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Interrater Reliability of the Accesstools Assessment with Novice Raters

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INTERRATER RELIABILITY OF THE ACCESSTOOLS ASSESSMENT WITH NOVICE RATERS

by

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ABSTRACT

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Public buildings accessibility is of societal importance for all individuals, especially people with disabilities (PWD). Despite of all the efforts that have been made on the societal and community levels, PWD are still limited from participating in the community due to inaccessible environments. One of the major limitations in the current practices regarding public buildings' accessibility is the lack of a commonly accepted, comprehensive, and metrically sound tool to objectively measure the accessibility of public buildings. Such a measure is needed.

AccessTools is a newly developed assessment tool to identify, document, and objectively measure the complete accessibility of different building elements. This dissertation investigates the interrater reliability (IRR) of the AccessTools assessment and reports on three studies. The first study evaluates the IRR of AccessTools after performing on-site assessments and studies the effects of training on the IRR of the tool. The second study investigates the IRR of AccessTools after performing video-simulated assessments, and studies the effects of training, raters' educational level,

collection sites, and students' performance in the knowledge quiz on the IRR of the tool. The third study investigates the effects of the branching system in AccessTools on IRR.

573 participants were recruited for this study from students taking Assistive Technology related courses from multiple universities in the US over two academic years. The study included completing a self-paced online training program on several topics surrounding the accessibility of public buildings and performing accessibility evaluations on restaurants using the AccessTools assessment. Participants were asked to complete a knowledge quiz at baseline, and after completing each of the training and evaluation tasks. A cross-over design was implemented to study the effect of the training program. In the first academic year, the students performed on-site accessibility evaluations, while video-simulated evaluations were implemented in the second academic year due to the COVID-19 pandemic. The Gwet's AC1 agreement coefficients were compared across the different raters' groups, collection sites, and restaurants.

The results of this study revealed that the AC1 reliability coefficients for both studies were found to be of 'Moderate' strength when averaging across the restaurants (AC1 for Study 1 was 0.504, and 0.531 for Study 2). Interestingly, the results from the two studies showed that training had a negative effect on the IRR of the tool, and that the undergraduate raters achieved higher AC1 coefficients compared to their graduate peers. Agreement coefficients differed across the collection sites. The participants' group with higher scores in the knowledge quiz had significantly higher AC1 agreement coefficients across all three assessed restaurants. The branching study revealed that different branching levels had mixed effects on AC1 agreement coefficients. A

simulation study was conducted to investigate the effects of answering higher root level questions in the implemented branching system of the tool.

Overall, the AccessTools assessment achieved at least a ‘Moderate’ strength IRR across the two evaluation mediums. Several factors need to be considered in order to improve the IRR of the tool. A more comprehensive tool-specific training module is needed. Another factor is to consider changing the scoring system of the higher root level questions into a dichotomous system, while maintaining the trichotomous system for the lower root level questions. Additionally, the findings of this study and other studies suggest that video-simulated evaluations could improve training of novice raters’ before measuring community building accessibility.

To

my family,

my friends,

and specially my dad, you will always live in my heart.

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LIST OF ABBREVIATIONS

ABA	The Architectural Barriers Act
ADA	The Americans with Disabilities Act
ADAAG	The Americans with Disabilities Act Accessibility Guidelines
AIMFREE	The Accessibility Instruments Measuring Fitness and Recreation Environments
ARB	AccessRatings for Buildings
AUDIT	Accessibility and Universal Design Information Tool
CASPAR	Comprehensive Assessment and Solution Process for Aging Residents
CHEC	Community Health Environment Checklist
CHIEF	Craig Hospital Inventory of Environmental Factors
CU	Columbia University
FABS	Facilitators and Barriers Survey of environmental influences on participation
FIU	Florida International University
ICF	International Classification of Functioning
I-HOPE	In-Home Occupational Performance Evaluation
IRR	Interrater reliability
MQE	Measure of the Quality of the Environment
OT	Occupational Therapy
OTP	Occupational Therapy Practitioners
OTPF	Occupational Therapy Practice Framework
OTs	Occupational Therapists

PAI	Personalized Accessibility Information
PEO	Person-Environment-Occupation model
PWD	People With Disabilities
R2D2	Rehabilitation Research Design and Disability
RATE-IT	Restaurant Accessibility and Task Evaluation Information Tool
SAFER-HOME	Safety Assessment of Functional and the Environment for Rehabilitation
TTSS	Trichotomous Tailored, Sub-branching Scoring
TWU	Texas Woman's University
UD	Universal Design
UWM	University of Wisconsin-Milwaukee
κ	Kappa coefficient

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I. INTRODUCTION

An essential feature to every human being's development and functioning is participation in everyday occupation. It is through participation that we acquire skills and competencies, connect within our communities, and find purpose and meaning in life (Law, 2002). Participation is one of the major determinants of quality of life, and the lack of participation or occupational deprivation leads to poor health and well-being (Whiteford, 2000). Although most of us take participation for granted, this dramatically changes when we have a temporary condition or a disability hindering our ability to participate in the community. The recent shift in viewing disability as the result of a personal deficit that hinders the performance of function and activities, into viewing disability with a more integrative and holistic paradigm that focuses on the dynamic interaction between the person and the environment, signifies the importance of the environment as being a facilitator or a barrier for participation.

Statement of the Problem

Participation in the community and the accessibility of public buildings is of societal importance for all individuals, especially for people with disabilities (PWD). Unfortunately, after three decades of enacting the Americans with Disabilities Act (ADA), and despite all of the efforts that have been made on the societal and community levels, PWD are still limited from participating in the community due to inaccessible environments (Clarke et al., 2011; Giesbrecht et al., 2011; Hammel et al., 2015; Jenkins et al., 2015; Rosenberg et al., 2013). This urges us to rethink and study

the practices currently implemented to identify the weak links and provide possible solutions to resolve this issue.

Comprehensive assessment of the accessibility of public buildings and addressing accessibility barriers is fundamental to empower PWD to engage and participate within their communities. Providing sufficient information regarding the accessibility details of the buildings that can be tailored to their impairments and functional capabilities is also imperative. A gap in the current literature on public building accessibility is the paucity of valid and reliable methods for assessing and analyzing accessibility problems with a comprehensive perspective that not only focuses on the physical aspect of accessibility, but also considers accessibility requirements for individuals that may have cognitive, visual, or auditory impairments.

