table you sit at important to your overall experience. (i.e. round, square, small, large) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.225[c]	Retain the null hypothesis.
19	The distribution of Which type of table you sit at important to your overall experience? - Round Table is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.377[c]	Retain the null hypothesis.
20	The distribution of Which type of table you sit at important to your overall experience? - Square Table is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.483[c]	Retain the null hypothesis.
21	The distribution of Which type of table you sit at important to your overall experience? - Small Table is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.957[c]	Retain the null hypothesis.
22	The distribution of Which type of table you sit at important to your overall experience? - Large Table is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.090[c]	Retain the null hypothesis.

23	The distribution of Is being able to comfortably navigate around the restaurant, i.e. avoiding tables, chairs, obstructions, important to your overall experience? is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.003[c]	Reject the null hypothesis.

a. The significance level is .010.

b. Asymptotic significance is displayed.

c. Exact significance is displayed for this test.

Color/Contrast Graphs & Mann-Whitney *U*-Test

Figure 21. Wall Color/Pattern (Neutral Vs. Bright Colored) EqTD

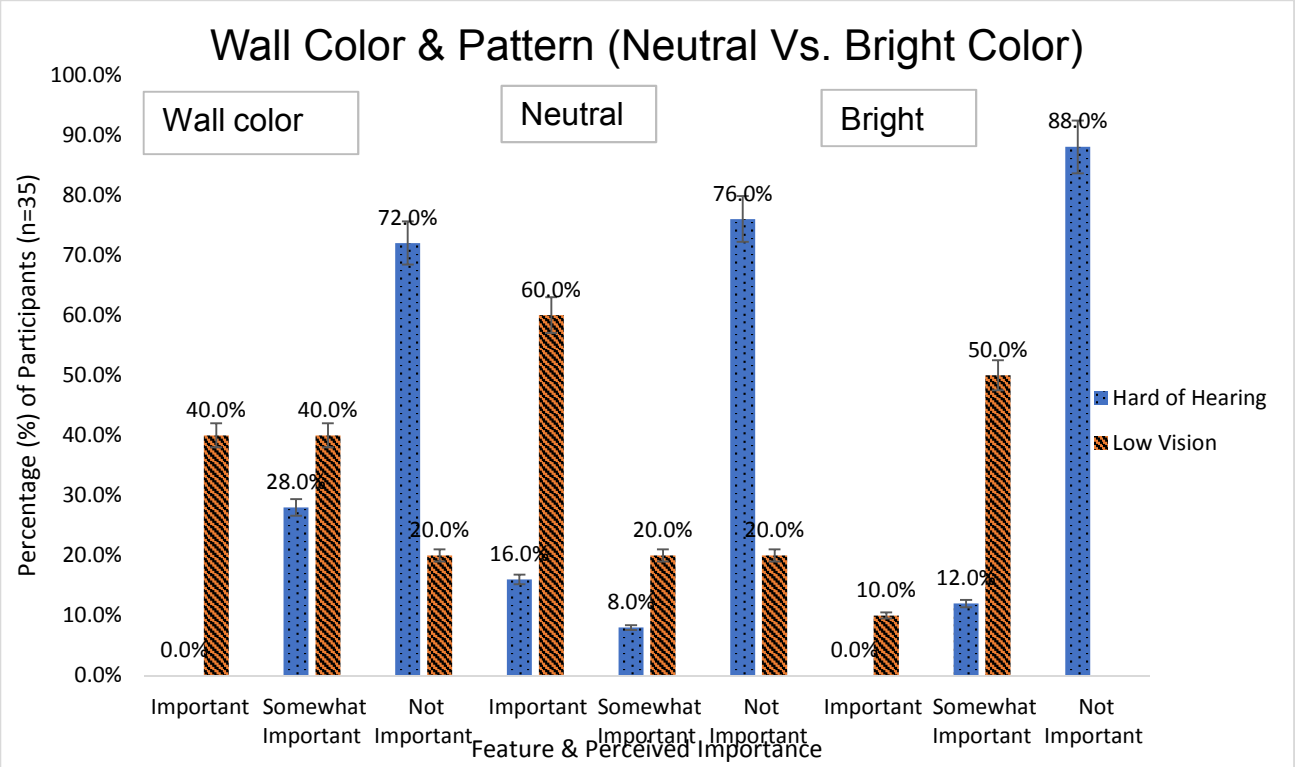


*Figure 22.*Wall Color/Pattern (Patterned Vs. Plain) EqTD

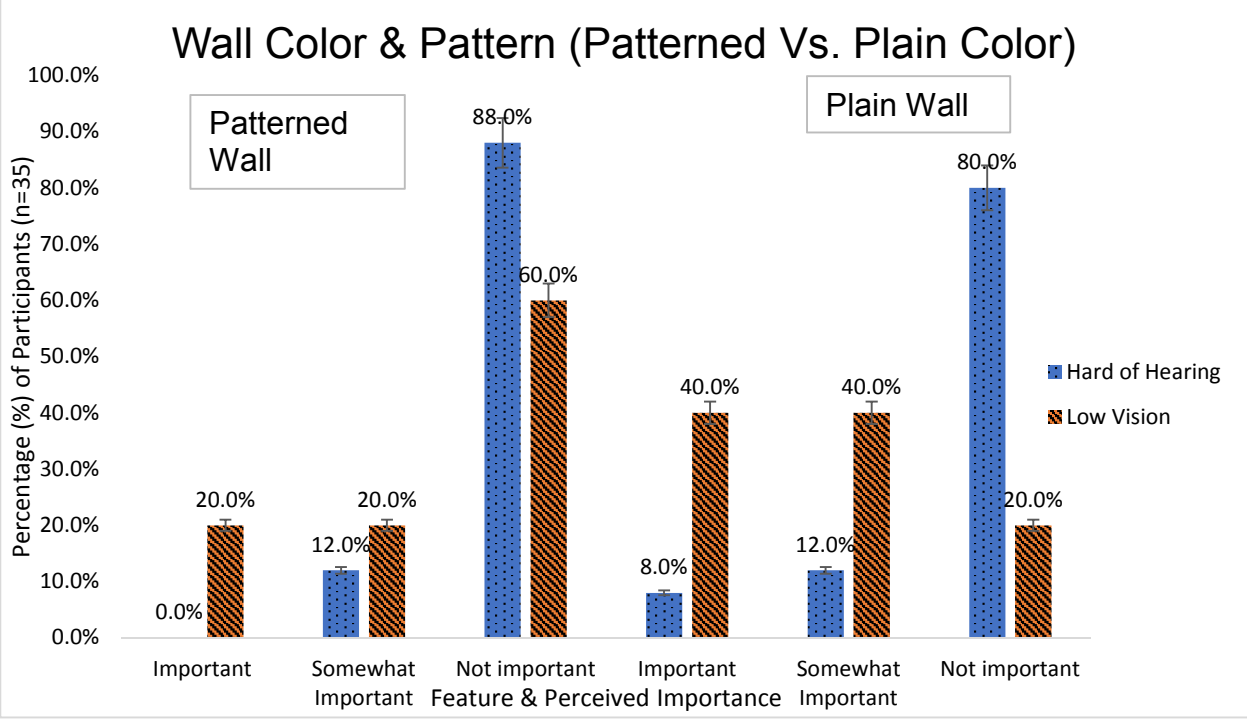


Figure 24. Floor Color & Pattern (Neutral Vs. Bright) EqTD

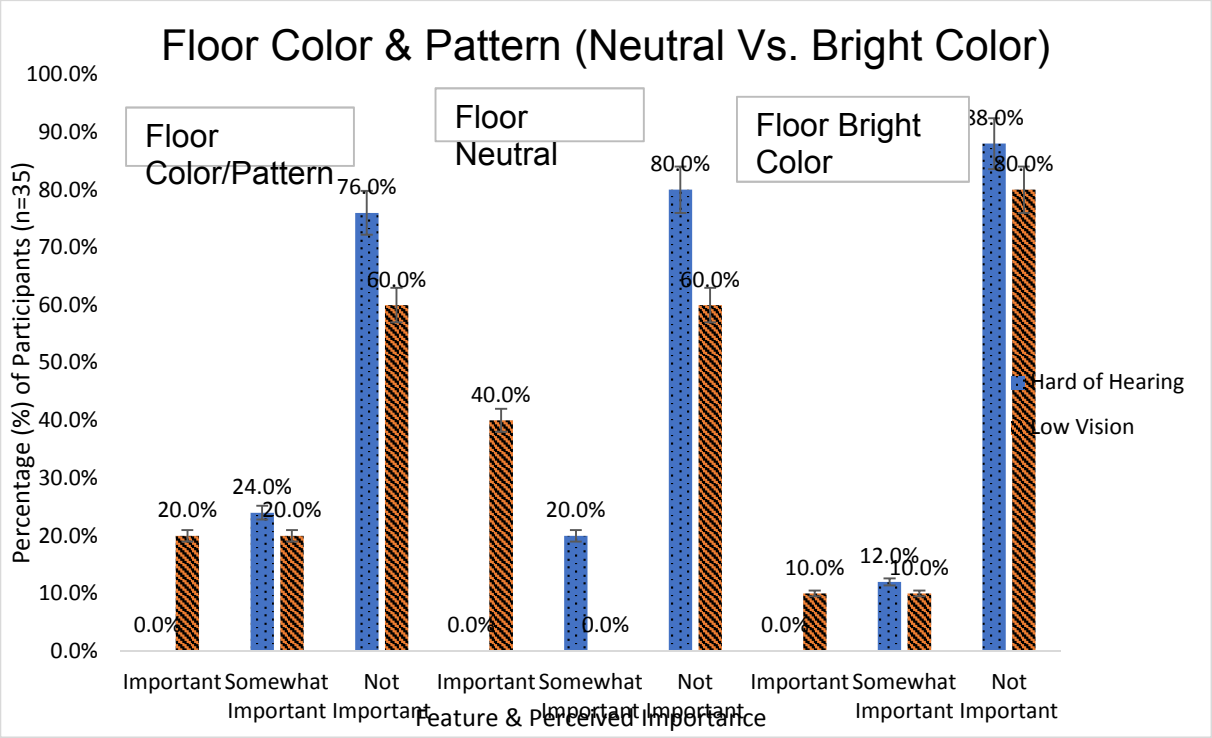


Figure 23. Floor Color & Pattern (Patterned Vs. Plain) EqTD

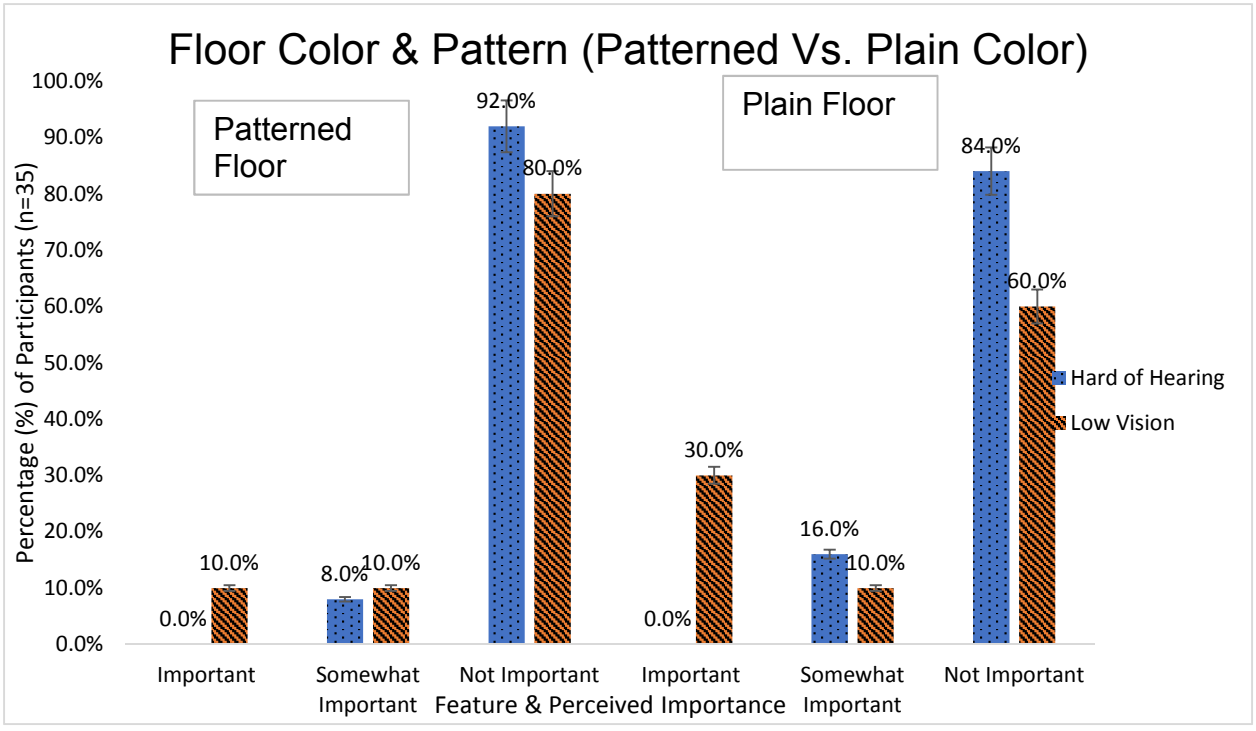


Table 18. Color/Contrast Mann-Whitney U-Test EqTD

Color/Contrast Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a, b]	Decision
1	The distribution of Is color and contrast of your environment important to your overall experience? (i.e. walls, floors) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.000[c]	Reject the null hypothesis.
2	The distribution of Is the colors and pattern of the wall important to your overall experience? (i.e. neutral or bright; patterned or plain) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.003[c]	Reject the null hypothesis.
3	The distribution of Which color and patterns of the wall is important to your overall experience? - Neutral Color is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.007[c]	Reject the null hypothesis.
4	The distribution of Which color and patterns of the wall is important to your overall experience? - Bright Color is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.023[c]	Retain the null hypothesis.
5	The distribution of Which color and patterns of the wall is important to your overall experience? - Patterned Wall is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.174[c]	Retain the null hypothesis.
6	The distribution of Which color and patterns of the wall is important to your overall experience? - Plain, Not Patterned is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.004[c]	Reject the null hypothesis.
7	The distribution of Is the color of the floor important to your overall experience? (neutral color or bright, patterned or plain) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.358[c]	Retain the null hypothesis.

8	The distribution of Which color and patterns of the floor is important to your overall experience? - Neutral Color is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.212[c]	Retain the null hypothesis.
9	The distribution of Which color and patterns of the floor is important to your overall experience? - Bright Color is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.679[c]	Retain the null hypothesis.
10	The distribution of Which color and patterns of the floor is important to your overall experience? - Patterned Floor is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.577[c]	Retain the null hypothesis.
11	The distribution of Which color and patterns of the floor is important to your overall experience? - Plain, Not Patterned is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.198[c]	Retain the null hypothesis.

a. The significance level is .010.

b. Asymptotic significance is displayed.

c. Exact significance is displayed for this test.