AccessTools is a novel, comprehensive, and efficient accessibility assessment tool that has been recently developed to be used by trained assessors. This tool aims to provide a comprehensive assessment of public buildings and objectively identify accessibility barriers hindering PWD from using these buildings. The tool has been in the construction phase for several years, and several iterations and revisions to enhance its content validity has been implemented. However, formal quantitative evaluation of the reliability and validity of the tool has not been established yet.

Purpose of the Study

Sound psychometric properties are a crucial prerequisite for any assessment instrument. Thus, studying validity and reliability of an instrument are important, particularly to provide objective, evidence-based data about the effect of interventions to

remediate the environmental barriers hindering the participation of PWD on a community level. The focus of this study is to evaluate and substantiate the interrater reliability (IRR) of the AccessTools assessment, as well as to study the effects of a developed training protocol on the users' performance. To this date, there has been no research conducted that has explored the IRR property of the AccessTools assessment.

Significance of the Study

The literature reported that the relationship between environment and participation is complex. The lack of proper conceptual and operational definitions has created confusion in defining the best approach to measure each of these constructs. Up to this point, there is no commonly accepted, metrically sound tool to measure the accessibility of public buildings (Alvarelhão et al., 2012; Whiteneck & Dijkers, 2009), which highlight the urgent need for such assessment.

II. LITERATURE REVIEW

Several topics and aspects need to be discussed to identify the gaps in the current literature and practices regarding the accessibility of public buildings. Therefore, the prevalence of disability; the different views on the disability experience; the paradigms, frameworks, and models emphasizing the current conceptualization of disability; the history and current accessibility legislation; the gaps in public buildings accessibility on the different environmental levels; and the gaps in the currently available accessibility assessment tools for public buildings need to be discussed.

Prevalence and Different Views of Disability

According to the U.S. Census Bureau, there are over 41 million people living in the United States with a disability, representing 12.7% of the total population. It is estimated that over 20 million have an ambulatory difficulty, 15 million with a cognitive difficulty, 11 million with a hearing difficulty, and over 7 million with a vision difficulty (U.S. Census, 2019). This also implicates millions of individuals that have more than one type of disability.

In the rehabilitation field, there is a consensus that the disability experience is multifactorial and dependent on personal, environmental, and societal characteristics (Asch, 2000; Meyerson, 1988; Tate & Pledger, 2003). Disability can be viewed as a contextual variable that is dynamic through time and circumstances, and the relative degree of disability and experience fluctuates depending on condition, time, and context (Tate & Pledger, 2003). Thus, disability can be viewed as situational and should be addressed within a social context, since functional limitations can be exacerbated by social and environmental factors. Therefore, the constraints presented by the physical and social environments mediate the disability experience (Scotch, 1988; Verbrugge & Jette, 1994).

Guiding Paradigms in Research on Disability and Rehabilitation

The unique and multifactorial nature of disability fueled the transition from viewing disability with a medically oriented lens, which presented disability as the result of a personal deficit that hinders the performance of function and activities, into viewing disability with a more integrative and holistic paradigm that focuses on the dynamic

interaction between the person and the environment (DeJong & Hughes, 1982; Iwarsson & Stahl, 2003; Letts et al., 1994; U.S. Department of Education, 2006; Verbrugge & Jette, 1994). Several paradigms, frameworks, and models emphasized the importance of this conceptualization of disability, leading to an increasing impact on how health care providers practice and conduct research. Some examples are the integrative socioecological conceptual framework of disability (Moos, 1979), the biopsychosocial model (Engel, 1977), the social model of disability (Oliver, 1990), and integrative conceptual framework of disability (Tate & Pledger, 2003). Oliver (1990) argued that environmental barriers are proved to be greater factors in the "disablement" of PWD than their actual impairments. Subsequently, removing the social and physical environmental barriers is fundamental to increase their participation in the community and overall quality of life.

These frameworks and models coincide with the International Classification of Functioning, Disability and Health (ICF) model addressing function and disability as multi-dimensional concepts that relate to: (1) the body functions and structures of people (functioning at the level of the body); (2) the activities of people (functioning at the level of the individual); (3) the participation or involvement of people in all areas of life (functioning of a person as a member of society); and (4) the environmental factors which affect these experiences (and whether these factors are facilitators or barriers) (World Health Organization, 2002). The person's disability and level of functioning are conceptualized as outcomes of interactions between health conditions (diseases, disorders, and injuries) and contextual factors. Figure 1 illustrates the ICF model and displays how these different factors are intertwined to achieve participation. The

contextual factors include external environmental factors and internal personal factors. The personal factors influence how disability is experienced by the individual and are not specifically coded or classified in the ICF because of the wide variability among cultures. These factors include race, gender, age, educational level, and coping styles to name a few (Heerkens et al., 2017).

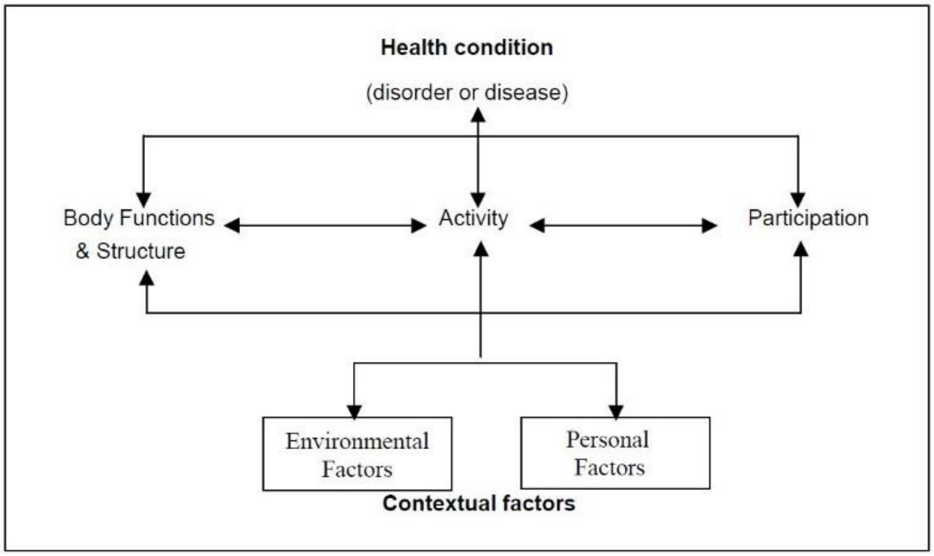


Figure 1: ICF disability model (World Health Organization, 2002)

Environmental factors make up the physical, social, and attitudinal environment in which people live and conduct their lives. Social attitudes, architectural characteristics, legal and social structures, as well as climate and terrain are some of these environmental factors. In the ICF model, disability is multidimensional and interactive, in which all components of disability are important, and any of them may interact with one another. The ICF model highlighted the importance of environmental factors because they affect every aspect of our lives and play an integral role in being an enabling or a disabling factor for community participation, especially for PWD (World Health Organization, 2002).

Merriam-Webster's Dictionary (2021) defines the environment as “the conditions that surround someone or something; the conditions and influences that affect the growth, health, progress, etc., of someone or something; the aggregate of social and cultural conditions that influence the life of an individual or community”. On a theoretical level, environment can be discussed on three main levels: micro, meso, and macro environments (Bronfenbrenner, 1977; Guy-Evans, 2020). The micro-environment refers to the persons and spaces closer to the individual. It usually addresses the living situation, such as the home environment, and the persons that share it, such as family members, roommates, and significant others. The meso-environment addresses the individual's community and the persons in it, such as workplace and work colleagues, school and classmates, restaurants, parks, and stores. The macro-environment refers to the society within which one lives. It includes structures, policies, and attitudes that define the society and its relationship to the person living in it (McColl & Bickenbach, 1998). These levels are not fixed, but rather, offer a conceptualization about the interaction between the person and the environment (McColl, 1998).

Not only does the environment need to be accessible for PWD, but they also need to interact and participate within the environment. The ICF model defines participation as involvement in a life situation. The ICF model categorizes participation into these domains: learning and applying knowledge; general task and demands; communication; mobility; self-care; domestic life; interpersonal interactions and relationships; major life areas such as work or school; and community, social, and civic life (World Health Organization, 2002).

Public Building Accessibility

Accessibility Legislation

The Architectural Barriers Act (ABA) of 1968 stands as the first measure by Congress to ensure access to the built environment for PWD. The ABA requires that buildings and facilities that are designed, constructed, or altered with Federal funds, or leased by a Federal agency, comply with Federal standards for physical accessibility (Architectural Barriers Act, 1968).

Section 504 of the 1973 Rehabilitation Act was the first disability civil rights law to be passed in the US. The following statement was of major importance for addressing the issue of accessibility for PWD:

> *"No otherwise qualified handicapped individual in the United States . . . shall, solely by reason of his handicap, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance or under any program or activity conducted by any Executive agency or by the United States Postal Service" (Section 504 of the Rehabilitation Act, 1973).*

The year of 1990 is recognized as a landmark year for PWD in the modern history of the US as the ADA civil rights law was enacted (ADA, 1990). The ADA is the comprehensive disability law which prohibits discrimination on the basis of disability and promotes equal opportunities for persons with disabilities in the areas of employment, access to public services, access to public and private transportation, and telecommunication services. Title III of the ADA mandates that all "public

accommodations to which the general public has access, including services, businesses, agencies, public transportation, and other entities, must be accessible to individuals with disabilities” (APA.org, 2021). Following the ADA, the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) were published in 1991. The ADAAG further defines the specific measurements that qualify a public facilities’ attributes as "accessible". In 2010, the ADA published revised and enforceable standards called the "2010 Standards for Accessible Design" (ADA, 2010).

Gaps in Public Buildings Accessibility

The definition of accessibility includes a common, everyday meaning as well as specific meanings in different contexts. According to Merriam-Webster’s Dictionary (2021), the word ‘accessible’ is an adjective synonymous with “approachable, at hand, attainable, available, close, convenient, handy, and within reach”. The concept of accessibility is multidimensional and can be viewed from different perspectives. It can be discussed in terms of accessibility to the physical environment, to information, or to societal activities and services (Iwarsson & Stahl, 2003), as well as in terms of micro, meso, and macro environmental levels (Bronfenbrenner, 1977; McColl & Bickenbach, 1998). It also can be viewed from different perspectives, including objective versus subjective or from an individual versus a group/population perspective. On the objective side, accessibility is concerned with the extent to which norms and guidelines in legislation and other official documents are met. On the other hand, PWD are the only experts on defining accessibility issues, and thus their subjective measure of accessibility should be addressed (Iwarsson & Stahl, 2003).

Looking at accessibility from an individual perspective calls for a client-centered approach, thus a more subjective rather than objective measure of accessibility, since the unique personal needs and requirements must be addressed. Most often this is the case when addressing PWD needs on a micro level, such as adaptations to the person's home environment. Several home accessibility assessments have been developed to address these needs on a micro level, Table 1 lists some of these assessments.

Considering accessibility from a group or population perspective is far more complicated due to the wide variety of capabilities that need to be addressed. This calls for legislations on a macro level to establish the norms and guidelines that can address these diverse requirements, such as the ADA accessibility guidelines in the US.

The actual interaction between PWD and the environment on a community level happens in the meso level. Therefore, the quality of the implementation and the possible limitations in the macro level legislations or the adherence to its accessibility guidelines will appear in the meso level. Thus, it is of empirical importance to have comprehensive, reliable, and valid professional environmental assessments that measure the accessibility of public buildings in relation to existing norms and guidelines. Particularly, assessments addressing these guidelines in relation to functional capacity in individuals or groups of individuals with disabilities.

The development of such guidelines needs a comprehensive theory ensuring that an inclusive design is being implemented to create environments which are capable of being used by a wide range of people. The major approach to achieve such inclusive design lies within Universal Design (UD) (Mace, 1985, 1997; Ringaert, 2001). In the US,

these macro level legislations currently reside in the ADA and its accessibility guidelines (ADAAG).

Universal Design (UD)

The concept of UD is based on the principle of designing a product, service, or environment for only one population which is comprised of individuals representing diverse characteristics and abilities. This is contrary to the idea of accessible design involving the normal population and the population diverging from normality (i.e. PWD) (Connell & Sanford, 1999; Iwarsson & Stahl, 2003; Steinfeld & Maisel, 2012).