Services/Communication Graphs & Mann-Whitney U Test

Figure 25. Reservation System (Phone, Online, In-Person) EqTD

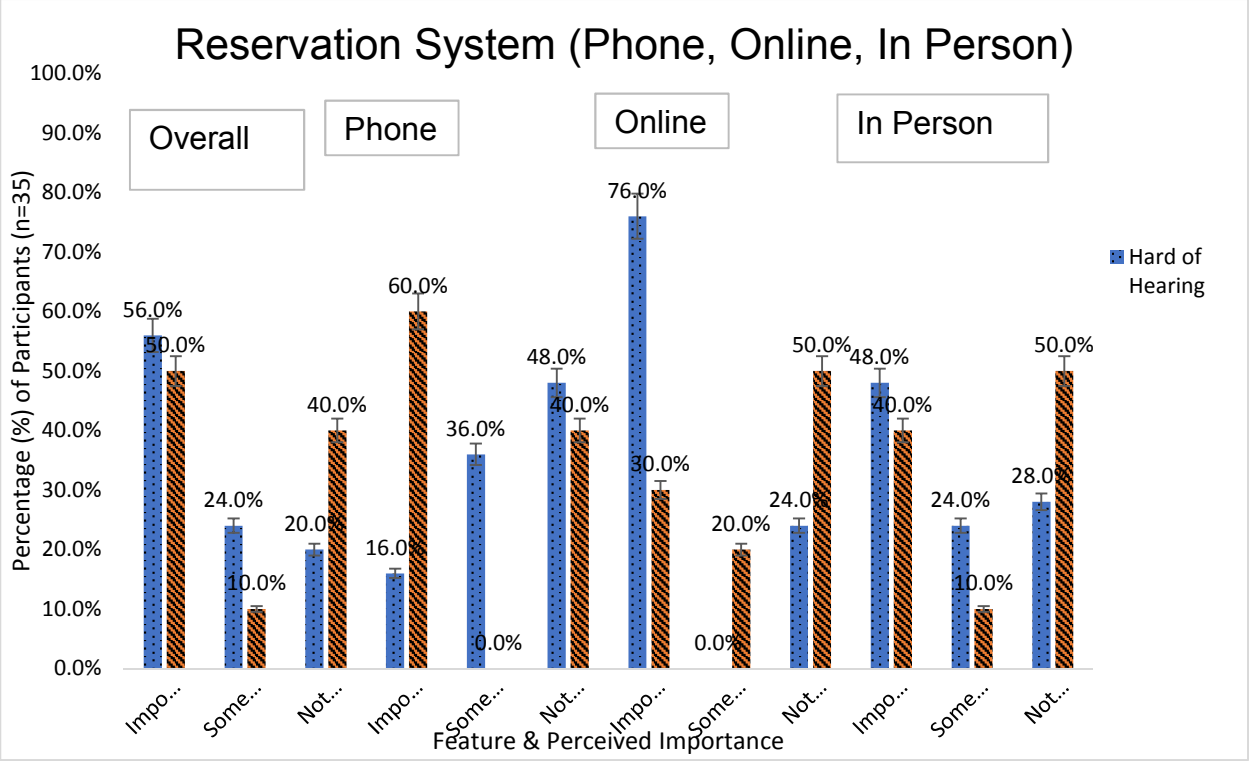


Figure 26. How to be seated (Visual Sign vs. Person relays Message) *EqTD*

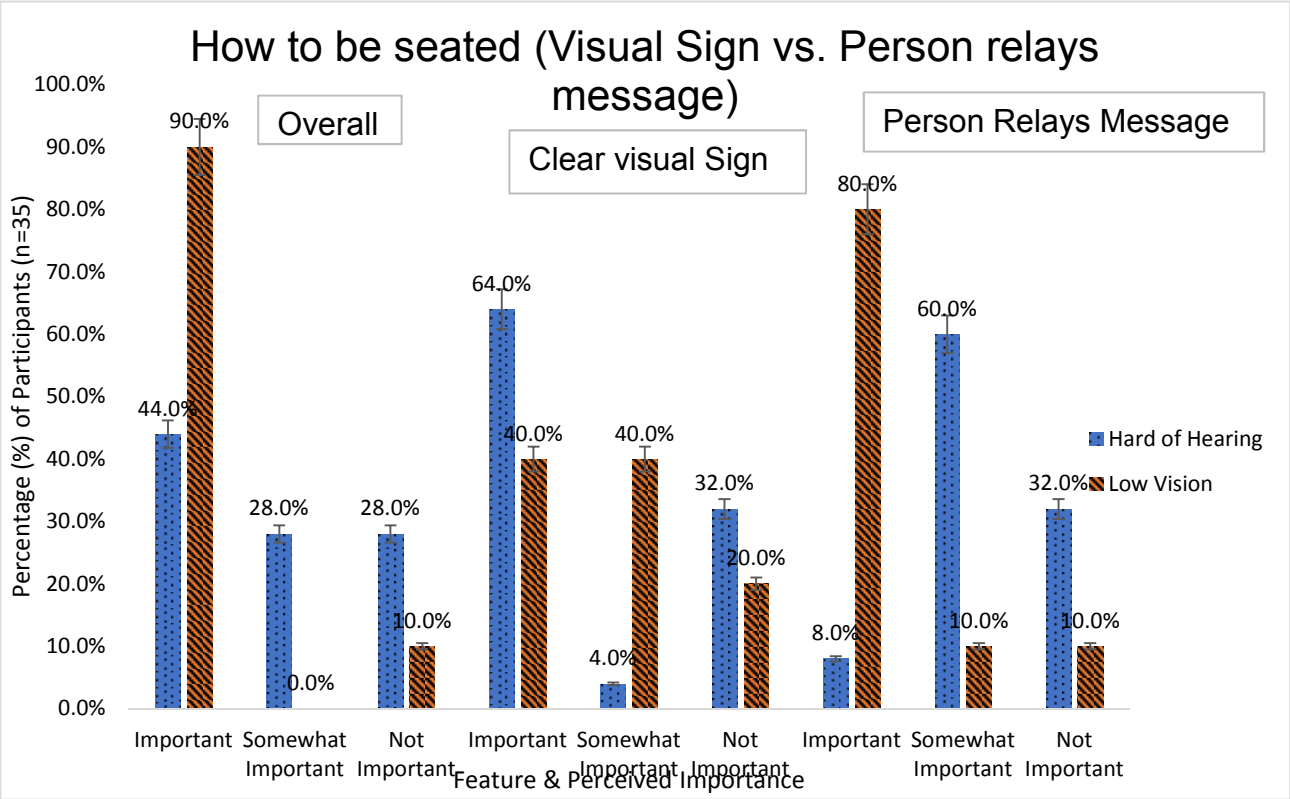


Figure 26. Finding a seat (Self vs. Being Guided) EqTD

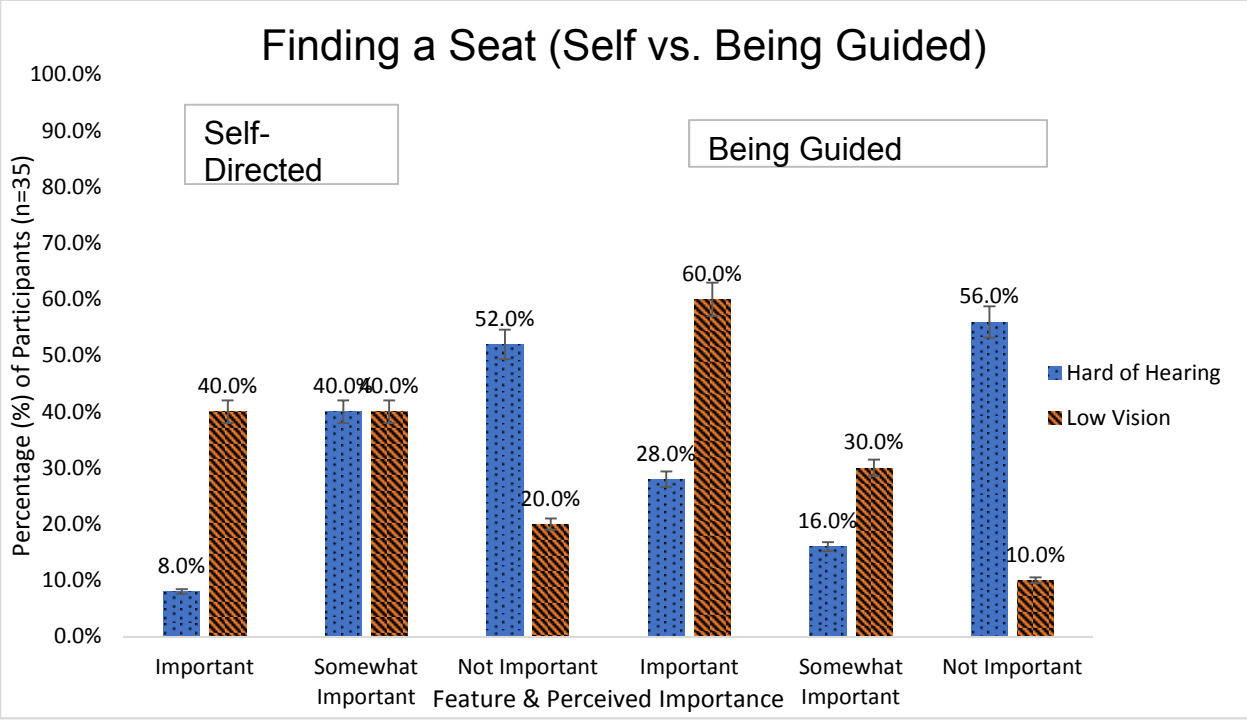


*Figure 27.*Clear Communication When to be Seated (Auditory, Tactile, Visual Cue) EqTD