UD as a term was first introduced by Ron Mace and is defined as “the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design” (Mace, 1985, 2008), or “the best approximation of an environmental facet to the needs of the maximum possible number of users” (Iwarsson & Stahl, 2003, p. 61).

The UD incorporates seven principles, illustrated in Table 2 (The Center for Universal Design, 1997), with the purpose of articulating the concept of UD in a comprehensive way and their implementation to all environments, products, and communications (Iwarsson & Stahl, 2003). In the built environment, barriers should be remediated by incorporating UD into the design process to provide physical access to environments, such as public spaces and buildings (Layton & Steel, 2015; Young et al., 2019).

Table 1: Home accessibility assessments

Name	Purpose	Population	Reliability and Validity
Safety Assessment of Functional and the Environment for Rehabilitation-Health Outcome Measurement and Evaluation (SAFER-HOME v.3) (Chiu et al., 2006)	Assesses client's ability to safely carry out functional activities in the home environment and evaluates effectiveness of modifications and changes in safety intervention over time.	Older adults Adults with Physical or cognitive disabilities	Content validity of the SAFER Tool was established through the use of a review panel of seniors and clinical experts, and was supported by item analyses (Letts & Marshall, 1996). High (0.83) internal consistency (Chiu & Oliver, 2006; Letts et al., 1998).
In-Home Occupational Performance Evaluation (I-HOPE) (S. L. Stark et al., 2010)	Measures in-home activity performance and change in fit of the person and his or her environment before and after home modification interventions.	Older adults	Good internal consistency (α range = 0.77 - 0.85). Excellent IRR across trained raters (ICC range = 0.94 – 1.0) (S. L. Stark et al., 2010) Good internal consistency. Excellent content validity (Keglovits et al., 2015)
Housing Enabler (Iwarsson, 1999)	Measure the accessibility of a particular environment for a particular person and relies on the perspective of an occupational therapist to identify the client's functional limitations and barriers in the environment.	Older adults Individuals with physical and perceptual functional limitations	Moderate to good overall inter-rater reliability (Iwarsson et al., 2005)
Comprehensive Assessment and Solution Process for Aging Residents (CASPAR) (Sanford et al., 2001)	Provide recommendations for home modifications without having to perform an on-site assessment. It can be administered by an older adult, a family member, or non-specialist therapist to identify problems in undertaking in the home environment.	Older adults Individuals with a variety of impairments	Good criterion validity High inter-rater reliability (Sanford et al., 2001)

Table 2: Universal design principles

Principle	Definition
Equitable use	Usable and marketable to people with diverse abilities
Flexibility in use	Accommodates a wide range of individual preference and abilities
Simple and intuitive use	Easy to understand, regardless of experience, knowledge, language skills or current concentration level
Perceptible information	Communicates necessary information effectively, regardless of ambient conditions or sensory abilities
Tolerance for error	Minimizes hazards and adverse consequences of accidental or unintended actions
Low physical effort	Can be used efficiently and comfortably, with a minimum of fatigue
Size and space for approach and use	Appropriate size and space for approach, reach, manipulation, and use regardless of body size, posture, or mobility

Macro level

The creation of the ADA and its updated accessibility guidelines (ADAAG) in 2010 allowed thousands of PWD to gain access to formerly inaccessible community buildings by providing standards and guidance for accessibility and accommodations aimed at removing barriers to facilitate community social participation (Umeda et al., 2017). Although implementation of the ADA and its accessibility guidelines has been challenging, great strides have been made toward increasing the accessibility of public and private spaces for people with various types of impairments.

Despite this great advancement in enhancing public buildings to increase accessibility for PWD, the ADAAG remained limited for several reasons: (1) the ADA provides only absolute minimal guidelines for building features, but documentation emphasizing a best practice approach which goes above and beyond the minimum requirements of ADA to achieve a greater degree of accessibility that results in full

inclusion of PWD is still limited (Voight et al., 2008); (2) older and historic buildings are exempt from ADAAG, and a reporting system describing accessibility barriers that is personalized to the impairments of PWD is missing; and (3) accessibility is relative and based on persons' functional capabilities, and the ADAAG only provides information on compliance with technical norms and standards, and falls short on measuring the performance of how a building or setting actually works for a range of users (subjective experience) (Edwards et al., 2018; Flores-Boffa, 2018; Hammel et al., 2015; Iwarsson & Stahl, 2003; Rimmer et al., 2017; Tutuncu, 2017; Umeda et al., 2017).

Meso level

As mentioned previously, most, if not all, the reported accessibility issues are not on a micro-environment level since the modifications made in home environments are custom-tailored to fit the needs of the individual with a disability and the members sharing the same space with him/her. In public buildings, these accessibility issues are mostly focused on the meso-environment level due to the larger pool of users with various capabilities and disabilities. The following direct quotations from PWD in an article by Hammel, et al. (2015) exemplify this problem.

> *"I've got my home all set to go; it's completely accessible. But if I go outside my home, it's a different story...stores, train stations and bus stops, places to eat, and especially bathrooms; bathrooms anywhere are a big problem. So my wife and I land up calling ahead and they say yes, they are ADA accessible, but when we get there, there's no way they are accessible. So we go back home or only go to the places we know are good. So when you asked me do I participate, I'd say back "it depends"; it depends on lots of things" (2015, p. 582).*

“There’s so many places in the city that aren’t accessible. I used to go to them before the SCI and haven’t since cause I can’t count on being able to get in the door. Or the bathroom” (2015, p. 585).