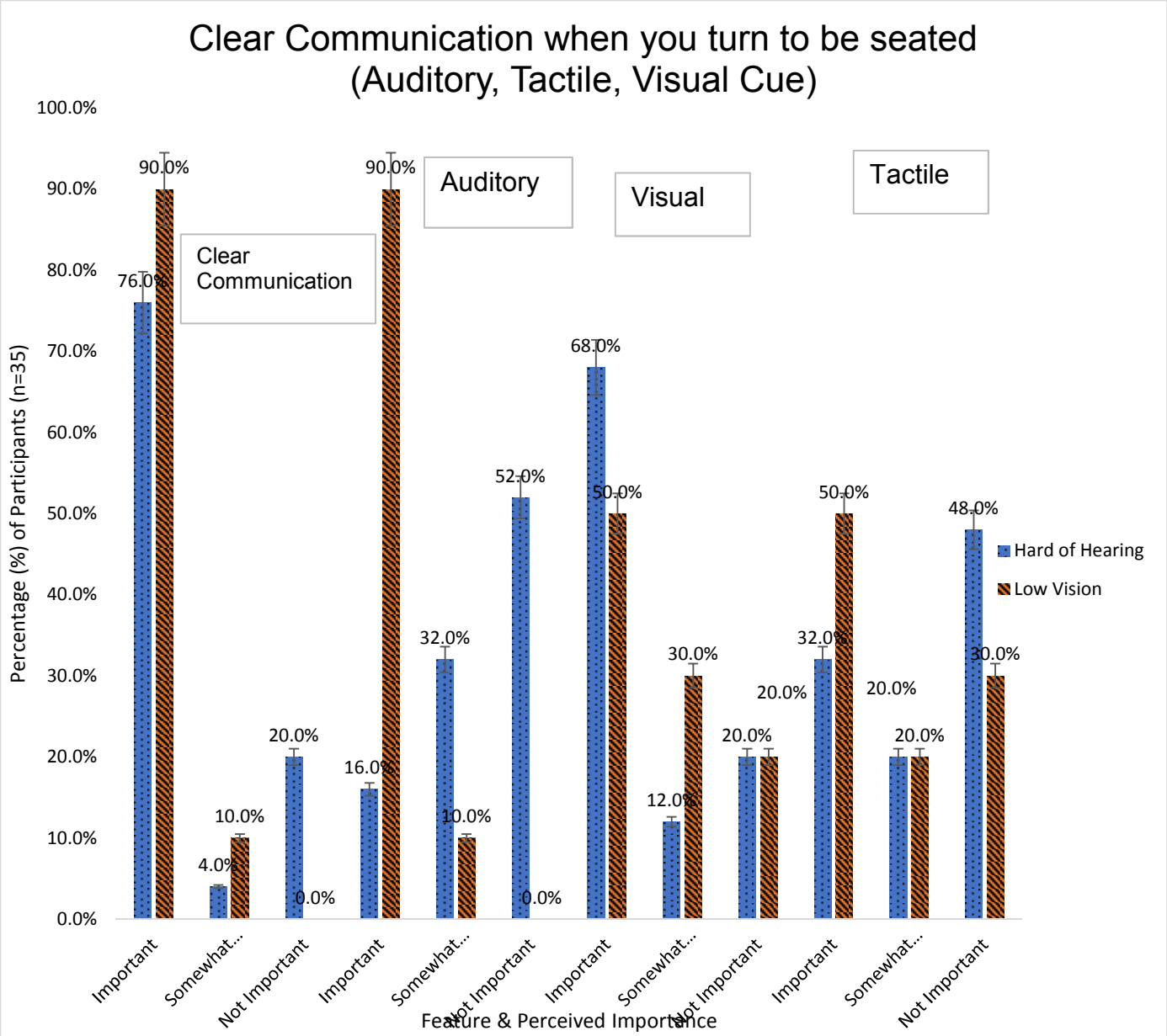


Figure 28. Menu Presented (Online, Physical Copy, Menu on Screen) EqTD

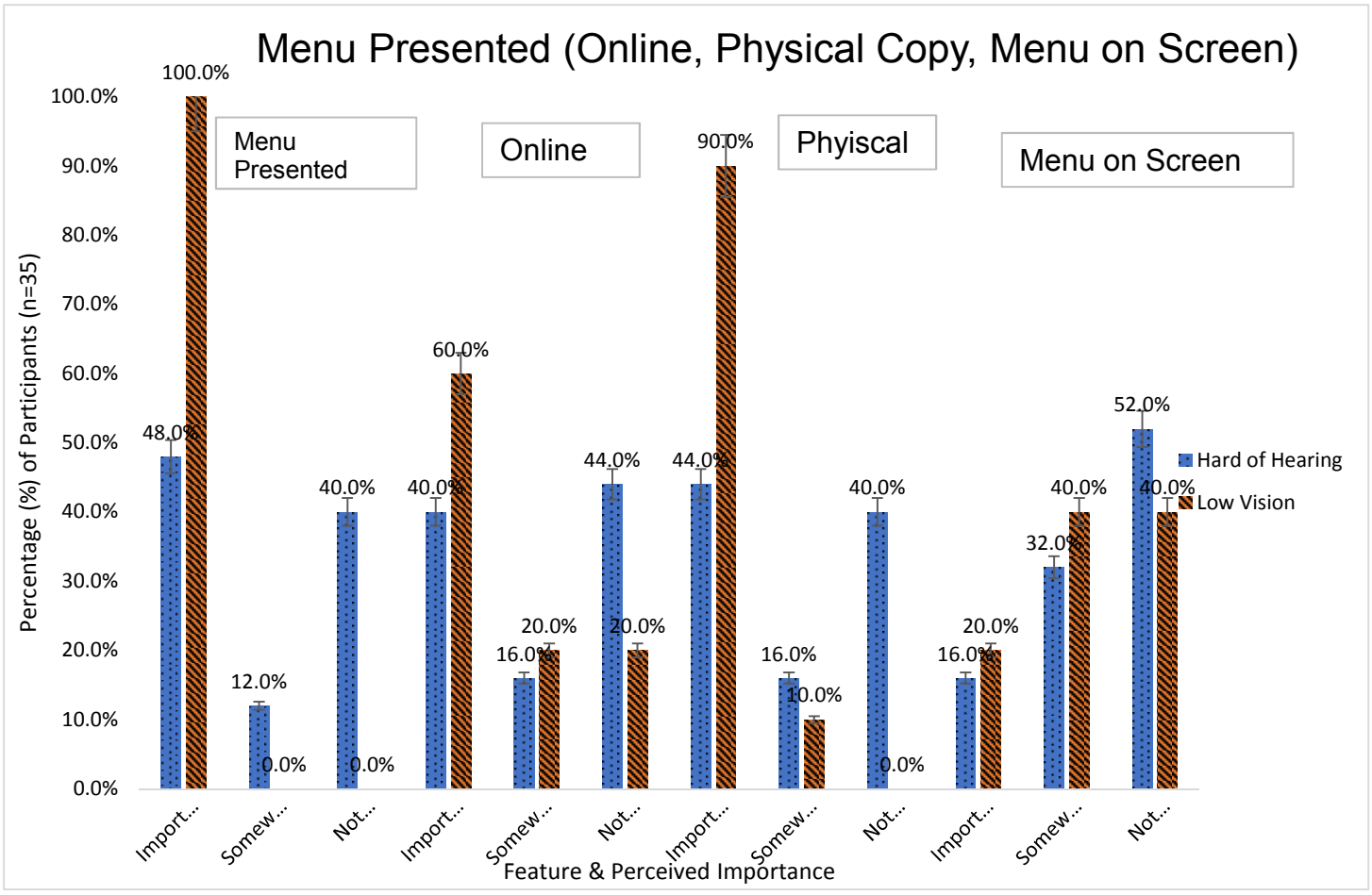


Figure 29. Menu Presented (Pictures/Pictograms or Numbers corresponding) EqTD

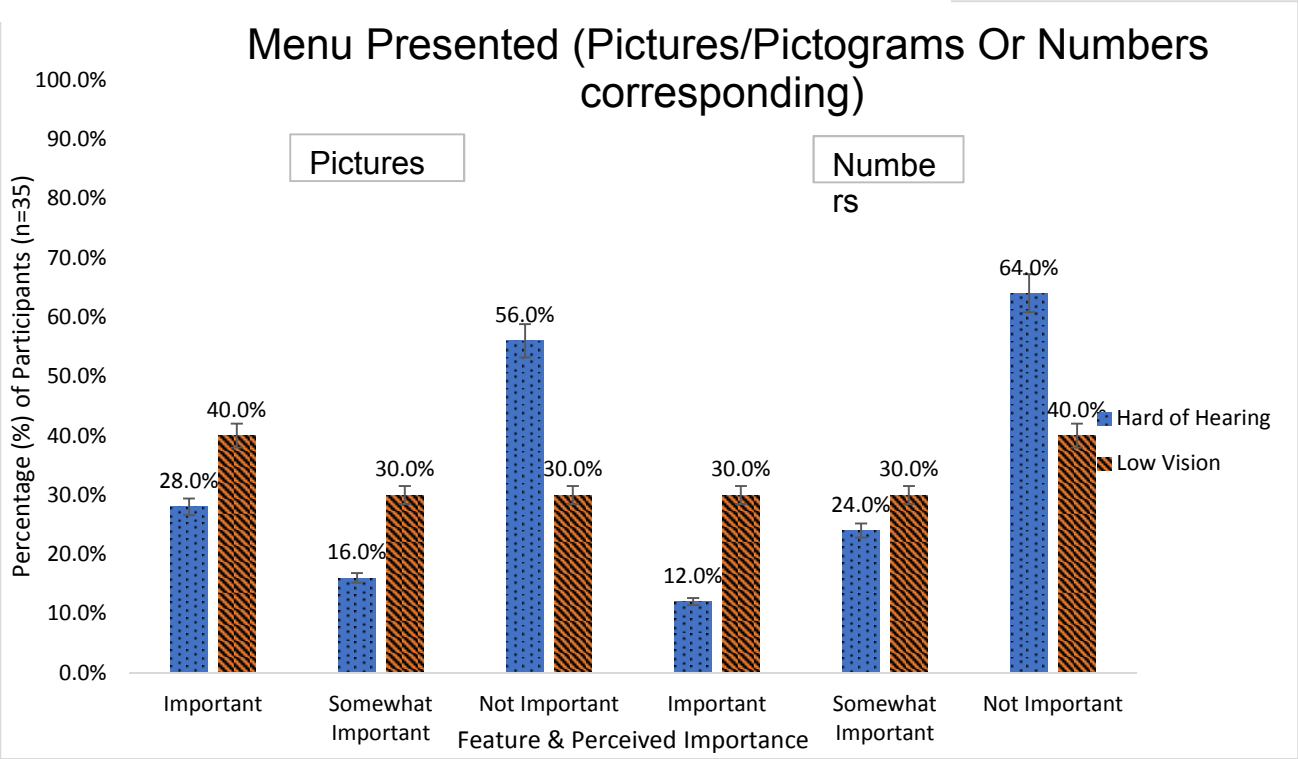


Figure 30. The way you order food (Server Vs. Self-Serve Kiosk) EqTD

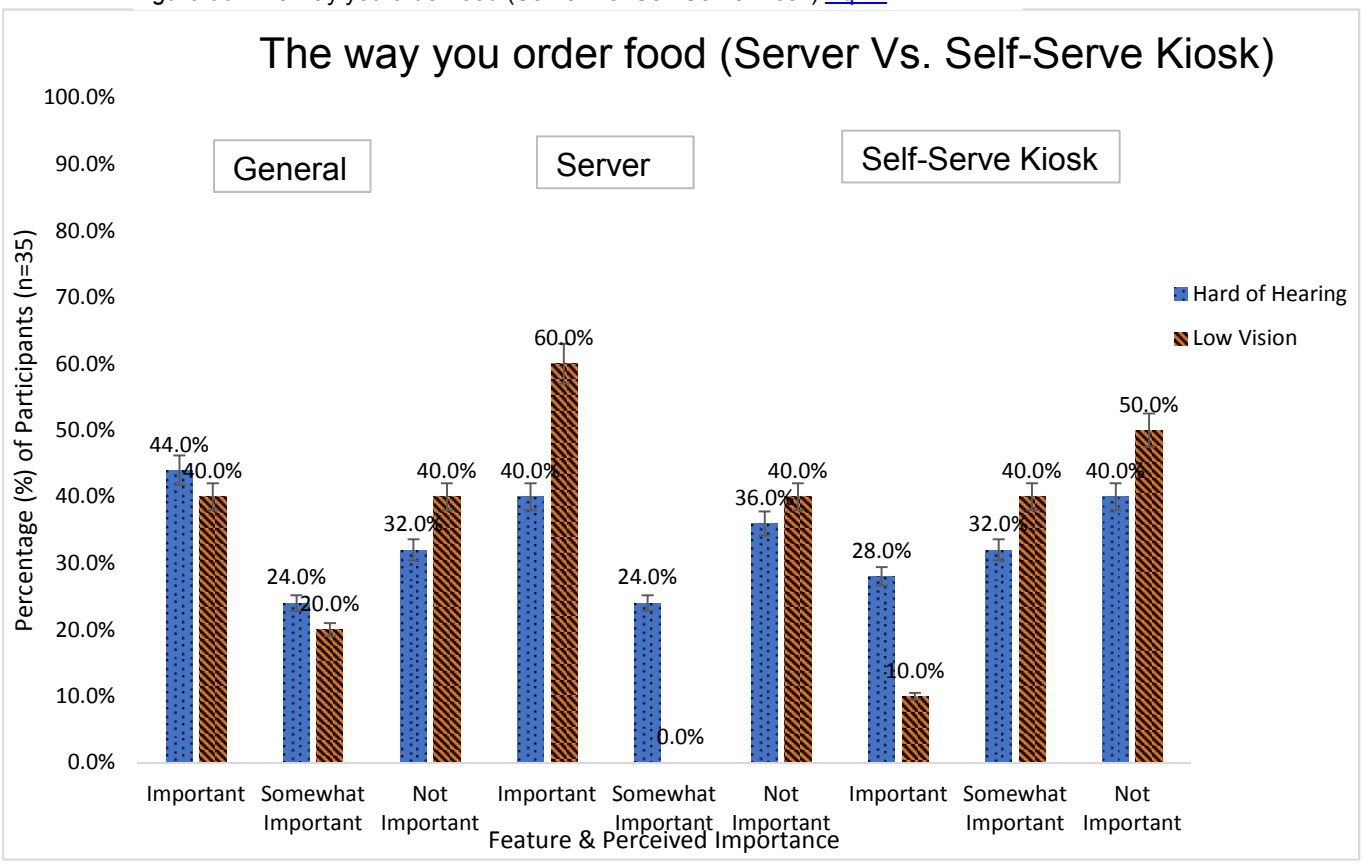


Figure 31. Cue for Food Pick Up (Visual, Auditory, Tactile Cues) EqTD

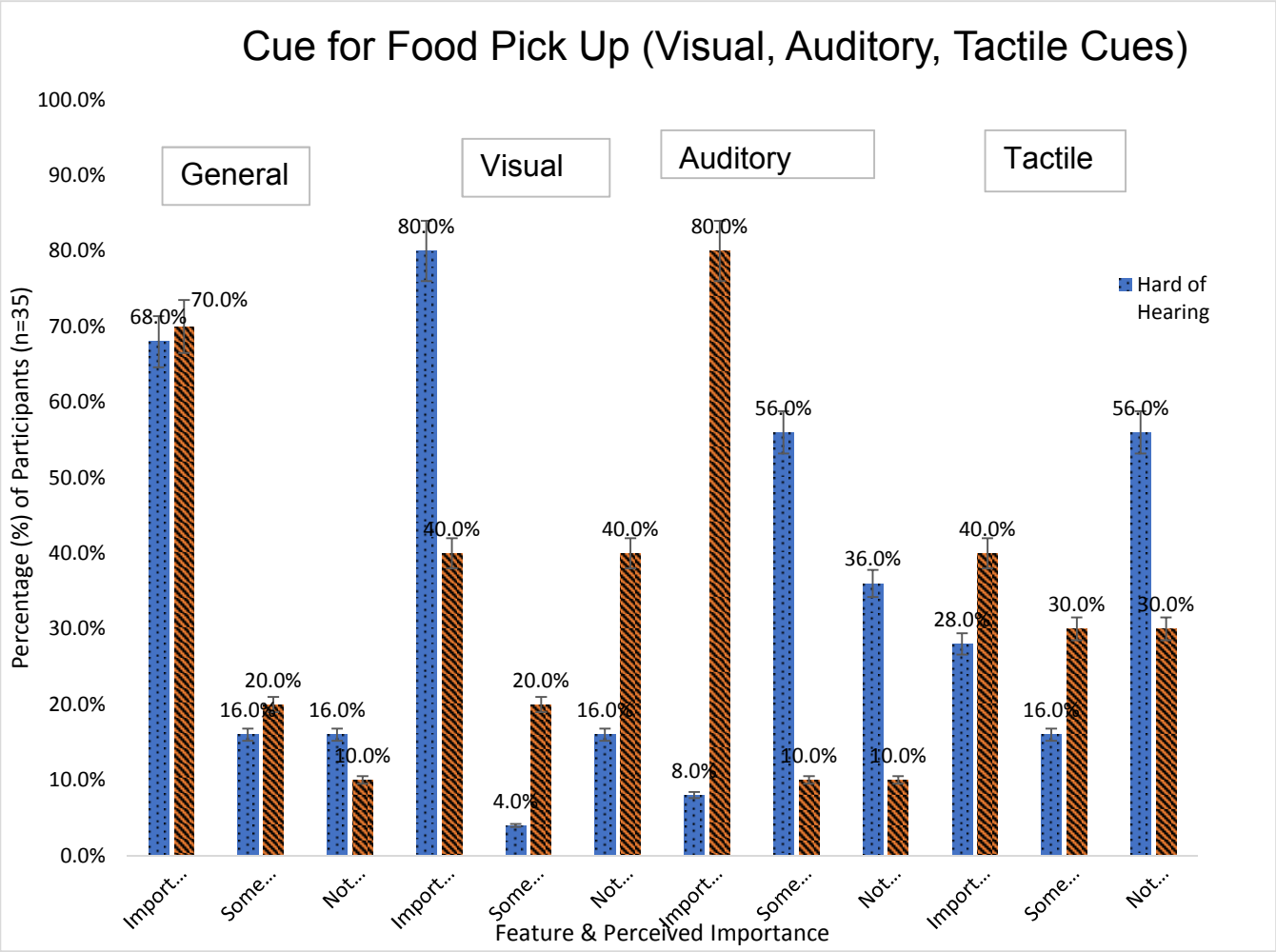


*Figure 32.*Receive Food (Self-Serve Vs. Server). EqTD

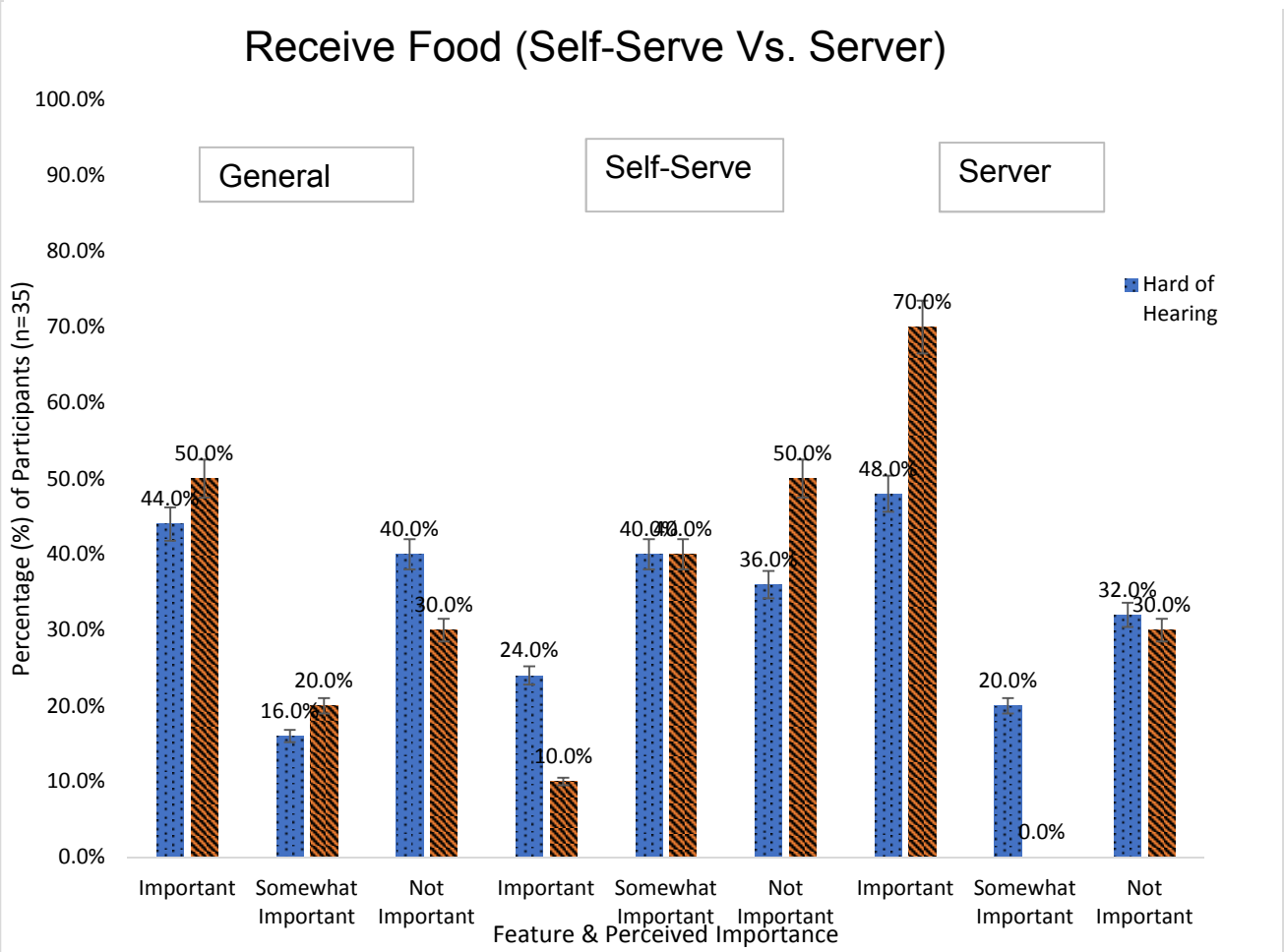


Table 19. Services/Communication Mann-Whitney *U*-Test EqTD

Services/Communication Hypothesis Test Summary

	Null Hypothesis	Test	Sig.[a, b]	Decision
1	The distribution of Is services/communication important to your overall experience? (i.e. Reservation/paging system, menu, self-serve kiosk): is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.162[c]	Retain the null hypothesis.
2	The distribution of Is the way you use the reservation system (i.e. phone, online, in-person): is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.553[c]	Retain the null hypothesis.
3	The distribution of Which reservation system is important to your overall experience? - Phone is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.186[c]	Retain the null hypothesis.
4	The distribution of Which reservation system is important to your overall experience? - Online is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.059[c]	Retain the null hypothesis.
5	The distribution of Which reservation system is important to your overall experience? - In-person is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.439[c]	Retain the null hypothesis.
6	The distribution of Is understanding how to be seated and finding your seat important to your overall experience? (i.e. Sign or person present stating; please wait to be seated, Please sit anywhere): is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.050[c]	Retain the null hypothesis.
7	The distribution of Which method is important to your overall experience? - Clear message through visual sign is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.602[c]	Retain the null hypothesis.

8	The distribution of Which method is important to your overall experience? - Person relays message to you is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.001[c]	Reject the null hypothesis.
9	The distribution of Which method is important to your overall experience? - Finding my own seat is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.041[c]	Retain the null hypothesis.
10	The distribution of Which method is important to your overall experience? - Being guided to my table is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.031[c]	Retain the null hypothesis.
11	The distribution of Is clear communication on when it is your turn to be seated regardless of pager or person important to your overall experience? (i.e. auditory, tactile, or visual cues?) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.483[c]	Retain the null hypothesis.
12	The distribution of Which communication method is important to your overall experience? - Auditory cues is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.000[c]	Reject the null hypothesis.
13	The distribution of Which communication method is important to your overall experience? - Visual Cues is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.529[c]	Retain the null hypothesis.
14	The distribution of Which communication method is important to your overall experience? - Tactile Cues is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.339[c]	Retain the null hypothesis.

15	The distribution of Is the way the menu presented important to your overall experience. (i.e. online, physical copy, menu board, pictures on menu, numbers corresponding to menu items) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.017[c]	Retain the null hypothesis.
16	The distribution of Which way is the menu presented that impacts your overall experience? - Online menu is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.255[c]	Retain the null hypothesis.
17	The distribution of Which way is the menu presented that impacts your overall experience? - Physical menu is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.021[c]	Retain the null hypothesis.
18	The distribution of Which way is the menu presented that impacts your overall experience? - Menu on a screen is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.602[c]	Retain the null hypothesis.
19	The distribution of Which way is the menu presented that impacts your overall experience? - Pictures and pictograms on the menu are the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.287[c]	Retain the null hypothesis.
20	The distribution of Which way is the menu presented that impacts your overall experience? - Number corresponding to items on the menu is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.212[c]	Retain the null hypothesis.
21	The distribution of Is how you order food important to your overall experience? (i.e. server, self-serve kiosk) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.760[c]	Retain the null hypothesis.

22	The distribution of Which way to order food is important to your overall experience? - Server is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.653[c]	Retain the null hypothesis.
23	The distribution of Which way to order food is important to your overall experience? - Self-serve kiosk is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.418[c]	Retain the null hypothesis.
24	The distribution of Is the cues used to inform you when your food is ready to pick up important to your overall experience? (i.e. Visual cue, auditory cue, tactile cue): is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.872[c]	Retain the null hypothesis.
25	The distribution of Which cue is important to your overall experience? - Visual cue is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.083[c]	Retain the null hypothesis.
26	The distribution of Which cue is important to your overall experience? - Auditory Cue is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.001[c]	Reject the null hypothesis.
27	The distribution of Which cue is important to your overall experience? - Tactile Cue is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.287[c]	Retain the null hypothesis.
28	The distribution of Is how you receive your food important to your overall experience? (i.e. self-serve or server) is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.679[c]	Retain the null hypothesis.
29	The distribution of Which way you receive food is important to your overall experience? - Self-Serve is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.377[c]	Retain the null hypothesis.
30	The distribution of Which way you receive food is important to your overall experience? - Server is the same across categories of What is your disability?	Independent-Samples Mann-Whitney U Test	.483[c]	Retain the null hypothesis.

a. The significance level is .010.
b. Asymptotic significance is displayed.
c. Exact significance is displayed for this test.

Appendix D. Recruitment Email

Hello,

My name is Anna Bruckbauer, and I am completing a thesis within the Master of Occupational Therapy program at the University of Wisconsin-Milwaukee. I am conducting a research study aimed at exploring sensory accessibility needs for individuals with disabilities. This survey aims to compare sensory accessibility needs of individuals who are deaf/hard of hearing with individuals who have low vision; to help increase full engagement in the restaurant going experience (pre-covid-19 pandemic).

I am emailing to ask if you would be interested in completing this survey either through the online survey or through a phone call. Participation in this study will take between **10-20** minutes, depending on the level of feedback you provide me. I am looking for participants to complete this survey who fit the inclusion requirement below. If you have the chance and are interested, please complete the survey online or contact me to set-up a time to complete the survey by phone; by **October 26th, 2020**

Inclusion requirement:

- Either Deaf/ hard of hearing or Blind/Visually impaired (Not both)
- Does not have any other disabilities that impact their sensory experience.
- Able to read, write, and comprehend English.
- 18-40 years old.

Participation in this research study is completely voluntary and your answers will be anonymous. If you are interested in participating, please click on the link for the survey and additional information here:

https://milwaukee.qualtrics.com/jfe/form/SV_5o1r7ewq5NCVpMF

If you have any questions, please do not hesitate to contact me via email at mccar272@uwm.edu or give me a call at 608-206-5293.

Thank you for your time,

Anna Bruckbauer
M.S. Student, Occupational Therapy
University of Wisconsin-Milwaukee - Occupational Science and Technology
mccar272@uwm.edu | (608)-206-5293

Appendix E. Additional Comments at the end of the Survey

Table 20. Additional Comments Provided at the end of the survey EqTD

Disability	Comment
Hard of hearing	Seating and ability to move around is important because I and others might not be symmetrical and prefer to face the rest of a group a similar way.
Hard of hearing	Overpowering background noise is always my number one problem in restaurants. I find myself not enjoying myself in restaurants I know have really loud music and find myself not going back. I have single sided hearing loss so seating can help mitigate those options such as closed off booths or corner seats. But open concept is a nightmare for me as I get distracted by all the sights and sounds to focus on my own events and friends and family.
Hard of hearing	Having everything written down is important, specials can be on the table. Servers are usually great to communicate with. Loud rooms are hard to understand anyone and so are dark rooms. Dim rooms are okay as long as there is sufficient lighting for your party specifically. The questions about table importance did not allow us to explain that it's important to be able to face everyone, instead of sitting in rows at a rectangular table for example
Hard of hearing	This survey was extremely poorly designed. I hope your results are useful, but I do not think it's very likely they will be. Your questions were often incomprehensibly vague, and when they were not, they were usually massively redundant.
Low vision	No comments added, felt this covered a lot more than most surveys.

Appendix F. Research Proposal

Literature Review

Introduction

As human beings, we fill up our time with occupations and purposeful activities that has meaning and value to every individual ((Hinojosa, Kramer, Royeen, & Luebben, 2003). As cited in AOTA, 2014a). One of the occupations addressed in the Occupational therapy framework is Social Participation (AOTA, 2014b). Through social participation, individuals can connect and create shared physical and emotional experiences. By increasing social participation, the ability to improve quality of life increases (Goh et al., 2019, Mikula et al., 2016; Andonian et al., 2011). When exploring the factors of engagement for social and community participation, the built environment can create barriers for people living with disabilities. Often time people with various sensory, and motor disabilities experience many challenges and obstacles in their daily lives (Østensjø, S., Brogren, E., & K, N., 2003; Scott Richards et al., 1999). With the discussion of accessible and universal design, much of the focus is directed towards individuals who have mobility and easily identifiable disabilities that affect their independence to navigate their built environment. However, there is often little discussion on how the built environment can impact those with sensory disabilities and how the sensory need for each disability is both unique and can have several overlaps. In the United States alone there are over 48 million people who have lost their sense of hearing (National Institute on Deafness and other Communication Disorders [NIDCD], 2015), and over 3 million people who are living with low vision, but not quite legal blindness (National eye institute, 2019). This number of people is expected to rise over

the next 20 to 30 years. This literature review will define populations that experience hearing and vision sensory disabilities that impacts the navigation of their environment. Secondly, the unique built environmental accessibility needs will be explored through building guidelines. Thirdly, the subject of Sensory accessibility needs will be explored as individuals specifically navigate the restaurant environment. Fourthly, various building tools and checklists used to assess both physical and sensory accessibility will be discussed. Finally, an in-depth literature search on survey development, content validity, and data analysis will be explored.

Literature Review

In this section, the Person-Environment-Occupation Model will be introduced to help guide the literature search and review. The person explored will be various sensory populations of deaf, low vision, and Usher syndrome. These will present the clinical presentation of each disability, and how they perceive and view the world around them. Next, occupational therapy students with universal design training will be discussed to understand the role they play. After exploring each population, the various environments will be explored. In each environment, the necessary physical and sensory accessibility needs are discussed for individuals with low vision and deaf to successfully and comfortably access their environment. Following the discussion of the unique needs for each population a term called *Sensory Accessibility* will be explored to help compare the similar needs individuals who are deaf or low vision may share. Once the understanding of accessibility needs for the environment, various public building assessments will be assessed and evaluated to determine if they discuss in a broad enough term to have a full comprehension of an individual's sensory accessibility need.

Finally, the access ratings for building project is discussed explaining how the information collected and gathered will help benefit a comprehensive building accessibility project to help meet the needs for different types of users. After discussing the apps, the different types of validity and focus groups will be discussed to help formulate a process for data collection.

The Person – Environment-Occupation model

The Person-Environment- Occupation (PEO) model (Law et al., 1996) is the guiding framework for this thesis study. The PEO model identifies the relationship between a person, their environment and occupations, and how they can support and enhance the person's ability (Law et al., 1996). This model illustrates how the environment, when modified correctly to be supportive, can enhance an individual's performance (Park, 2011). Using the PEO model, the fit between the person, environment, and occupation is analyzed to evaluate the extent to which the building design enables the person versus disabling the person (Baumann, 2014). This theory makes the important point and shifts the focus form a person with a disability to their surrounding environment and how that plays a role in their engagement in social participation.

Person

Deaf population

One of the populations of individuals that experience daily challenges in life are individuals who are deaf or hard of hearing. About 20% of individuals, or 48 million people, in the United States have reported some sort of hearing loss (National Institute on Deafness and other Communication Disorders [NIDCD], 2015). Hearing loss is

defined as when the average threshold across four speech frequencies (0.5-1-2-4) is greater than 25 decibels hearing levels (NIDCD, 2015).Individuals with a hearing loss are categorized into different thresholds for the various levels of impairments and deficits they may have (Table 1). Individuals with normal hearing will have <20 decibels (db) of hearing loss, and individuals with profound/deafness will have >81db of hearing loss. These thresholds are the medical definition of hearing loss and are also paired with the terms hearing impaired and hearing loss. The values are partially accepted by those who are a part of the Deaf community. Individuals of the Deaf Community often view the term of hearing impaired and disabled as a negative and oppressive label for a population that can do everything but hear. The Deaf community embrace the various levels and abilities of hearing and layer it with language, value, beliefs and culture (Hauan, 2017). They ignore the amount of residual hearing the person may have, and focus on the person's ability to embrace and engulf the values and beliefs. The national deaf center uses the term "deaf" to be an all-inclusive manner as many people may identify as Deaf, deafblind, deafdisabled, hard of hearing, late-deafened, and hearing impaired (NDC, 2017). For the rest of this thesis, the term deaf will be used to include the fluidity of identities within the deaf population. Another population of deaf individuals are deaf children, among whom about 90% are born to hearing parents. With the power of technology today, several pieces of equipment are being made to aid deaf users to navigate the hearing world. These devices can include hearing aids, cochlear implants, and bone anchored hearing aids (NHS, 2018). Due to the uniqueness of various communication styles, the physical environment that will support the optimal participation and experience will vary.

Communication and deaf

Individuals who are deaf can communicate in a variety of ways. There is truly no "one-size-fits-all" nor is there a "typical" deaf person (NDC, 2019). Individuals who are deaf communicate using visual, auditory, and or tactile modes if the user is deafblind. Other uses utilize American Sign Language, cued speech, speech reading also known as lip reading, and gestures (NDC, 2019). Auditory communication can also rely on residual hearing and spoken English received through the ear often times supported with hearing aids and cochlear implants to help interpret sound (NDC, 2019).

Vision impairment population:

Another population are individuals who experience low vision. According to the National Eye Institute (2010) about 3 million people experience low vision in the United States. It is projected the number will continue to rise to 5 million in 2030, and 9 million in 2050 (National Eye institute, 2019). Low vision can be mean that one's "visual acuity is 20/70 or poorer in the better-seeing eye and cannot be corrected or improved with regular eyeglasses" (American Foundation for the Blind [AFB], 2019). An individual who experiences 20/70 vision means that, when a person is 20 feet away from an eye chart they will see what a person with unimpaired or 20/20 vision can see from 70 feet away (AFB, 2019) [Table 2]. Individuals with low vision can be diagnosed at a doctor's office during an eye exam. There are some discrepancies in what defines low vision. On a functional basis, low vision is an uncorrectable vision loss that interferes with daily activities. Low vision can vary from "legal blindness", as individuals with legal blindness can benefit from vocational training, rehabilitation, disability benefits, and low vision devices. Legal blindness is defined as a visual acuity of 20/200 or less in the better-

seeing eye with best conventional correction. Legal blindness can also describe a visual filed of 20 degrees or less also known as tunnel vision in the better seeing eye (AFB, 2019). When an individual is diagnosed with low vision they can be categorized as visually impaired. Different levels of visual impairment exist. The main test used to test vision impairment is the Snellen visual acuity. If a person scores a 20/70 to a 20/160 they have a moderate visual impairment. If a person scores a 20/200 to 20/400 or a visual field of 20 degrees or less, they are classified as a severe visual impairment. Finally, a person with 20/500 to 20/1000 or a visual field of 10 degrees or less is considered profound visual impairment. The issue with these definitions are they do not describe functionality (AFB, 2019). Individuals with a visual impairment may be able to perceive the difference between light and dark environments. About 15% of individuals who have eye disorders are totally blind.

Usher Syndrome:

Usher syndrome is a condition that affects and individuals hearing, and vision and it worsens over time. Usher syndrome is the result of several different gene mutations. The person's hearing is a sensorineural hearing loss, which means it is affected by abnormalities in the inner ear. Additionally, a person experiences a loss of vision from a disease called retinitis Pigmentosa, that affects the layer of light-sensitive tissue at the back of the eye (Genetic home reference (GHR), 2019). There are three types of Usher syndrome, they are categorized based on severity of hearing loss, the presence or absence of balance problems, and the age at which symptoms appear (GHR, 2019).The most common forms of Usher syndrome in most countries is Type 1

and Type 2. Type 3 Usher syndrome represents about 2 of all Usher syndromes cases (GHR, 2019). Refer to Table 3 for a summary and details about Usher syndrome.

Aging Population:

By the year of 2030, the U.S. population will hit a major turning point of 77.0million people over the age of 65 years old. This means 1 in 5 residents in the United States will be within retirement age (US Census, 2018). As the population ages, more and more individuals are wanting to live as independently as possible. The aging population in the Untied States is important to discuss within this research as age related hearing and vision loss can affect the independence of individuals. Individuals can start to lose their hearing around the age of 65-74 years old, or known as Presbycusis (NIDCD, 2018). By the age of 75 years, nearly half have difficulty hearing. Age related hearing loss can affect both ears equally, and will gradually be affected. Many people who have age related hearing loss may not be aware of the severity of their situation. As people age their vision start to be affected through a variety of disorder. Age related vision loss is called Presbyopia, and can start to affect individuals in the mid-40s, starting with close distances. Vision is one of the main problems individuals may face as they grow older (American Optometric Association (AOA), 2020). As older individuals age, they may need various adaptations to help independently navigate their environment including needing more light, doing close work, changes in color perception, problems with glare, and reduced tear production (AOA, 2020). There are a variety of ways people can adapt their vision and hearing as they age include hearing aids and eye glasses. These corrections can help them maintain independence and functionality while performing day to day tasks.

Environments:

There are several types of environment, the physical, social, and psychological environment (Brandt & Pope, 1997). The physical environment can be broken into the natural and the built environment. Even though all the environments can have an effect, the built environment will be what is focused on for this thesis (Brandt & Pope, 1997). Foley and colleagues (2014) studied young individuals with down syndrome and the effect of the environment on their social participation and social roles. It was found the physical environment had more of an affect than the social environment and physical could be easily modified (Foley et al., 2014).

Environment and the deaf population:

Currently, there are few research studies that relate to the sensory accessibility needs of individuals who are deaf and hard of hearing. However, a key and important working draft from Dr. Hansel Bauman, an architect and professor at Gallaudet University offers a 150-item guideline to help architects design spaces that provide the best sensory experience for individuals who are deaf and hard of hearing (Personal communication, Dr. Hansel Bauman, 2019).

Bauman's draft is part of a three-year long DeafSpace design guidelines (DSDG). The DSDG is a living document and is continuously being expanded and built upon. DeafSpace guidelines looks at basic room sizes, configurations, adjacencies, and strategies for utilizing light, color, materials, and acoustics (Bauman, 2010). Due to the unique needs for the deaf and hard of hearing population, DeafSpace created a pattern book of ideas that addressed five major points of a cross between the deaf experiences

and the built environment; space and proximity, sensory reach, mobility and proximity, light and color, and acoustic and electromagnetic interference.

Space and Proximity:

"Proximity looks at how far apart the individual engaged in conversations stand depending on the degree of intimacy between them (Bauman, 2010)". Due to the communication needs of a signed language and needing direct eye contact to communicate, this is an important factor to focus on. Spatial implication is also important as a clear visual window to hold a conversation must also be recognized (Bauman, 2010). Bauman discusses the different types of space needed depending on the situation and the number of people surrounding the main communicator. The settings include private space, within public spaces, formal gathering space, presentation space, and collective spaces. Private spaces include providing some degrees of enclosure to allow the main communicator to have their visual field facing the open area of the room. Formal gathering spaces encourages round and horseshoe shaped arrangements versus square and rectangles. This ensures full visual access to everyone in the discussion. Collective spaces include various of places include having visual connections between different floors, and flexible and casual seating arrangements.

Sensory Reach:

Sensory reach is defined by the [person's] interrelated systems of perceptions that are used to understand and orient in space (Bauman, 2010)". Bauman explains since many people believe the person's sensory reach is limited to the visual, however it expands to vibratory, tactile, and shared or social cues to maintain the 360-degree

sensory reach. The goal of DeafSpace is to extend the sensory reach through visual, vibratory and tactile information. Some modifications look at reflection, the transparency of walls and doors and vibration zones within the room. Sensory reach also considers some communication systems such as visual annunciation systems, shaking devices, and strobe lights.

Mobility and proximity:

"Signers holding conversation while walking run into risk of tripping, colliding with others, colliding with physical obstructions or drifting into traffic" (Bauman, 2010). The goal is to look at proximity and mobility is pathways, ramps and stairs, thresholds, and rhythm and vertical cues. These include corridors, swinging doors, soft intersections, shoulder zones, ramps and stairs having good eye visuals, various textures for thresholds, and various factors for landscapes.

Light and Color:

By assessing various light and colors used in a visual field, an evaluator might find ways to help with reducing eye strain and increasing focus and attention. The first element is color and texture. The color of walls and texture should be basic and help contrast any shade of human skin. Recommended colors are blue and green walls. The solar control day light and shade should decrease glare and backlighting. By having the most amount of natural light helps to increase spatial awareness. Finally, electric light should be used to help enhance visual communication, and highlight gathering places and reinforce a presentation (Bauman, 2010).

Acoustic:

The goal of acoustic should help to minimize the background noise for individuals using cochlear implants and hearing aids. Reverberation of sound waves is one of the main sources of distracting background noises and should be avoided (Bauman, 2010). Electromagnetic (EM) fields, can also interfere with hearing aids. These are used daily to help transmit radio, television, and cellular telephone signals. More research needs to be completed in this section, however mechanical rooms and electrical equipment should be located away from gathering places (Bauman, 2010).

Environment and Low vision:

Looking at a different disability population, individuals with low vision are often left out of the discussion as well. Both the Architectural Barriers Act of 1968 (ABA) and The Americans with Disabilities Act of 1990 (ADA) has created guidelines to help accommodate people of various disabilities to access federal facilities. Some of the guidelines help accommodate some needs for individuals who are blind, however the standards often fall short of addressing the needs of people with low vision (national institute of building sciences, 2015). Stuart Knoop, (2013), discusses in his *Architecture for Low Vision* how ADA and ABA (Architectural Barriers Act), does not have high enough standards for individuals with low vision to navigate their built environment. He first assesses Light, Glare, and contrast of a building. Individuals with low vision require a lot of light to help define and orient themselves. Knoop brings up the concern of the glare produced by electrical lighting and natural outdoor lighting. The right amount of lighting is still being researched Further discussion leads to the landscaping of the built environment. Some considerations to keep in mind include avoiding glaringly reflective

surfaces, and ensuring curbs, steps, and changes in the walking surface are visible to help avoid tripping. Knoop argues not enough consideration is put into designing for individuals with low vision, as more emphasis is placed on individuals who use wheelchairs, blind, and are hearing impaired (Knoop, 2013).