A recent cross-sectional survey data set reported similar experiences that reveal the continuing limitations of the ADAAG. The survey linked the accessibility of public buildings, personal accessibility experiences, and the role that accessibility information might play in assisting PWD with their community participation (Burns, Mendonca, et al., 2021). This survey was distributed by a local independent living center and generated 109 complete responses from PWD with a mean age of 54 years that ranged from 24-84 years. The participants self-reported their disabilities or responded on behalf of PWD and completed a brief 23-item questionnaire with 22 closed-ended questions and one open-ended item. The results yielded that 70% of respondents experienced arriving at an establishment only to be presented with a barrier that prevented them from accessing the building; and 60% report being unable to complete a task related to the building due to an environmental barrier. Accessibility knowledge was further examined in this study, and it was reported that 69% of participants have been in a situation where accessibility information about a building prior to arriving would have been beneficial. In addition, 87% thought having known about building accessibility would support planning community activities. Participants were also questioned regarding technology and results demonstrated that 98% respondents identified having access to a computer or mobile device, yet only 13% indicated that they were familiar with any apps that provided accessibility information. Seventy-one percent of participants responded being “probably” or “definitely” interested in an app designed to provide accessibility

information about buildings. While this local survey is not conclusive, the data and qualitative responses corroborate many of the frustrations depicted in the literature. The following are some direct quotations from PWD who participated in the study.

> *“I called ahead to a restaurant to ask whether it was accessible for wheelchairs. They said it was. I wheeled the two miles to the location to find only steps into the place. I phoned them to ask where the accessible entrance was and they said to meet them at the side door where there was a step of about 7 inches high. They came out and told me to "tip back in the chair" a power wheelchair) and they would get me in. (They were going to lift the chair and me up into the building.) I told them "No way!" and left."*

> *"Looking for an accessible entrance and not being able to find one is embarrassing and it confuses me as to why I and others with mobility issues who use accessible entrances would be embarrassed by a public buildings' noncompliance with the ADA and the Rehab Act of 1973. [It] feel[s] incredibly foolish racing around a rather large building in the dark and never uncovering the hidden accessible entrance" (Burns, Mendonca, et al., 2021).*

Furthermore, Smith et al. (2019) explain that “… while it may seem obvious that people with disabilities experience barriers to full participation, this has not been reported” and many issues in the disability community go unreported, making it difficult to determine how to solve accessibility issues.

These personal experiences reveal critical limitations of the current practices of measuring the accessibility issues and barriers in the built environment that PWD are facing to community participation due to (1) the lack of sufficient personalized

accessibility information for public buildings, and (2) some buildings claim to be ADA compliant; however, they are still inaccessible for some PWD. These problems highlight the need for a system that can professionally measure the accessibility of public buildings and their objective adherence to the ADAAG, while also being capable of capturing the subjective experience of PWD. The system should also provide personalized accessibility information where PWD can have detailed accessibility information on the accessibility of a building in regard to their personal needs. Lastly, the system should include a comprehensive accessibility assessment tool that is generic and is able to identify the barriers hindering PWD from accessing and using any public building.

Accessibility Assessment Tools for Public Buildings

The complex nature of the relationship between environment and participation, and the lack of proper conceptual and operational definitions, have created confusion in defining the best approach to measure them. Thus, it is not surprising that there is no commonly accepted, metrically sound tool to measure either of these constructs on a community level. The complexity of measuring the environmental factors is reflected in the heterogeneity among the developed instruments, as there are several aspects of interest depending on what is measured or the purpose of the measurement (Alvarelhão et al., 2012; Whiteneck & Dijkers, 2009).

Two approaches were mainly used for the development of accessibility assessment tools for the built environment. One approach focused on measuring the subjective experience of the users in order to identify the barriers in the environment. The other approach calls for constructing an objective measure to design questions that

elicit objective reports of the environment (Alvarelhão et al., 2012; Dickinson & Colver, 2010; Magasi et al., 2015; Whiteneck & Dijkers, 2009). Several wide-ranging, general-purpose instruments were developed to assess the influence of the environment through measuring the subjective experience of the person's perceived needs, external environment, and outcomes. Specifically, these instruments are targeting the measurement of environmental barriers through reflecting on the individuals' needs and their aspirations to participation. Although the personal subjective experience of users is integral, it does not deliver objective reports of the environment (Dickinson & Colver, 2010).

Each approach presents its own challenges and shortcomings. Although the subjective experience is best to address an individual's needs, it only addresses accessibility barriers from a single user's perspective. Thus, if a comprehensive assessment of accessibility barriers is desired, a large pool of users, covering the wide range of abilities and disabilities, is needed to assess each building to identify all the present barriers, which make this approach impractical and almost impossible to achieve. Objective measures, on the other hand, are required to be extensive and assess each element of the built environment against the wide range of needs of users and their unique capabilities and disabilities. Therefore, such instruments are lengthy and time consuming, and their development requires a team of experts that understand the different needs of PWD.

The two approaches are equally important and needed in order to provide a comprehensive assessment of the environment (Garcia et al., 2015; Magasi et al., 2015; Mosca & Capolongo, 2018; Rimmer et al., 2017; Umeda et al., 2017). In their

paper, Magasi et al. (2015) argued that there is no single best approach to the measurement of the environment, and multimodal approaches that integrate both self-report and objective measures are most appropriate. They also suggested that the integration of data visualization techniques to provide accessibility information is necessary and can empower people, especially PWD, to plan out participation in diverse environmental contexts such as restaurants, movie theaters, and doctors' offices.

In summary, the complex nature of measuring the accessibility of the built environment requires the development of measurement instruments (systems) that are able to capture both objective (adherence to accessibility guidelines) and subjective (users' experiences) accessibility issues; generalizable to be used for different types of public buildings; have sound psychometric properties; comprehensive in terms of identifying barriers beyond "visible" disabilities; practical, as such instruments are intensive and time consuming; and have an adequate training protocol.

Currently Available Assessment Tools

Several accessibility assessment tools for the built environment have been developed. Each have their strength and limitations. Some of these tools measure the environment objectively such as the ADA Checklist (ADAChecklist.org, 2021) and the Accessibility Instruments Measuring Fitness and Recreation Environments (AIMFREE) (Rimmer et al., 2004). The ADA Checklist is one of the most commonly used accessibility assessments. It intended to identify the accessibility barriers in a building, but no studies were conducted to test its reliability or validity. Even though it represents the minimum required standards in the ADAAG, it comes with a disclaimer that it is not

meant to be used as a guide to measure all building accessibility standards nor does it even include all the standards that are required by law (ADAChecklist.org, 2021). The most frequently cited environmental measures for community buildings in the rehabilitation literature are the Craig Hospital Inventory of Environmental Factors (CHIEF) (Whiteneck, Harrison-Felix, et al., 2004; Whiteneck, Meade, et al., 2004), the Community Health Environment Checklist (CHEC) (S. Stark et al., 2007), the Facilitators and Barriers Survey of environmental influences on participation (FABS) (Gray et al., 2008), and the Measure of the Quality of the Environment (MQE) (Fougeyrollas et al., 2002; Garcia et al., 2015). A comparison chart discussing the major strengths and limitations of these tool is presented in Table 3. A comprehensive list of the available accessibility measures of community buildings is available on the Rehabilitation Research Design and Disability (R_2D_2) center website (R2D2 Center, 2021b). The list provides information about the types of targeted buildings, population, users, and the type of scale for each assessment.