The National Institute of Building Sciences has published the 6th design guideline for the visual environment in 2015. These guidelines serve as a roadmap for future research and guide regulatory and design communities. The guidelines focus on access to the exterior spaces, interior space, finishing material, fixed and movable furniture, and the lighting design both used in the daylight and electrical lighting.

Comparing Sensory Accessibility needs

Finally, the literature was searched to find any guidelines would compare the unique sensory needs each population would have. An extensive literature search returned only, one document, Rhyl's work, which was published in 2010. The term *Sensory Accessibility* was introduced by Camilla Ryhl, in the *journal of Architectural Research* (Ryhl, 2010). Sensory accessibility refers to specific design considerations that enable the choice to stay, participate and experience the environment. While accessibility allows physical access to a space (See Tables 4 and 5). It was concluded acoustics was a primary barrier to sensory accessibility. Acoustics could be accessed through all including people who were deaf. They could access through vibrations through spatial surfaces like walls and floors (Rhyl, 2010). Additional research should is needed to explore which pieces help support the experiences of sensory accessibility.

Occupation:

Participation:

Social participation is one of the occupations humans wish to engage in. Participation can be defined as self-care, domestic life, interpersonal interactions and relationships, community, and social and civic life (Carey, 2012) The concept of being and belonging are all thing that people must do (Hitch, 2014). Many people with disabilities aim to achieve a sense of 'being', which can be described as living, existing, and enjoyment of the inner life (Wilcock, 1999). However, to fully participate in society one must feel they 'belong' (Wilcock, 1999). Belonging is strongly identified as people's interpersonal relationships, which can reflect social interactions, mutual support, friendship, and a sense of inclusion and affirmations from others (Hitch, 2014). Without the ability to engage in social participation, the likelihood of social isolation increases. Several research teams have documented the health benefits of engaging in social and community participation, among which include decreasing drugs and alcohol abuse, decreasing mortality rate, and increasing the support individuals have during challenging times (Berkman & Syme, 1979; Brummett et al., 2001; Ruberman et al., 1984). Overall, increasing social participation can be a therapeutic tool and can increase a person's overall quality of life.

Restaurant Environment:

One of the places populations with and without disabilities engage socially is at a restaurant. What is a restaurant? It can be defined as "A place you can buy and eat a meal" (Srivastava, 2015) or "A business establishment where meals or refreshment… usually inside a building where you go to eat food. Which, most of the time you pay for"

(Srivastava, 2015). The why of dining out can be variable depending on situations and the individuals. Studies have shown how much and what price individuals are willing to spend while dining out, but few studies have explored they why of dining out. Andersson, (2004), explores the reasons people may go to a restaurant. For the exploratory study, Andersson discusses the categories Scitovsky (1986) has suggested on the way in which dining out has served human needs. The first is physiological needs addresses the biological needs and desire. The second is social and our sense of belonging to groups that we wish to belong to. Finally, the third is intellectual needs; and, this can include sources of interest, entertainment and excitement. This also includes enjoyable work, music, literature, watching sport and such. The physiological need is satisfied through eating while dining out. The social needs can be satisfied through dining out with friends or going to a restaurant highly approved by our group. Finally, intellectual needs can be stimulated through delicious dishes, or entertaining evenings. the potential why's behind dining out. The results of this study concluded the purposes of restaurants varied depending on the meal. During lunch, customers wanted their physiological need to be satisfied. However, when dining at evening time there was a strong connection to meeting social needs.

Restaurants and people with Disabilities:

Previous research has explored how accessibility information impacts consumer decision-making for people with disabilities (Mendonca & Smith, 2009). Previous research has investigated the factors that individuals such as care givers or person with disabilities use in selecting a restaurant that will meet their accessibility needs (Baumann, 2014; Park, 2011). In a survey, participants were asked to select 5-10

features they valued in a restaurant when choosing a place to dine out. Respondents answered quality, accessibility, location/ proximity dietary need, atmosphere, parking, preferences and other features (Baumann, 2014). Accessibility had more participants who had disabilities rate it as important versus those who did not have a disability. As previously mentioned, the ADA often lacks addressing accessibility needs of various disabilities including attitudes and knowledge of service personnel, noise level, sense of safety, level of crowding, dietary restrictions, and even menus with Braille or Large print (Baumann, 2014). These accessibility barriers prevent individuals from being able to access the restaurant environment. Baumann (2014), notes that people with disabilities eat at restaurants half as frequently as the average population. This disparity is important to address as restaurants can serve as an important place for physiological and social needs to be met.

Public Building Assessments:

Tools and Checklists

A variety of tools and checklists have been developed to help assess accessibility of a public building. Using the recommended guidelines from Sensory disability accessibility needs, and looking at the various architectural features, each tool assesses the built environment in different ways. Below is a table that compares the various checklists and follow the development and instruction below. For this study, I focus on sensory aspects of design that both Deaf, Hard of hearing, and individuals with low vision share. In a previous section, individuals with low vision or hard of hearing rely heavily on hearing and vision to way find and communication. Similarly, individuals who

have low vision or are Deaf often rely on vision. For this reason, I will specifically look at how each assessment looks at Visual cues, and sound level.

Lighting: Lighting indicates any type of assessment of lighting. Whether that is adequate lighting for wayfinding, or lipreading. The exact measurement is not indicated in most of the studies. Further research should focus on simple terms of dim lighting, day light, Led lights, and brightness in general. Many guidelines suggest a soft, diffused light.

Acoustics: Acoustics is described as reverberation or decibel levels. It can also be described on a functional level on whether two people could complete a conversation without straining or exerting extra effort to hear. There are different standards for sound level and for the purpose of this study, I will focus on sound levels on a functional level. Can a person hold a verbal conversation without straining to hear.

Openness: Openness indicates spatial awareness. Does the tool look at space proximity? Is there enough space to navigate safely? Can the person have a visual cue to how large or small a room is? Can a person see and “read” the activities of their surroundings? Is there enough space for adequate communication?

Services: Regarding services, there are various terms that can be used. For the function of this comparison, services will be defined as not the built environment, but rather the social environment. Does someone at a reception desk greet you? Are captioning devices available? However, services does not mean, service as someone doing the work for you. For example, you sit down as a restaurant and a server comes to take your order.

Color and Contrast: These terms are important to note as a separate comparison. Color and contrast are key to visual wayfinding and communication. Color and contrast can include glare, shadow patterns, and backlighting. Does the color of objects help to contrast skin tone, and help to visual facilitate wayfinding?

Community Health and Environmental Checklist (CHEC)

Another assessment tool created to help assess building accessibility is the Community Health and Environment Checklist (CHEC) (Washington University in St. Louis, 2019). Currently the CHEC- Mobility is the only published assessment that has had reliability tested. However CHEC – Vision and CHEC-Hearing are under further testing and investigation (Personal communication, Jessica Dashner). The main goal of CHEC-M is to question whether a person with a mobility limitation can get into the site, do what he or she needs to do, and then get out without much difficulty. CHEC-M looks at three main areas on the site which include entrance, using the building, and restrooms for usability by people with mobility limitations. The entrance includes parking, ramps, and entrance doors. The building includes interior doors, hallways/space, seating arrangement, and elevators. A systematic review looking at assessment tools specifically assessing the accessibility of fitness and recreational sports centers (Calder & Mulligan, 2014). One of the tools used that match the criterial of their systematic review was CHEC-M. At the time of the review, CHEC-M had not been used in any research studies. Additionally, the developers do not provide details on how scoring is used (Calder & Mulligan, 2014). To look at CHEC- Hard of Hearing (CHEC-HOH), there are five sections including building sounds, Communication, Employee Assistance, Room Arrangement, and Amenities (Personal Communications,

Jessica Dashner, 2019). The assessment includes specific requirements in each section. For each requirement it assess both services and building design related to the section. For building sound and building design the floor space is looked at for sound-absorbing material or carpeting where the conversations are most likely to occur. Room arrangement, assesses seating near a wall, or close to main speaker, seating allow individuals to be in close proximity, and alternative rooms are available. Amenities and building design asses that one wall is white or another light color. Although the CHEC-HOH adequately assesses the level of sound in the environment which may be important for a hard of hearing individual. It does not discuss specific building criteria to make the interaction between person and built environment easier. For example, it does not address adequate spacing, windows on doors for visual access, and reducing glare on flat surfaces. The CHEC-HOH is great for understanding accessibility services a business may provide. This service aspect is something ARB and Deaf Space both lack. However, services are not the focus of ARB and Deaf Space.

Measure of accessibility to urban infrastructures for adults with physical disabilities (MAUAP):

The Measure of accessibility to urban infrastructures for adults with physical disabilities (MAUAP) attempts to analyze exterior and interior access to the built environment for people with physical disabilities including motor, visual, and hearing (Gamache, 2016). This 133 objective checklist was developed based off scientific articles published up to 2010 (Gamache, 2016).The MAUAP was developed through literature search, and then content validity with two panels of experts. The first panel consisted of the research team who had a variety of experiences related to all persons

with physical disabilities. The second panel of experts focused on individuals in the community, with roles ranging from people who lived with the physical disability, professionals of urban planning, and health clinicians. The number of individuals with a disability were 3 deaf and hearing-impaired panelists, and person who was living with a visual and hearing impairment (Gamache,2016). The results looked at Seven different infrastructures (see Table 7). This comprehensive checklist provides three angles to assess accessibility of a built environment. The first angle is the characteristics left unchecked, which indicate the environmental problem. The second angle is the percentage of boxes checked with allows and objective measure for how accessible an infrastructure might be, and finally the evaluator is able to add comments

Ability App:

The Ability app was founded in 2014 by Alex Knoll, and aims to find accessible features in public places. The ability app is not ready for public views and is undergoing beta testing. The ability app covers individuals with vision impairments, deaf or hard of hearing, mobility filter, and cognitive filter. Cognitive filters include sound sensitivities, light sensitivities, visual noise level, and so much more. The Vision impairments includes background noise level, visual noise level and many more features. Finally, the hearing filter looks at visual noise level, background noise level, and many other service features (ability app, 2019).

Sound print:

Sound print is an app-based service where users can measure sound levels through their smart phone devices. A study published by the creator of Sound print suggests noise levels in many locations can be endangering to the health of employees

and patrons, reported sound levels were generally underestimated, and the average sound level sin restaurants and bars were correlated by neighborhood and type of cuisine (Scott, 2018).

Comparison of Checklists and Tools:

When exploring and comparing the tools and checklists [table 6], there was one app I wanted to point out immediately for Deaf and Hard of Hearing individuals. Sound print only addresses the acoustic of various places. However, similar end results as Access rating for buildings project. SoundPrint is also like the CHEC-HOH, and CHEC-LV in providing their data to consumer through the use of an interactive map. From the accessibility standpoint, almost all the apps were able to address the important of lighting to aid in communication and wayfinding, except for sound print. Acoustics was addressed via decibel levels except for CHEC-LV. This shows hearing is not often considered when assessing sensory accessibility needs, however, hearing can play an important factor. One interesting and important feature to note is the limited focus on service. One thing CHEC-HOH and MAUAP emphasizes is the ability for a location to provide services. The only tool that assesses all five criteria is the MAUAP. The second best tool according to this checklist is Access ratings for building project that looks at everything extensively, except for services. Finally CHEC-HOH is a great tool for a screening an environment to give a minimal accessibility rating.

<u>Access Rating for Building Project</u>

Development of AccessTools/Place

Currently there are some guidelines in place set by the American with Disabilities Acts of 1990 (Williams et al., 2015). However, these guidelines are the minimum guidelines and can often be time consuming to read and difficult to understand. Also, for individuals to assess accessibility, people must visit the building in advance to scope it out. To fix this issue AccessTools was created as part of the Access Ratings for Building (AR-B) project (Williams et al., 2015). Edyburn et al., (2015) developed an app that not only provided summary data but also allow of custom searches. The app was developed using four steps, conceptualization, design, implementation, and testing/revision. In order to implement the conceptualization, they created the access Ratings for Building (AR-B) system. This system has two parts, mobile and web-based capabilities to help provide personalized accessibility information about public buildings for people with disabilities, their families and friends (Edyburn et al, 2015). Next it included two components, one for trained raters to evaluate and investigate the building and the other for consumers to rate and share experiences. The goal for the system was to target three main user populations including the general public including people with disabilities, trained raters, and finally building owners, administrators and policy makers. The established motivation to use the app included making an informed choice between location looking up specific locations to plan around barriers, and finally provide feedback on building accessibility (Edyburn et al., 2015). In order to make AccessPlace user friendly and accessible they chose to use an Android and iOs native apps with a website for traditional computers. The program to develop the app was the Application Programing Interface that can handle storing and retrieving information from a database and implements basic logic such as finding and ranking results of searches.

To make the usability of the app accessible and functional flow chart design was used that showed the relationships between contents, as well as having check boxes that allowed multiple answers to be selected at once. To implement the app, the team moved through the steps to allow the app to be displayed through the Apple and google Developer program. At the time the preceding was published, AccessPlace was in it's testing phases (Edyburn et al., 2015).

AccessTools is an app that allows trained raters to objectively assess features of building for their accessibility for each population (Smith, Schwartz & Ahmed, 2014). AccessTool evaluates 11 different building features for common accessibility issues (Smith, Schwartz, & Ahmed, 2014). These features include, doorways, elevators, floor & ground surfaces, handrails, parking, ramps, restaurant specific features, restrooms, routes, signs, stairways, and table and chairs. In order to find trained raters to utilize AccessTools, they must watch web tutorials and pass a test on the components of evaluating (Smith, Schwartz, & Ahmed, 2014). Smith, Schwartz, & Ahmed, focused on the user interface of the development of AR-B. The results of piloting the app including several accessibility design features including large san serif fonts, custom buttons with large surface areas, and a blue & purple color palate. The glitches frustrated several individuals but building owners and individuals with disabilities reported the app showed appropriate content that would be helpful for day-to-day lives (Smith, Schwartz, & Ahmed, 2014).

Access Light:

One of the features Access Ratings for Buildings project tried to analyze was the sound and light quality for people with disabilities (Johnson et al., 2015). Johnson et al.,

(2015), explains individuals with impaired vision and sound can be affected by the quality of light and sound in the environment. Poor quality of these two factors can lead to “decrease in productivity”, which can result to an overall decrease in quality of life. This study looked at using smartphone sensors to measure the suitability of an environment. Light meters were often too expensive and much more accurate than the smartphone hardware and software. In order to accurately measure the light levels of an environment additional equipment would need to be purchased (Johnson et al., 2015). One issue with using smartphones is light intensity was measured for photography, thus measuring illuminance and luminance. Luminance measure the brightness values of the reflected lights from an object (Negar et al., 2014). The study found *Access Light* compared to a light meter that the light meter calculates the Lux values for any environment. Lux is the unit of illuminance and luminous emittance (Johnson et al., 2015). Light meters are also able to measure the incident, the light than an object is exposed to an it comes from the source of the light, and reflected light levels. Using the algorithm professional light meters uses the app, *Access Light*, uses the hardware and software’s on the iOS devices to copy the professional light meters (Johnson et al., 2015). *Access Light* uses the ISO, shutter speed, and aperture on the iOS’s hardware and software. ISO speed controls the sensors sensitivity to the light. The aperture is the camera lens that controls the amount of light, and the shutter speed controls the time limit of the aperture to remain open. Compared the professional light meter and Access Light, it can provide similar lux values. It is also able to provide accessibility.

Access Sound:

In addition, to light, smartphones have been known to have sound meters in their hardware. These devices are dependable and can filter noise as well as provide accurate sound levels without too much external accessories. The unit's sounds are measured in are decibels. Johnson et al., (2015), created *Access Sound*, an app that uses the front microphone to collect the sound data from the environment. When compared with professional light meter, *Access Sound* was able to not only provide sound level, but the accessibility level as well. The App was able to identify if noise levels were potentially hazardous and notify users, which could be helpful for people with disabilities who are not able to properly estimate the sound level in a room.

However, the question raised is if the questions being asked are appropriately representing all disabilities. Currently the flow of using AccessTools is adjusted based off the user's answers (Williams et al., 2015). A preliminary structured interview/discussion between two experts in the fields discovered there were several categories of areas that needed to be expanded on, or additional information needed to be included (personal communication, McCartney & Franklin, 2018).

ARB Disability profiles:

When users create a profile on AccessPlace, they answer a short series of questions to determine their personalized accessibility information (PAI) which asses their ability or inability to perform certain functional tasks. The information is then compiled together and creates the functional impairment profiles (Spaeth et al., 2015). Users will which is tailored to the individual's functional impairments (Spaeth et al., 2015). The information provided is automatically numerically coded to represent their unique profile. When a user finds a location, they want to access the accessibility

ratings, the vector of the location and the user's vectors will automatically compare the all of the reviews. Reviews that have similar vectors to their profile will be displayed at the top. However, if an individual that does not have a disability choose to use AccessPlace, such as a caregiver or a friend, they need to follow a standardized profile. Previous research has identified 14 different disabilities. The person living without a disability can then choose a standardized profile. ARB extended (comprehensive) profiles. Expert standardized profile will be created content validity studies, using experts or persons living with the disability.

Relevancy to Access Ratings for building project:

A previous exploratory study identified a lack content for individuals who are deaf. The biggest area the taxonomy forgot to address was heightened visual needs. Through continued research it was discovered individuals with low vision share very similar accessibility needs as individuals who are deaf. The accessibility needs of two separate sensory disabilities is not discussed in depth in literature. This research will benefit the taxonomy of AccessTools main database that will be used to create the survey participants will complete. This will increase the awareness of the ARB project to people with disabilities and will help increase the support of our project. Second, participants will complete a modified content validity study to determine if questions are relevant and clear for people with their disability.

Validity:

Validity looks at how meaningful the research components are. Due to assessing the effectiveness of the accessibility tools to demonstrate a fair representation of users with a disability the validity of the tool must be assessed. For quantitative studies there

are three different types of validity: content, construct, and criterion validity (Heale & Twycross, 2015). There are six types of validity that should be considered: statistical conclusion validity, internal validity, construct validity and external validity, criterion, and face validity (Drost, 2011 &). Each type of validity may have threats as well, which makes it not accepted by others. Each type of validity and potential threats are listed as following.

Construct Validity

Construct validity explores if the research instrument or tool measures the intended construct. It looks as if you can draw inferences about test scores related to concepts being studied (Heale & Twycross, 2015). Construct validity is shown through homogeneity meaning the instrument is measuring one construct. Convergence, tool being used measures similar concept to that of other instruments. Finally, theory evidence, measure when the behavior is similar to theoretical propositions of the construct measured in the instrument (Heale & Twycross, 2015). Construct validity can be divided into two categories which are described as *Translation* and *Face Validity*.

Translation Validity:

The translation validity looks at the degree to which constructs are accurate “translated” into the “operationalization” (Drost, 2011). This is done through subjective judgment and examining the content domain, also known as content validity.

Face validity

Face validity is considered the subjective judgment of a construct. Due to the subjective nature of the validity, it is seen as a weak form of construct validity (Drost, 2011).

Criterion Validity

Criterion validity looks to see if it is like any other instrument that measure the same variable. It is measured through convergent validity which shows the instrument is highly correlated with instruments measuring the same variable (Heale & Twycross, 2015), Divergent validity, which demonstrates the instrument is poorly correlated to other instruments that measure different variables, and finally predictive validity measures the instrument will have high correlations with future criterions (Heale & Twycross).

Statistical conclusion validity

Statistical conclusion validity is the type of validity that looks to see if there is a relationship between two variables being tested (Drost, 2011). Some major threats could be low statistical power, violation of assumption, reliability of measure, and random heterogeneity of respondents (Drost, 2011).

Convergent and Discriminant Validity:

Convergent and Discriminant Validity are subsections of Construct Validity. Convergent validity looks at how closely related the new measurement is to other variables and other measures of the same construct (Krabbe, 2017). If measures are supposed to be related, they should reflect being related. Discriminant Validity discusses measures that should not be related, are not related (Trochim, 2006). Some threats to convergent and discriminant validity include the common method variance.

Common Method variance happens when the --- is caused by the instrument, rather than what the instrument is attempting to uncover (Drost, 2011).

Internal and External Validity

The internal validity focuses on the research itself. Looking to see if the completion of the research itself was valid. Often threats to this type of validity include instrument testing, selection, diffusion of treatment, bias. External validity looks to see if there is a casual relationship from two different construct. It validates the study or relationship implies generalizing to other persons, settings, and time.

Content Validity

Content Validity is a quantitative or qualitative method. However, it is mainly qualitative (Drost, 2011). Due to the nature of assessing the questions it was appropriate for this study. Content validity looks at whether the instrument adequately covers all the content that it should with respect to the variable (Heale & Twycross, 2015). Subset of content validity is *Face validity*, This is where experts are asked their opinion about whether and instrument measure the concept intended (Heale & Twycross, 2015).There are several ways to perform the qualitative measure of content validity. O'Brien et al. (2013), used 2 interviewers to ask it's 22 participants their questions. O'Brien et al. used the Feinstein theory of sensibility. The Feinstein validity included face and content validity (O'Brien et al., 2013). "Content validity refers to the suitability in the selection and aggregation of components, including omission of important items, inclusion of unsuitable items suitability of response options, and quality of the data that are collected" (O'Brien et al., 2013). Questions asked for coding were,

“how suitable are the items?, What were the important items included across all 4 dimension? What were the unsuitable items that could be excluded? What items should be modified? Order of the items. Items to add to the questionnaire?” (O’Brien et al, 2013). An interview guide was included in the appendix (O’Brien et al, 2013).

Establishing content validity:

Content validity is usually established in a three-step process. In A quantitative study design, content validity is determined using a content validity scale. In qualitative research, content validity is determined through a content validity ratio (Zamandzadeh et al., 2015). When content validity is determined, panel members are asked to rate instrument items in terms of clarity and relevancy using a 4- point ordinal scale (Zamandzadeh et al., 2015). Terminology includes (1[not relevant], 2 [somewhat relevant], 3[quite relevant], 4[highly relevant]) (Zamandzadeh et al., 2015). Related to clarity terminology includes (1[not clear], 2 [item need some revision], 3[clear but need minor revision], 4[very clear]). To obtain content validity index for each item, (I-CVIs), the number of those that judge the item as relevant or clear (3 or 4), was divided by the number of experts for relevancy (Zamandzadeh et al., 2015). There are two ways to calculate the agreement of a relevancy or clarity of a question. The first is universal agreement which uses a dichotomous scale. Values 3 and 4 are combined and values 2 and 1 are combined. They are either relevant or not relevant. The number of questions rated as relevant by all judges is divided by the total number of items. The second is averages at the item-level. Sum of I-CVIs is divided by the total number of items. Both types of analysis will provide different data and it is imperative to report which method you used for calculation (Zamandzadeh et al., 2015). A good CVI is considered 80

percent agreement or higher for new instruments (Clemson, 1999; Zamandzadeh et al., 2015)..If CVI is higher than 79%, the item is appropriate, if the item is between 70-79% the item should be revised, and finally if it is less than 70% the item needs to be eliminated (Zamandzadeh et al., 2015).

Data Analysis:

Pearson Chi- Square Test

The Pearson Chi-Sqare test is used for nominal or ordinal sale data (Portney & Watkins, 2015). Portney and Watkins suggest the use for surveys and analyzing the number frequencie of responses. In this type of analysis the null hypothesis states there is no difference exists between the actual proportions measured in a sample and this theoretical distribution. If observed data is significantly different we can reject the null hypothesis (Portney & Watkins, 2015). In the Pearson chi-squre there are 2 requirements. 1: frequencies represent individuals counts and 2: categories are mutually exclusive. Therefore meaning each individual will be counted for, and cannot be repeated. Finally the value of cells should be 5 or more in at least 80% of the cells, and no cell should have an expected less than one (McHugh, 2013). We calculate the Chi-Squre by using the equation $X^2 = \sum \frac{(O-E)^2}{E}$. The O represents Observed frequency and E represents expected frequency. Calculating the sum of each row and the sum of each column. The sums are called “marginals”. The equation to find expected frequency equals $\mathrm{E}=\mathrm{M_R}\times\mathrm{M_C}/n$ (McHugh, 2013). $\mathrm{M_R}$ represents the row marginal for that cell, $\mathrm{M_C}$ represents the column marginal for that cell, and *n* =represents the total sample size.

Fisher Exact Test

The second Chi-square test is the Fisher's exact test (McHugh, 2013). This si used when you have 2 nominal variables This can be used when results seem promising but the sample size seems small. The most common size table is a 2x2, however 2x3 table can be used (McDonald, 2014). This test is recommended to be used when the sample size is smaller than 1,000. The null hypothesis states one variable is independent of the second variable. The fisher tests looks at the probability of a value of a test statistics. You will test the probability of getting the observed data. When observing a table with more than two rows or columns, you do a fisher exact test for each pair, then you use a Bonferroni correction for multiple tests. When analyzing a 2x3 table, Freeman and Halton (1951) proposed a testing method that recognizes the 18 arrays.

Research questions:

1: How do deaf individuals perceive importance of specific sensory accessibility features compare to individuals with low vision in the restaurant environment?

Hypothesis 1: Lighting, openness, and color/contrast sensory accessibility needs will not have a statistically significant difference between individuals of deaf and low vision.

Hypothesis 2: Acoustics and person based services sensory accessibility needs will have a statistically significant difference between deaf and low vision individuals.

Importance to the field of Occupational Therapy

Social participation is an important occupation individuals with and without disabilities engage in. Even though there is a small percentage of the entire population is part of the deaf or low vision population, there is a wider aging adults. By

understanding some ways the built environment is perceived in via sensory accessibility, we can better address Universal Design. Additionally, this research can help contribute to better the Access Ratings for Building project and help identify if there are missing features trained raters need to assess. With this knowledge, trained raters will be able to approach building accessibility more holistically and help to foster an environment that encourages and support individuals to stay rather than engage in the fast-paced grab and go society.

Proposed Methodology:

Proposed Participants:

To try and capture a wider deaf and low vision population around the country, individuals will be recruited from word of mouth, social media, and recommendations through email. Most participants will come from the Milwaukee area. Individuals will be recruited from the University of Wisconsin Milwaukee Accessibility resource center, Independence First, Vision Forward, Milwaukee Area Deaf Associations and other organizations serving people with disabilities. Participants will then complete an eligibility survey to determine if they are able to complete the next survey related to sensory accessibility. Inclusion criteria include: 18-40 years old, must be either deaf, or have low vision, must be able to read and understand English and or American sign language. The term deaf in this study will describe a wide range of abilities to hear and communication styles the individual may use, Exclusion criteria include: participants have another disability that creates barriers to accessing the restaurant environment, including but not limited to mobility, cognitive, and the co-current disability of deaf and low vision or low vision and deaf. Ideal participant from each group would be 10 participants from each population with a total of 20 participants completing the survey.

Survey development participants: For the development of both the descriptive and modified content validity survey, a total of 4 experts will be used. One expert will be an expert in deaf studies, another expert in low vision, a third expert in occupational therapy, and a final expert in universal design.

Instruments:

Eligibility survey: this brief survey will be developed to help determine if an individual is eligible to participate in the research. The biggest exclusion criteria is the co-current disabilities that may affect a person's sensory accessibility needs. Additionally, age is another factor that needs to be determined. The ages of participants should stay within 18-40 years old.

Descriptive survey: The descriptive portion of the survey will identify the degree of hearing loss, and vision impairment. It will also identify age, gender and preferred communication. There may be a difference of individuals who are deaf and use sign language as a main communication style, and individuals who are deaf and use verbal communication.

Survey: To compare this, a modified context validity index scale will be used. Content validity scale is appropriate for this measure as a content validity study can provide information on the representativeness and clarity of each item. One limitation is content validity scales does not address content that may have been omitted from the measures. A comment section will be added throughout the survey to allow participants to provide subjective data or better clarity.

<u>Survey Development:</u>

The survey will be developed through an online based survey tool, Qualtrics. The initial portion of the survey participants complete will have basic demographic information to identify age, gender, type of disability, degree of disability, and how often they frequent restaurants. This will give a general understanding if the participants attend restaurants often, or if attending restaurants may be limited to a variety of reasons. The second portion will assess the sensory accessibility needs of each participant.

Through extensive research, five areas have been identified as similar sensory accessibility needs in order to stay in an environment: Openness, Acoustics, Lighting, Color/Contrast, and Person-based services. In order to develop the survey for participants to take, the taxonomy of Access Tools will be raked through and questions will be pulled and assigned to various sensory accessibility features stated above. Once questions in the taxonomy of Access Tools are assessed, they will be coded as each sensory accessibility need feature, Openness, Acoustics, Lighting, color/contrast, and person-based Services. This coding will help with analysis later.

Once the taxonomy of Access Tools is looked through, it will be analyzed a second time and additional criteria will be added or current questions will be modified to fit the researchers goals. Coding will be provided to determine if the item is a new item, or modified item in the categories of Openness, acoustics, lighting, color/ contrast, and person-based services.

Once the survey is developed it will be sent to the 4 experts to perform a content validity test to determine if the questions are both relevant and clear. Experts will examine the survey twice. The first time through experts will determine the relevancy of each question following the Content Validity Index Scale and rating each question as:

relevant (4), relevant but needs minor revision (3), item needs some revision (2), or not relevant (1). The second time around, the experts will determine if the language of the questions are clear, using the Content Validity Index Scale scoring system: Very clear (4), Clear but needs minor revision (3), item needs some revision (2), and not clear (1). Once the raters complete the Content validity index for relevancy and clarity of each item, it will be sent back for data analysis, revisions and modification, and a final look through.

Procedure:

While the survey is being finalized, participants will be recruited. Interested participants will email to express their interest. Participants will then be sent a brief eligibility survey to determine if they are able to participate. A list of participants will be collected and stored in a secure location. When the survey is completed. Eligible participants will then be provided a link to complete the survey online. Directions will be provided in both written and ASL to help with clearer understanding. ASL interpretations will be provided by the researcher or the Students in the interpreting program here at UW-Milwaukee. When participants take the survey, they will go through each question provided on an online survey. Participants will be prompted to think of a situation where they are going to a restaurant of any kind and are looking for a place that they not only can access, but also are able to stay. In the survey participants will complete a modified content validity index scale of each questions. Relevancy and clarity will be assessed for content validity. Traditional content validity index scales use the term “relevant” versus “important”. At each questions participant will have the opportunity to rate the question on an ordinal scale as important (2), somewhat important (1), or not important (0). Each

choice is provided a number to help with data analysis later. While participants are completing the survey, they will be encouraged to select somewhat important if they are unclear about a question. When a participant selects somewhat important, the branching system will expand into more detail where participants can score each criterion individually. If a participant selects not important (0) or important (2), it will automatically score the branches below it as the same. Participants will complete the whole survey and can choose to opt out at any time. When participant are done with the survey, they will have additional space to provide comments, be thanked for the time, and have the option to learn more about the results of the study.

Proposed Data Analysis:

Data analysis will be completed in a few ways. When participants answer a 2, 1, or 0, all of the information will be collected in a table. See Table 8 for hypothetical results and data. In each category of lighting, openness, color/contrast, acoustics, and person based services. Next, percentages of each cell will be reported over the whole. For example, 50% of deaf participants stated lighting was important and 75% of low vision participants states lighting was important. To determine if the result are significantly different, either a Pearson chi-square test or Fisher Exact test will need to be performed. To determine which, the cell size of each box will need to be glanced at to determine if the requirement of five participants in a cell is met. If all cell has five or more participants, then a Pearson chi-square test can be performed. If all the cells do not have five or more, then a Fisher Exact test should be performed. However, based on McDonald (2014), it Is recommended for sample sizes less than 1,000 participants a Fisher Exact Test should be performed.

Some limitations for choosing this analysis is the sample size may be too small. The hypothesis of not finding a significant different between populations for the categories of lighting, openness, color/contrast and acoustic may be accepted due to not having enough participants versus an actual represented significant difference. Additionally, person-based services may not show a significant difference due to sample size.

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Appendix: Tables and Figures

Table. 1 Levels of Hearing loss (Bance, 2007)

Type	**Decibels (db) lost**
Normal	<20 db
Mild	20-40 db
Moderate	41-60 db
Severe	61-80 db
Profound/ deafness	**>81 db**

Table 2. Levels of Visual Impairments.

Label	Snellen Visual Acuity	Low vision, Legally blind
Moderate Visual impairment	20/70 to 20/160	Low vision
Severe visual impairment	20/200 to 20/400 20 degrees or less visual field	Legally blind
Profound Visual Impairment	20/500 to 20/1000 Visual field of 10 degrees or less	Legally blind
Total blindness	Lack of light perception	

Table 3. Usher Syndrome

Type	When it Impacts	How it impacts hearing/ vision, balance
Type 1	Birth	Hearing: Severe to profound hearing loss. Vision: Progressive vision loss caused by retinitis pigmentosa become apparent in childhood. Balance: Vestibular abnormality, affects balance.
Type 2	Hearing at Birth/ vision at adolescence or Adulthood.	Hearing: Mild to severe, affects high-frequency sounds. May become ore sever over time Vision: Becomes present at Adolescence or adulthood Balance: Not affected
Type 3	Adulthood	Hearing: normal hearing at birth. Hearing loss begins during late childhood

		or adolescence after speech development. Becomes more severe over time. Middle age profound hearing loss. Vision: caused by retinitis pigmentosa develops in late childhood or adolescence. Balance: develop vestibular abnormalities that cause problems with balance.