Relevance to the Field of Occupational Therapy

Occupational therapy (OT) is a holistic and inclusive profession. Thus, it is not surprising that several occupational theorists and authors emphasized the importance of the person – environment relationship even before the enactment of the ADA (Dunning, 1972; Fidler & Fidler, 1978; Kielhofner & Burke, 1980; King, 1978; Reilly, 1962). After the ADA, this relationship became a central theme of theorists and authors (Baum et al., 2015; Christiansen, 1991; Clark et al., 1991; Dunn et al., 1994; Gage, 1995; Law et al., 1996; Schultz & Schkade, 1993; Smith, 2017).

Table 3: Most cited and used public buildings assessment tools

Instrument	Description	Strengths	Limitations
ADA Checklist	Quantify elements of public buildings' built environment. Four priorities: 1) Accessibility approach and entrance 2) Access to goods and services 3) Access to public toilet rooms 4) Access to other items: such as water fountains	• Provides ADAAG codes. • Detailed assessment of the building accessibility barriers • Can be used to all public buildings	• Users' perspectives are not measured • No reliability or validity studies.
Accessibility Instruments Measuring Fitness and Recreation Environments (AIMFREE)	Survey containing several questions about various elements of fitness facilities, including physical environment, equipment, programs, policies, training, and staff behavior. Its purpose is to measure the accessibility of fitness or recreational areas for persons with mobility or sensory impairments. Subscales: General measures of accessibility: 1) Bathrooms 2) Elevators 3) Entrance areas 4) Parking lot 5) Telephones 6) Water fountains Fitness center-specific measures of accessibility: 1) Equipment 2) Fitness program 3) Hot tubs/saunas 4) Information 5) Locker rooms 6) Policies Professional behavior Professional knowledge/attitudes Professional support and training Swimming pool	• Provides ADAAG codes. • Detailed assessment of the fitness facility accessibility barriers.	• Not generalizable to other public buildings. • The current version was not designed to measure accessibility for persons with cognitive disabilities.
Community Health Environment Checklist (CHEC)	Measures the aspects of the physical environment and the usability of public buildings, such as stores and restaurants, on features that people with disabilities find important, in	• Provides some ADAAG codes • Measures the perspective of PWD on	• Does not identify accessibility barriers specific to the built environment.

	relation to 1) mobility, 2) hard of hearing, and 3) low vision.	accessibility barriers	• The current version was not designed to measure accessibility for persons with cognitive disabilities.
Craig Hospital Inventory of Environmental Factors (CHIEF)	Long-version: 25 Short version: 12 Quantification of barriers experienced within five domains of environmental factors: 1) Policies 2) Physical and Structural 3) Work and School 4) Attitudes and Support 5) Services and Assistance	• Measures the subjective perspective of PWD on accessibility barriers to participation	• Does not identify all accessibility barriers specific to the built environment
Facilitators and Barriers Survey (FABS)	Survey of environmental facilitators and barriers to participation by people with mobility impairments. 65 main questions organized into 6 sections: 1) personal mobility devices 2) home environment: features 3) community environment: features 4) community destination access 5) community facilities accessibility 6) community environment: services and attitudes	• Measures the subjective perspective of PWD on accessibility barriers to participation	• Does not identify accessibility barriers specific to the built environment
Measure of the Quality of the Environment (MQE)	Assess the role of environmental factors in one's ability to maintain life habits in relation to their limitations and capacities. A list of 109 items divided into 9 domains: 1) social network 2) attitudes of the family 3) labor market 4) income 5) commercial services 6) judicial services 7) socio-sanitary services 8) educational services 9) public infrastructure services, community organization services, physical accessibility, lands, roads	• Measures the subjective perspective of PWD on accessibility barriers to life participation and quality of life	• Does not identify accessibility barriers specific to the built environment

	and distances, natural elements, objects, technology, technical aids, political systems, social rules		

A prime example of one of these models is the Person-Environment-Occupation (PEO) model (Law et al., 1996). The model emphasizes occupational performance as it is shaped by the interaction between the three domains: person, environment, and occupation. The person domain includes person-related characteristics such as cultural background, personality, health, cognition, physical performance, and sensory capabilities. The environment domain focuses on the physical, cultural, institutional, social, and socio-economic environment that a person lives in. The occupation domain refers to the groups of tasks and activities that individuals engage in and meet their self-maintenance, expression, and fulfillment needs. The PEO model conceptualized the three domains to be dependent on one another to create a person's occupational performance as it is dynamically shaped by the overlapping area of the three domains, representing the level of congruence of the interaction between the domains. The higher the level of congruence, the higher the quality of occupational performance. The occupational performance is viewed through a lifespan perspective in which all three domains would change throughout one's life. This model can serve as the backbone theory to the development of assessment tools to understand and analyze problematic areas that affect clients' occupational performance through enhancing the congruence of the three domains.

The PEO model along with the Occupational Therapy Practice Framework (OTPF) itself emphasizes the crucial role occupational therapists (OTs) have as players

in assessing the accessibility of the environment for PWD. The OTPF defines context "as the environmental and personal factors specific to each client (person, group, population) that influence engagement and participation in occupations" (AOTA, 2020, p. 9). The OTPF emphasizes the role of context as an enabling and disabling factor for participation, and OTs should recognize that for individuals to truly achieve full participation, meaning, and purpose, they must not only function, but also engage comfortably within their own distinct combination of contexts (AOTA, 2020).