Table 4. Sensory Disability Accessibility Need

Disability	Hearing	Touch	vision
Blind	x	x	
low Vision	x		x (Varies on residual vision)
deaf		x	x
hard of hearing	x (varies on residual hearing)		x

Table 5. Architectural feature and Impairments

Architectural feature	Deaf	Hard of Hearing	Blind	Low Vision
Spatial Proportions	abc	Large Openings	No large spaces; however a room need to feel grand if it is grand.	Visual grandness is important
Openings (daylight, windows, doors, interior, exterior)	abc	Need Large openings; large windows		Daylight and openness of design is important. Skylight
Connections (visual, acoustics, and physical)	abc	abc	Internal staircases were seen as dangerous.	Internal staircase was seen as dangerous
Acoustics (reverberation time)	abc	Sloped ceilings were negative	4m levelled ceilings. >.7 seconds or more meant discomforts.	0.5-0.7 was acceptable.
Complexity	abc	abc		

Table 6. Tools and Checklists Comparisons

	Lighting	Acoustics	openness	Services	Color/ contrast	Data presented to consumer					
Access Tools	x (Access Light)	x (access sounds)	x		x	App					
CHEC-HOH	x (lip reading)	x (decibels)		x	x	Web page					
CHEC-LV	x					Web page					
MAUAP	x	x (decibels)	x	x	x	?					
Sound print App		x (decibels)				App					
Deaf Space Guidelines	x	x	x		x	Textbook					
Design Guidelines for the Visual Environment						x	x			x	PDF Document

Table 7. MAUAP Infrastructure and items count

Infrastructure	**Number of items**
Parking lot	11
Pedestrian Facilities	11
Building access from exterior	17
Interior Maneuvering areas	12
Infrastructures for learning and leisure	33
Services	26
Public restrooms (with and without stalls)	23

Table 8. Hypothetical results n=20

Lighting	Important (2)	Somewhat important (1)	Not Important (0)	
deaf	8	2	0	10
low vision	7	1	1	10
	15	3	1	20
Oppenness	Important	Somewhat Important	Not Important	
deaf	5	2	3	10
low vision	3	2	5	10
	8	4	8	20
Color/contrast	Important	Somewhat Important	Not Important	
deaf	6	3	1	10
low vision	4	3	3	10
	10	6	4	20
Acoustics	Important	Somewhat Important	Not Important	
deaf	4	4	2	10
low vision	2	3	5	10
				20
Person-based services	Important	Somewhat Important	Not Important	
deaf	2	5	3	10
low vision	6	3	1	10
	8	8	4	20

Assessment of Sensory accessibility needs

DEMOGRAPHIC/BACKGROUND INFORMATION

123. What is your age?
18-21
22-24
25-30
31-35
36-40
40+

124. What is your disability?
deaf
Hard of hearing
Blind
Low Vision

125. If deaf/hard of hearing do you wear any assistive devices?
Hearing aids
Cochlear Implants
Bone Anchored hearing aids
I do not wear any assistive device
Other_____

126. If deaf/hard of hearing, do you use any form of sign language as a main form of communication?
Yes
No
N/A

127. I go to restaurants: Select the one that applies the most
Daily
Weekly
Once a month
Once every three month
Once or twice a year

128. I got to _____ type of restaurants: Select all that apply
Fast-Food (McDonalds, Burger King, Taco Bell…)
Coffee Shops (local or chain)
Sit down restaurant (Local or chain)

129. I go to restaurants to meet my_____ needs: Select all that apply
Physiological: (hunger)
Social (Dates, socialize, celebrations and special occasions)

Intellectual (studying,
Dating
Studying
Special occasions: (Anniversaries, birthdays, celebrations)
Other _____

Appendix G. EqTDs of Tables

Table 1. Brief: Table 1. is a table depicting the levels of hearing loss range?

Essential: Table 1 provides a more detailed outline of the levels of hearing loss for individuals who experience hearing loss. Data reported on the left is the label of the hearing loss and the information on the right-hand columns is the level of hearing loss represented in Decibels or dB.

Return to content or continue to Detailed

Detailed: Table 1 is six rows and two columns that describes the levels of hearing loss of individuals who identify as hard of hearing. This table is broken up into two section with the title of the table located at the top, with the citation of Bance, 2007. The table is then divided into two with the degree of hearing loss first, and then the next column is the represented Decibels or dB lost. The range of hearing loss is represented using numerical text, and hearing loss less than twenty decibels is considered normal, and hearing loss greater than eighty-one decibels is considered profound deafness.

Table 2. Brief: Table 2. Depicts the level of vision impairments.

Essential: Table 2 represents both the medical and functional loss with visual impairments. This table compares the label of moderate visual impairment, sever visual impairment, profound visual impairment, and total blindness, with the gold standard vision test, Snellen Visual Acuity. The final comparison made is the legal definition of blindness as participants who may have some partial sign remaining can still be considered blind.

Return to content or continue to detailed

Detailed: Table 2 is broken up into three separate columns to demonstrate the comparison of the label of visual impairments, with the medical model, and the legal model ranging from low vision to blind. This graph does not have any thick lines separating the text and is separated by spaces.

Table 3. Brief: Table 3. Depicts the sensory disability primary accessibility needs.

Essential: Table 3. This table represents those who experience some form of sensory loss disability. This table is based off of Rhyl sensory accessibility work and compares the various ways individuals with sensory accessibility deficits perceive their world. Participants who are blind take their world in through hearing and touch, while participants who are deaf take their world in through touch and vision. Individuals who are hard of hearing and low vision both take in information through hearing and vision and relies on their residual senses to perceive their world.

Return to content or continue to detailed

Detailed: Table 3 is broken up into five rows, 4 columns. is separated with the title of the table at the top, with a five by four grid beneath. In the top row displays the various ways individuals take int heir world through hearing, touch, and vision. On the left-hand column, the disabilities are listed out as blind, low vision, deaf, and hard of hearing. In the boxes, an X is located when a primary sense is used to access their environment. Blind has an X below hearing and touch. Low vision has an X below hearing and vision.

deaf has an X below touch and vision. hard of hearing has an x below hearing and vision.

Table 4. Brief: Table 4. Depicts a comparison chart of tools and checklists to rate public buildings.

Essential: Table 4 depicts Several individuals and organizations have created building accessibility assessment tools to determine if a building is following the American with Disabilities Act- Architectural Barriers Guidelines. However, these guidelines fall short of functionality. Based on similar sensory accessibility needs for individuals who are hard of hearing and low vision, these building accessibility assessments were compared to determine if they accurately and adequately assessed all the areas and categories of Lighting, Acoustics, Openness, Services, and Color/Contrast. Only one assessment adequately assessed all areas which included the MAUAP.

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Detailed: This tools and checklist comparison table is a seven by 6 table that is organized in a grid like fashion. The building features of lighting, acoustics, openness, services, and color/contrast is located at the top of the table, and the various assessments are located on the left-hand side. The first tool is Access Tools, and an X is placed in lighting, Acoustics, Openness, and color/contrast. Next is the CHECK-HOH and an X is placed in the Lighting, Acoustics, Services, and Color/contrast. CHEC-LV has an X in lighting. MAUAP has an X in all the categories. Sound Print app only has an X in the acoustics, and DeafSpace guidelines has an X in lighting, acoustics, openness,

and color/contrast. Finally Design guidelines for the Visual environment has an X in lighting, Acoustics, and color/contrast.

Table 5. Brief: Table 5. is the Mann-Whitney U-Test summary for importance of lighting.

Essential: This table represents the statistical analysis of the distribution of hard of hearing and low vision participants answering lighting as an important feature for overall experience to engaging in the restaurant environment. the Mann-Whitney test is nonparametric that compares unpaired groups. This table represents a non-statistically significant difference, with a p=value of .122.

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Detailed: This table has eight rows and two columns. The descriptions are located in column one and the values are located in column two. column one is a darker gray to allow for easier distinction between the two columns. The title of the graph is bolded and centered on the top.

Table 6. Brief: Table 6. is the Mann-Whitney U-Test summary for importance of Openness.

Essential: This table represents the statistical analysis of the distribution of hard of hearing and low vision participants answering Openness as an important feature for overall experience to engaging in the restaurant environment. the Mann-Whitney test is nonparametric that compares unpaired groups. This table represents a non-statistically significant difference, with a p=value of 105.

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Detailed: This table has eight rows and two columns. The descriptions are located in column one and the values are located in column two. column one is a darker gray to allow for easier distinction between the two columns. The title of the graph is bolded and centered on the top.

Table 7. Brief: Table 7. is the Mann-Whitney U-Test summary for importance of Color/Contrast

Essential: This table represents the statistical analysis of the distribution of hard of hearing and low vision participants answering Color/Contrast as an important feature for overall experience to engaging in the restaurant environment. the Mann-Whitney test is nonparametric that compares unpaired groups. This table represents a statistically significant difference, with a p=value of 000.

Return to content or continue to detailed

Detailed: This table has eight rows and two columns. The descriptions are located in column one and the values are located in column two. column one is a darker gray to allow for easier distinction between the two columns. The title of the graph is bolded and centered on the top.

Table 8. Brief: Table 8. is the Mann-Whitney U-Test summary for importance of Acoustics.

Essential: This table represents the statistical analysis of the distribution of hard of hearing and low vision participants answering acoustics as an important feature for

overall experience to engaging in the restaurant environment. the Mann-Whitney test is nonparametric that compares unpaired groups. This table represents a non-statistically significant difference, with a p=value of 012.

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Detailed: This table has eight rows and two columns. The descriptions are located in column one and the values are located in column two. column one is a darker gray to allow for easier distinction between the two columns. The title of the graph is bolded and centered on the top.

Table 9. Brief: Table 9. is the Mann-Whitney U-Test summary for importance of Services/Communication

Essential: This table represents the statistical analysis of the distribution of hard of hearing and low vision participants answering Services/Communication as an important feature for overall experience to engaging in the restaurant environment. the Mann-Whitney test is nonparametric that compares unpaired groups. This table represents a non-statistically significant difference, with a p=value of .162

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Detailed: This table has eight rows and two columns. The descriptions are located in column one and the values are located in column two. column one is a darker gray to allow for easier distinction between the two columns. The title of the graph is bolded and centered on the top.

Table 10. Brief: Table 10. Represents the demographic information of participants who answered the survey.

Essential: This table demonstrates the participants demographics based on claim-based variable. There was a wide range of individuals who participated in this study, with the majority of participants in the age range of 25-30 years old n=17, mainly female n=42, reporting as Caucasian/white n=47, completing a bachelor's degree n=21, and n=46 of the individuals were not married. The survey tried to recruit a wide demographics of individuals, and recruited n=18 Deaf, n=25 hard of hearing, n=10 low vision, and n=7 blind participants.

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Detailed: This chart is divided into 6 columns, identified disabilities at the top going from left to right stating Deaf, Hard of Hearing, Low vision, Blind and Total. The chart is broken up into 5 different sections of age, gender, ethnicity, education level, and married. Under the age categories, the years are listed 18-21, 22-24, 25-30, 31-35, 36-40, Total. Under gender, the terms man, woman, genderqueer/non-binary are listed. Under ethnicity, the options White/Caucasian, Black or African American, Latino or Hispanic, Asian/Pacific Islander, two are more, Other/Unknown, prefer not to say. Education level states some high school, high school graduate, diploma, or the equivalent (ex. GED), Associated Degree, Bachelors' Degree, Master's Degree, Ph.D. or higher, prefer not to say, Total. Are you married states, Yes, No, prefer not to say?

Table 11. Brief: Table 11. Depicts the assistive devices deaf/hard of hearing people use.

Essential: This table displays the responses of participants who reported as deaf/hard of hearing n=47 total, and were asked if they used hearing aids, cochlear implants, or bone anchored hearing aids, or did not use any assistive devices. No participants answered bone anchored hearing aids. A total of 8 deaf participants, and 16 hard of hearing participants used hearing aids, 9 deaf and 3 hard of hearing used cochlear implants, and 4 deaf, and 7 hard of hearing participants reported not using any assistive devices.

Return to content or continue to detailed.

Detailed: This graph is separated into 2 separate columns. The first column on the left notes the various assistive devices, including hearing aids, cochlear implants, and I do not wear assistive devices. The second column is broken up into the 2 different disabilities of Deaf and Hard of Hearing and provides a total section at the end. The numbers reported are available in the Essential description, as well as the table.

Table 12. Brief: Table 12. Depict the number and percentage of deaf/hard of hearing participants who use signs.

Essential: This table represents participants who stated they were deaf or hard of hearing and if they used any form of sign language as a main form of communication or a mix of voice and sign. Those who stated Yes, as a main form of communication, Deaf n=3 (16.7%), Hard of hearing n=0 (0%). Those who answered no, Deaf. n=9 (50%), Hard of hearing n=19 (76%). Those who reported I use a mix of sign and voice, Deaf n=6 (33.3%), and Hard of hearing n=6 (24%). A total of n=3 (7%) of participants use signs, n=28 (65.1%) does not use signs, and n=12, (27.9%) uses a mix.

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Detailed: This table is separated into two columns with a line separating the amount of sign language and the disabilities. on the left and first column, it states, Disabilities, Yes, no, I use a mix of sign and voice, Total indicating if signed is used as a main form of communication. On the top of the table, the disabilities of Deaf, hard of hearing, and total are stated. Each category is separated into N and percentage (%).

Table. 13. Brief: Table 13. Depicts the assistive devices blind/low vision people use.

Essential: This table displays the responses of participants who reported as blind/ low vision total, and were asked if they glasses/contact, magnifier/low vision devices, others and I do not use assistive devices. No participants answered I do not use assistive devices. Most participants used other resources besides, the glasses/contact and magnifier devices. The types of assistive devices used were evenly distributed between the three.

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Detailed: This graph is separated into 2 separate columns. The first column on the left notes the various assistive devices, including glasses/contact, magnifier/low vision device, other, total. The second column is broken up into the 2 different disabilities Blind and low vision and provides a total section at the end. The numbers reported are available in the Essential description, as well as the table.

Table 14. Brief: Table 14. Depicts the Mann-Whitney U-Test hypothesis summary for lighting.

Essential: This table analyzes each question to determine if the distribution of the answers of participants who low vision is and hard of hearing are statistically different. The p-value is set to .01, and any value in the significant range that is above .01, states to retain the null hypothesis. The two statistically significantly different questions are the importance of type of lighting, compared to artificial or natural lighting and the focus of lighting. All the other questions did not show statistical differences.

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Detailed: This table is divided into 5 columns and 13 rows of information. in column 1, it provides you a number to reference the row and the questions numbers. Column 2 distinguishes the question that was being asked and states the distribution of …. and then the following questions. Column three discusses which test was used, all the columns are the same in stating Independent-Samples Mann-Whitney U test was used. Column 4 provides the statistical significance of each with the exact significance on displayed for the test. Additionally, the significance level was set for .010. Finally, the last column states if the researcher should retain or reject the null hypothesis.

Table 15 Brief: Table 15. Depicts the Mann-Whitney U-Test hypothesis summary for acoustics.

Essential: This table analyzes each question to determine if the distribution of the answers of participants who low vision is and hard of hearing are statistically different. The p-value is set to .01, and any value in the significant range that is above .01, states to retain the null hypothesis. None of the questions were statistically significantly different.

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Detailed: This table is divided into 5 columns and 8 rows of information. in column 1, it provides you a number to reference the row and the questions numbers. Column 2 distinguishes the question that was being asked and states the distribution of …. and then the following questions. Column three discusses which test was used, all the columns are the same in stating Independent-Samples Mann-Whitney U test was used. Column 4 provides the statistical significance of each with the exact significance on displayed for the test. Additionally, the significance level was set for .010. Finally, the last column states if the researcher should retain or reject the null hypothesis.

Table 16. Brief: Table 16. Depicts the Mann-Whitney U-Test hypothesis summary for Openness.

Essential: This table analyzes each question to determine if the distribution of the answers of participants who low vision is and hard of hearing are statistically different. The p-value is set to .01, and any value in the significant range that is above .01, states to retain the null hypothesis. Only one of the questions stated to reject the null hypothesis, indicating there was a statistically significance different, and questions 23 related to being able to comfortably navigate around the restaurant with avoiding tables, chairs, and other obstructions.

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Detailed: This table is divided into 5 columns and 23 rows of information. in column 1, it provides you a number to reference the row and the questions numbers. Column 2 distinguishes the question that was being asked and states the distribution of …. and

then the following questions. Column three discusses which test was used, all the columns are the same in stating Independent-Samples Mann-Whitney U test was used. Column 4 provides the statistical significance of each with the exact significance on displayed for the test. Additionally, the significance level was set for .010. Finally, the last column states if the researcher should retain or reject the null hypothesis.

Table 17. Brief: Table 17. Depicts the Mann-Whitney U-Test hypothesis summary for Color/Contrast.

Essential: This table analyzes each question to determine if the distribution of the answers of participants who low vision is and hard of hearing are statistically different. The p-value is set to .01, and any value in the significant range that is above .01, states to retain the null hypothesis. Four of the question came back statistically significant including the importance of color and contrast ($p<0.01$), The importance of the color or pattern of the walls ($p=0.003$), The distribution of neutral color on the walls ($p=0.007$), and the wall being plain and not patterned ($p=0.004$). These were all shown to be statistically different.

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Detailed: This table is divided into 5 columns and 11 rows of information. in column 1, it provides you a number to reference the row and the questions numbers. Column 2 distinguishes the question that was being asked and states the distribution of …. and then the following questions. Column three discusses which test was used, all the columns are the same in stating Independent-Samples Mann-Whitney U test was used. Column 4 provides the statistical significance of each with the exact significance on

displayed for the test. Additionally, the significance level was set for .010. Finally, the last column states if the researcher should retain or reject the null hypothesis.

Table 18. Brief: Table 18. Depicts the Mann-Whitney U-Test hypothesis summary for services/communication.

Essential: This table analyzes each question to determine if the distribution of the answers of participants who low vision is and hard of hearing are statistically different. The p-value is set to .01, and any value in the significant range that is above .01, states to retain the null hypothesis. Three of the statistics came back as statistically different, Question 8, The importance of a person relaying the message of how to be seated ($p=0.001$), Question 12 The importance of auditory cue when it is your turn to be seated ($p<0.001$), Finally the auditory cue question related to how to know when your food was ready was statistically different ($p=0.001$).

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Detailed: This table is divided into 5 columns and 30 rows of information. in column 1, it provides you a number to reference the row and the questions numbers. Column 2 distinguishes the question that was being asked and states the distribution of …. and then the following questions. Column three discusses which test was used, all the columns are the same in stating Independent-Samples Mann-Whitney U test was used. Column 4 provides the statistical significance of each with the exact significance on displayed for the test. Additionally, the significance level was set for .010. Finally, the last column states if the researcher should retain or reject the null hypothesis.

Table 19. Brief: Table 19. Depicts the comment section from the survey.

Essential: Participants were provided the opportunity add feedback at the end of the completed survey. A total of 5 participants, 4 being hard of hearing, and 1 low vision participant provided feedback regarding various features that affect their engagement. A common theme of loud background noise, sufficient lighting, and the ability to face everyone around tables was a common theme. One participant felt the desire to criticize the survey, with the assumptions they had read the instructions in its entirety.

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Detailed: This small table is separated into two columns. The first column identifies the individual's disability, and the right column is participants comments per verbatim without any correction to spelling, grammar, or sentence structure.

Appendix H. EqTD's of Figures.

Figure 1. Brief: Figure 1. This diagram depicts a visual of the thesis timeline.

Essential: This diagram demonstrates the process of the study timeline. The start of the thesis begins in Summer of 2019, to a Spring of 2020 date stamp. These dates are represented through an arrow pointing from left to right. The thesis timeline is divided into 3 different categories, of study and survey development prior to the IRB approval, then the data collection, and finally the data analysis. 10 dates are noted, and 6 out of the 10 happened before the IRB approval.

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Figure 2. Brief: Figure 2. This image Depicts the comparison of sensory cues relied on for visual and hearing impairments.

Essential: This image depicts the overlap and similarities in sensory cues used by individuals who experience both age related and congenital sensory loss. Individuals who experience age related sensory loss may rely more on their residual sense than individuals who experience congenital sensory loss. The overlap is not one sided, and there may be a mix is represented in a pyramid format, you have individuals who experience vision and hearing loss, but my rely on both hearing and vision to perceive the world around them. The blue dashed circle surrounding the terms congenital moderate hearing loss, congenital moderate vision loss, congenital mild vision loss, and congenital mild hearing loss represents the participants surveyed during this study.

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Figure 3. Brief: Figure 3. This diagram depicts the timeline of the study.

Essential: This figure depicts the study timeline starting in the top left hand corner. The process of the thesis timeline included Literature review process, identifying the gap in literature, Publishing and presenting at a conference, identifying similar accessibility needs, developing the survey and the first draft, receiving IRB approval and then re-writing the survey and doing a structured interview for validity. A second IRB amendment was approved, and there were two waves of recruitment emails. Data collected lasted for 2 weeks, with 105 participants via email, and 2 participants responded via phone. The clean up of the analysis, deleting partial responses, and those that did not meet inclusion criteria, and finally the final data analysis. This timeline represents the 2 and a half year process the study took to complete.

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Figure 4. Brief: This graph depicts the importance of lighting in a restaurant environment in a bar graph form.

Essential: This graph represents the distribution of importance of lighting for individuals who are hard of hearing and low vision. 48% of hard of hearing individuals responded lighting as an important feature, 40% of hard of hearing individuals responded lighting as a somewhat important feature, and 12% of hard of hearing respondents answered lighting as not important. 80% of Low Vision participants responded lighting as important, and 20% of low vision respondents stated lighting was somewhat important, and 0% state lighting was not important.

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Figure 5. Brief: This Graph Depicts the importance of openness in a restaurant environment in a bar graph form.

Essential: This graph represents the distribution of importance of openness for individuals who are hard of hearing and low vision. 48% Hard of hearing, and 80% of Low vision stated openness was important. 32% Hard of hearing, and 20% Low vision participants stated openness was somewhat important. 20% of hard of hearing and 0% of low vision participants stated openness was not important.

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Figure 6. Brief: This graph depicts the importance of color/contrast in a restaurant environment in a bar graph form.

Essential: This graph represents the distributions of importance of color/contrast for individuals who are hard of hearing and low vision. 4% of hard of hearing and 70% of Low vision participants stated color/contrast was important, 32% of hard of hearing and 30% of Low vision participants reported color/contrast was somewhat important. 64% of hard of hearing, and 0% of low vision participants stated color/contrast was not important.

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Figure 7 Brief: This graph depicts the importance of Acoustics in a restaurant environment in a bar graph form.

Essential: This graph represents the distributions of importance of Acoustics for individuals who are hard of hearing and low vision. 96% of hard of hearing and 40% of

Low vision participants stated Acoustics was important, 0% of hard of hearing and 50% of Low vision participants reported acoustics was somewhat important. 4% of hard of hearing, and 10% of low vision participants stated Acoustics was not important.

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Figure 8. Brief: This graph depicts the importance of Services/communication in a restaurant environment in a bar graph form.

Essential: This graph represents the distributions of importance of Services/communication for individuals who are hard of hearing and low vision. 52% of hard of hearing and 80% of Low vision participants stated Services/Communication was important, 32% of hard of hearing and 20% of Low vision participants reported Services/Communication was somewhat important. 16% of hard of hearing, and 0% of low vision participants stated Services/Communication was not important.

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Figure 9. Brief: This graph Represents the type of lighting important in a restaurant environment in a bar graph form.

Essential: This graph represents three different question from the lighting questions in the survey. If participants selected lighting as important or somewhat important, they were prompted to answer a question overall type of lighting, and sub sections of artificial or natural lighting. Low vision participants reported overall type of lighting as 70% important, 30% somewhat important, 0% not important. Hard of hearing participants stated overall type of lighting 16% important, 48% somewhat important, 36% Not important. Low vision participants stated artificial lighting 30% Important, 30%

somewhat important, and 40% not important. Hard of hearing participant stated artificial lighting as 20% important, 32% somewhat important, and 48% not important. Finally, Low vision participants stated natural lighting as 50% important, 40% somewhat important, and 10% not important. Hard of hearing participants stated natural lighting was 20% important, 32# somewhat important, 48% not important.

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Figure 10. Brief: This graph Represents the brightness of lighting important in a restaurant environment in a bar graph form.

Essential: This graph represents three different question from the lighting questions in the survey. If participants selected lighting as important or somewhat important, they were prompted to answer a question overall brightness of lighting, and sub sections of dim or bright lighting. Low vision participants reported overall brightness of lighting as 80% important, 20% somewhat important, 0% not important. Hard of hearing participants stated overall type of lighting 44% important, 44% somewhat important, 12% Not important. Low vision participants stated dim lighting 30% Important, 30% somewhat important, and 40% not important. Hard of hearing participant stated Dim lighting as 8% important, 36% somewhat important, and 56% not important. Finally, Low vision participants stated Bright lighting as 70% important, 20% somewhat important, and 10% not important. Hard of hearing participants stated natural lighting was 44% important, 28% somewhat important, 28% not important

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Figure 11. Brief. This graph Represents the importance of non-glare finish in a restaurant environment in a bar graph form.

Essential: This graph represents three different question from the lighting questions in the survey. If participants selected lighting as important or somewhat important, they were prompted to answer a question overall non-glare finish, and sub sections of non-glare finish on table vs. floor. Low vision participants reported Overall non-glare finish as 50% important, 20% somewhat important, 30% not important. Hard of hearing participants stated overall non-glare finish 16% important, 32% somewhat important, 30% Not important. Low vision participants stated Non-glare finish on tables 60% Important,10% somewhat important, and 30% not important. Hard of hearing participant stated non-glare finish on tables as 20% important, 20%somewhat important, and 60% not important. Finally, Low vision participants stated non-glare finish on floors as 30% important, 40% somewhat important, and 30% not important. Hard of hearing participants stated natural lighting was 20% important, 16% somewhat important, 64% not important

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Figure 12. Brief. This graph. Represents the importance of focus of light in a restaurant environment in a bar graph form.

Essential: This graph represents three different question from the lighting questions in the survey. If participants selected lighting as important or somewhat important, they were prompted to answer a question overall focus, and sub sections of task lighting vs. ambient lighting. Low vision participants reported Overall focus as 10% important, 30%

somewhat important, 60% not important. Hard of hearing participants stated overall non-glare finish 16% important, 56% somewhat important, 28% Not important. Low vision participants stated task lighting was 10% Important,40% somewhat important, and 50% not important. Hard of hearing participant stated non-glare finish on tables as 12% important, 40% somewhat important, and 50% not important. Finally, Low vision participants stated Ambient lighting as 16% important, 30% somewhat important, and 70% not important. Hard of hearing participants stated natural lighting was 0% important, 36% somewhat important, 48% not important

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Figure 13. Brief: This graph represents the importance of loudness of background noise in the restaurant environment in a bar graph form.

Essential: This graph represents four different question from the acoustic questions in the survey. If participants selected acoustics as important or somewhat important, they were prompted to answer a question of importance of overall background noise, being able to hear a whisper, being able to hear a conversation tone, and having 2 or fewer noise sources. For overall loudness of background noise, both hard of hearing and low vision participant responded the most in important, somewhat important for being able to hear a whisper, important for being able to hear a conversation tone, and both responded important for 2 or fewer noise sources.

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Figure 14 Brief: This graph depicts the bar graph of importance for sound absorbing materials.

Essential: This bar graph represents 3 different questions under acoustics. The highest reported percentage for the hard of hearing participants were important for overall importance of sound absorbing materials, somewhat important for walls, and somewhat important for flooring having sound absorbing materials. For low vision participants, the highest reported percentages were important and somewhat important for overall sound absorbing materials, somewhat important for walls, and tied for somewhat and not important for flooring.

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Figure 15 Brief: This graph Depicts the bar graph of the importance of variety of seating.

Essential: This bar graph depicts the percentages of respondents for the importance of variety of seating. The highest reporting percentage for each population in overall type of seating, low back booths, high back booths, chairs with arms, and chairs without arms. Hard of hearing reported not important for overall, not important for low back booth, not important for high back booths, not important for chairs with arms, and not important for chairs without arms. Low vision participants reported highest for somewhat important for overall seating, not important for low back booths, important for high back booths, not important for chairs with arms, and not important for chairs without arms.

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Figure 16. Brief: This bar graph Depicts the importance for centerpieces.

Essential: This bar graph depicts the percentages of respondents for the importance of variety of seating. The percentage for each population in overall centerpiece importance, centerpieces, condiments/napkin holders/ silverware, and food/drink specials menu. Hard of hearing reported somewhat important for overall, not important for centerpieces, not important for condiments/napkins/silverware, and not important for food/drink menu. Low vision populations reported somewhat important for overall, hugely not important for centerpieces, important for condiments/silverware/napkins, and not important for food/drink menus.

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Figure 17. Brief: This bar graph Depicts the importance for table location

Essential: This bar graph depicts the percentages of respondents for the table location. The percentage for each population in overall table location, near 1 wall, and near the corner of a room (or 2 walls). The highest reported in each group for hard of hearing was important for overall, not important near one wall, and tied for somewhat and not important near a corner. Low vision reported, Important for overall, tied for important and somewhat important near 1 wall, and tied for important, somewhat important for corner of the room.

Return to content Figure17

Figure 18 Brief: This bar graph Depicts the importance for table location part b.

Essential: This bar graph depicts the percentages of respondents for the table location. The percentage for each population in center of the room, near a window, away from a window, or in a private room. The highest reported in each group for hard of hearing was not important for center of the room, not important for near a window, not important for away from a window, and not important for a private room. The highest reported percentages for low vision was not important for center of the room, tied for important and somewhat important for near a window, not important for away from a window, and not important for a private room.

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Figure 19 Brief: This bar graph Depicts the importance of type of table.

Essential: This bar graph depicts the percentages of respondents for the type of table. The percentage for each population in general type of table, round, square, small, large. The highest reported in each group for hard of hearing was not important for type of table, not important for round, not important for square, not important for small, and not important for large. The highest reported for low vision as tied for important/somewhat important for type of table, not important for round, not important for square, not important for small, and not important for large.

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Figure 20. Brief: This bar graph depicts the importance comfortably navigating around the restaurant.

Essential: This bar graph depicts the percentages of respondents reporting the importance of being able to comfortably navigate around the restaurant. The highest percentage for hard of hearing was not important , and 100% important for low vision participants.

Return to content Figure20

Figure 21. Brief: This bar graph depicts the of importance of wall color importance.

Essential: This bar graph depicts the percentages of respondents for the wall color. The percentage for each population in general wall color, neutral, or bright color. The highest reported in each group for hard of hearing was not important for wall color, not important for neutral, and not important for bright colors. Low vision reported a tie for important and somewhat important for general wall color, important for neutral, and somewhat important for a bright color.

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Figure 22. Brief: This graph depicts of importance of wall pattern importance

Essential: This bar graph depicts the percentages of respondents for the wall pattern. The percentages represent patterned and plain wall importance. The highest reported percentage for hard of hearing was not important for pattern and not important for plain. Low vision reported Not important for patterned, and a tie for Important and somewhat important for plain wall.

Return to content Figure22

Figure 23 Brief: This bar graph depicts the of importance of floor color importance.

Essential: This bar graph depicts the percentages of respondents for the floor color. The percentage for each population in general floor color and pattern, neutral, or bright color. The highest reported in each group for hard of hearing was not important for floor color, not important for neutral, and not important for bright colors. Low vision reported not important for general floor color, not important for neutral, and not important for a bright color.

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Figure 24. Brief: This bar graph depicts the of importance of floor pattern importance.

Essential: This bar graph depicts the percentages of respondents for floor pattern. The percentages represent patterned and plain floor importance. The highest reported percentage for hard of hearing was not important for pattern and not important for plain. Low vision reported Not important for patterned, and a not important for plain floor.

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Figure 25 Brief: This bar graph depicts the of reservation systems.

Essential: This bar graph depicts the percentages of respondents for the reservation system. The percentage for each population in general, phone, online, and in-person. The highest reported in each group for hard of hearing was important for overall, not important for phone, important for online, and important for in-person. Low vision reported, important for overall, important for phone, not important for online, and not important for in-person.

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Figure 26. Brief: This bar graph depicts the importance of communication how to be seated.

Essential: This bar graph depicts the percentages of respondents for communication of how to be seated. The percentage for each population in general, clear visual sign, and person relays message. The highest reported in each group for hard of hearing was important for overall, important for clear visual sign, and somewhat important for person relays message. Low vision participants responded important for overall, tie for important and somewhat important for clear visual sign, and important for person relays a message.

Return to content Figure26

Figure 27 Brief: This bar graph depicts the importance of how to find a seat.

Essential: This bar graph depicts the percentages of respondents for communication of how to be seated. The percentage for each population in self- directed in finding a seat or being guided. The highest reported in each group for hard of hearing was not important for self-directed, and not important for being guided. Low vision populations reported a tie for important and somewhat important for self-directed seating, and important for being guided.

Return to content Figure27

Figure 28. Brief: This bar graph depicts of importance of cue when it's time for seating.

Essential: This bar graph depicts the percentages of respondents for communication when it is time to be seated. The percentage for each population is general clear communication, auditory cues, and tactile cues. The highest reported in each group for hard of hearing was Important for clear communication, not important for auditory cues, important for visual cues, and not important for tactile cues. Low vision participants reported, important for clear communication, important for auditory, important for visual, and important for tactile cues.

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Figure 29 Brief: This bar graph depicts the importance of presentation of menu.

Essential: This bar graph depicts the percentages of respondents for how the menu is presented. The percentage for each population is how the menu is presented, online, physical, menu on a screen. The highest reported in each group for hard of hearing Important for how menu is presented, not important for online, important for physical, and not important for menu on a screen. Low vision participants responded 100% important for how menu is presented, important for online, 90% importance for physical menu, and a tie for somewhat important and not important for menu on a screen.

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Figure 30. Brief: This bar graph depicts the importance of presentation of menu.

Essential: This bar graph depicts the percentages of respondents the importance of what is presented on a menu with pictures/pictograms or numbers corresponding. The highest reported in each group for hard of hearing Important for not important for

pictures, and not important for numbers. Low vision stated important for pictures, and not important for numbers.

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Figure 31. Brief: This bar graph depicts the of importance of how food is ordered.

Essential: This bar graph depicts the percentages of respondents the importance how to order food. The percentages represented are general importance, having a server, or having access to a self-serve kiosk. The highest reported in each group for hard of hearing was important for general, important for server, and not important for a self-serve kiosk. Low vision participants reported tie for important and not important for general, important for a server, and not important for self-serve kiosk.

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Figure 32. Brief: This bar graph depicts the importance of cue when food is ready.

Essential: This bar graph depicts the percentages of responses for the importance of the type of cue when the food is ready for pickup. The questions represented are general, visual cues, auditory cues, and tactile cues. The highest reported percentage for hard of hearing includes important for general, important for visual, somewhat important for auditory, and not important for tactile. Low vision participants stated important for general, tie for important and not important for visual, important for auditory, and important for tactile cue.

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Figure 33. Brief: This bar graph depicts the importance how food is received.

Essential: This bar graph depicts the percentages of responses for the importance how food is received. The questions represented are general, self-serve or serve. The highest reported percentage for hard of hearing includes important for general, somewhat important for self-serve, and important for server. Low vision participants stated important for general, not important for self-serve, and important for server.

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