To further the discussion about the role of OTs in this process, Smith in his 2017 Eleanor Clarke Slagle Lecture, listed some of the unique features that that occupational science and occupational therapy provide, which makes OTs inclusive in many perspectives:

> *"We are broadly educated across the liberal arts and the social, physical, and biological sciences.*
>
> *We bring the perspective of an applied therapy profession that practices across all settings in which people live, work, and play. We speak the languages of acute, chronic, and community health; education; vocational success; and community participation without hesitation.*
>
> *We overtly create interventions to optimize the quality of life for everyone. This includes all people with all types of disabilities and impairments—motor, sensory, cognitive, and behavioral.*

We fundamentally understand all domains of human functional performance and its interactions with a full range of contexts and environments" (Smith, 2017, p. 8).

Several authors and pioneers in the OT field argued that OTs have a unique understanding of the diseases/disabilities and life span development and how these processes affect function and participation, specifically, how improving home and community environments through UD and accessibility improves functional ability outcomes (Young et al., 2014, 2019). They can play an important role in raising public awareness and advocating for UD, ADAAG, and aging in place by implementing the concepts of UD in home and community environmental modification and design collaborations (Rickerson, 2009; Young et al., 2019). Thus, UD should be used as a framework to enhance usability and access in public spaces, and the involvement of OTs in the built environment design and assessment is vital (Jenkins et al., 2015).

Looking over the involvement history of OTs in environmental accessibility, we can see that OT practice has been mainly focused on a client-centered approach that addresses the direct contexts of the clients on a micro-environment level, such as home environment, with less impact on community-based services.

In her 1994 Eleanor Clarke Slagle Lecture, Grady (1995) challenged OTs to be leaders in the development of inclusive communities to empower the participation of all individuals in the community. Some of these challenges that need to be addressed were "Developing programs that prepare people and their families for life in the community while working to prepare the community to welcome the gifts of diversity"; "Making a commitment to inclusion in community for all persons"; and "Developing skill in

analyzing environments and helping people identify the type of environmental milieu that will facilitate their adaptation process" (Grady, 1995, p. 309). All of these challenges are just as relevant today as they were more than a decade ago because community accessibility still presents as a major challenge for PWD.

These challenges are exemplified in the AOTA "Vision 25" for the occupational therapy profession to continue moving forward. The most recent statement for the ultimate vision of occupational therapy as a profession states, "Occupational therapy maximizes health, well-being, and quality of life for all people, populations, and communities through effective solutions that facilitate participation in everyday living" (AOTA, 2017, p. 1).

Participation is recognized as the 'raison d'être' of occupational therapy, and the main unique contribution of OTs to society (Law, 2002). Law (2002) emphasized that "*Occupational therapy, at its best, recognizes the force of the environment as a means of intervention*" (p. 646), and for participation to occur on a community level, we need to focus intervention on changing environments. Therefore, it is essential to prepare occupational therapy students from an educational perspective to work with communities and with organizations of PWD and not simply with individuals (McColl, 1998), and to increase their knowledge of the ADA standards to put them in a better position to advocate for and create inclusive environments (Redick et al., 2000).

The AccessRatings for Buildings (ARB) Project:

For over a decade, the R_2D_2 at the University of Wisconsin-Milwaukee (UWM) has been working on the ARB project which aims to develop a mobile and web-based

system with the goal of providing up-to-date accessibility information about public buildings for PWD, their families and friends, and building owners (R2D2 Center, 2021a). The ARB Project is funded by the National Institute of Disability and Rehabilitation Research (initially funded by NIDIRR, later renamed NIDILRR).

This system comprises two main components (apps), AccessPlace and AccessTools, and three mini-apps, AccessSlope, AccessRuler, and AccessSound. These apps serve as data collection platforms to gather detailed accessibility information from building visitors with accessibility needs (subjective ratings) as well as trained accessibility evaluators through performing a comprehensive assessment of the building's publicly visited areas, collecting a significant number of objective measurements. Data collected from both parties are merged into an accessibility report that allows interested parties, such as building users, building evaluators, and building overseers (owners, managers, and policy makers) to view the identified accessibility barriers in a building (R2D2 Center, 2021a).

The ARB project utilizes the PEO model as the backbone theory for the development of the two main components, AccessTools and AccessPlace. AccessTools primarily assesses the environment characteristics (E component) of the built environment and identify accessibility barriers with regard to the person's (P component) capabilities. AccessPlace addresses the effects of the built environment on occupation (O component). Collectively, AccessTools and AccessPlace are able to assess the environment from an objective perspective and from users' experience (subjective) perspective.

AccessPlace

AccessPlace is a multi-platform mobile and web app, designed for building users, such as PWD, to rate accessibility features of a building, communicate encountered accessibility barriers, and obtain Personalized Accessibility Information (PAI) tailored to the individual's functional impairments (R2D2 Center, 2021a). The users create a profile addressing their impairments, and the system will personalize the display with building information that is most relevant to their specific accessibility needs. AccessPlace utilizes a star-rating system that allows users to rate the accessibility features of a building. Users may also view ratings and reviews provided by other PWD and building visitors concerning the accessibility of a building. This system provides the accessibility details to inform PWD about environmental challenges that they may encounter, identify buildings/businesses that are accessible for them, plan alternatives, bring assistance, or avoid particularly inaccessible buildings/businesses. This much needed accessibility information about barriers of public buildings will empower PWD and enhance their level of participation in the community.

AccessTools

AccessTools is an iOS app that is designed to be used by trained assessors to evaluate, document, and quantify the accessibility details of building elements. It incorporates detailed taxonomy including building types, general building elements, detailed ADAAG requirements, and additional functional building elements related to accessibility into one mobile application so the accessibility features of entire buildings can be assessed (R2D2 Center, 2021a).

Development of AccessTools

With the goal to be a comprehensive assessment tool that can be used to assess any building, AccessTools includes generic building elements, as well as specialty features. At this point, it only includes one specialty feature element for restaurants. The taxonomy of the AccessTools was developed based on several previously developed tools and AUDITs (Accessibility and Universal Design Information Tool), such as the Doorway AUDIT, Elevator AUDIT, Accessible Route AUDIT (R2D2 Center, 2021b), and the Restaurant Accessibility and Task Evaluation Information Tool (RATE-IT) (Park et al., 2020). Specialty features for the different public buildings, including but not limited to museums, libraries, and governmental buildings, will be added in the future. The current taxonomy is comprised of ten main elements: Health Safety Measures; Parking & Valet Parking; Main Entrance/Exterior Doorway(s); Other Entrance(s)/Emergency Exit(s); Reception & General Information; Indoor Routes; Seating; Restroom(s); Other Interior Doorway(s); Specialty Features (Restaurants).

Each element branches into several roots (sub-elements) until reaching the last level, referred to as the leaf level, to provide more specific and detailed questions to help the assessors make informed decisions about the accessibility of the building. Thus, each branching level contains booth root and leaf level questions, but only root level questions continue to branch. For example, the “Main Entrance/Exterior Doorway(s)” element includes: “Main Entrance Level Changes”; “Size of Doorway(s)”; “Floor”; “Opening & Closing”; “Ease of Lock”; “Visibility”; “Automatic Doors”; “Automatic Door Switch”; “Door Stops”; and “Signage”. Each one of these sub-elements is considered a root level question, and branches into either a subsequent root or leaf

level question, to provide the assessor with more details regarding the different features that need to be assessed.

The assessment contains 2,624 questions in total (Obiedat et al., 2021). In order to make the assessment more efficient, the AccessTools software utilizes a Trichotomous Tailored, Sub-branching Scoring (TTSS) system to elicit accessibility scores of each element and sub-element (Smith, 2002). For each question, the software

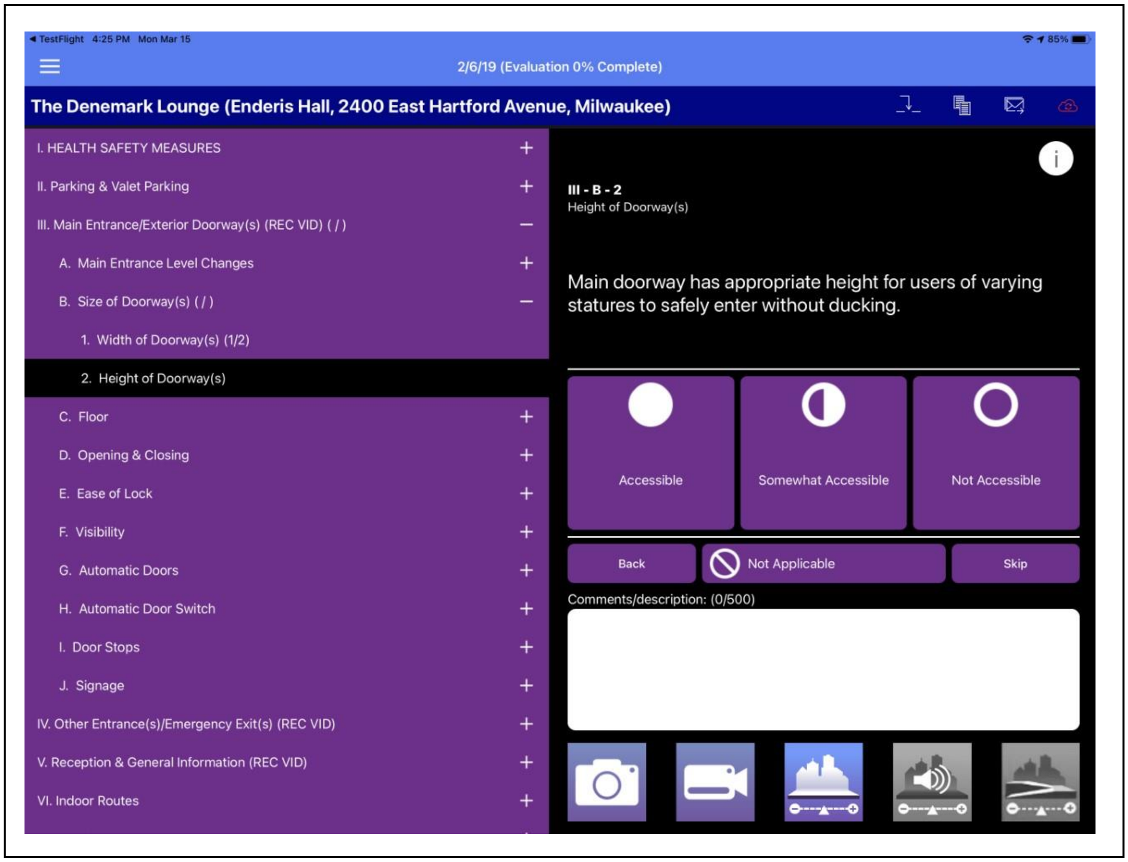


Figure 2: Screenshot of the AccessTools app

asks if a building feature is ‘Accessible’, ‘Somewhat Accessible’, ‘Not Accessible’, or ‘Not Applicable’ and uses skip logic to auto advance through hundreds of questions about the building to optimize user efficiency. Figure 2 depicts the expanding outline and scoring screen.

Three mini-apps were imbedded in the AccessTools app to reduce the time needed to perform the assessment. These apps are also available as stand-alone apps, and include: AccessSlope, AccessSound, and AccessRuler. These mini apps leverage the use of the iPad sensors to quickly measure inclines and decibels in the context of accessibility, thus removing the need for separate tools such as a level and clipboard. The iPad can also be paired with a laser ruler to measures distances for improved accuracy. The app also enables assessors to take photos and videos of specific building elements in order to provide a complete picture of an identified accessibility barrier.

Benson and Clark (1982) published a step-by-step guide for instrument development and validation. The guide identified four phases: Planning, Construction, Qualitative evaluation, and Validation. The development of AccessTools went through the planning and the construction phases, and the focus of this study targets the last two phases. To illustrate the validation process of AccessTools, a modified version of the step-by-step guide for instrument development and validation by Benson and Clark (1982) is presented in Figure 3.

The measurement of the construct “accessibility” and the development of instruments measuring this construct should follow a clinimetric approach (Magasi et al., 2015; Whiteneck & Dijkers, 2009). This is apparent since environmental factors do not represent a unitary hierarchically arranged construct as psychometric approaches to measurement assume (Magasi et al., 2015). Thus, the measurement of “causal indicators” used in clinimetrics, which are items that together create the construct of interest, is desired (Magasi et al., 2015; Whiteneck & Dijkers, 2009). In a clinimetric

approach, the identification of a set of indicator items that each make an incremental and unique contribution to the phenomenon of interest is the main goal for instrument developers (Feinstein, 1987).

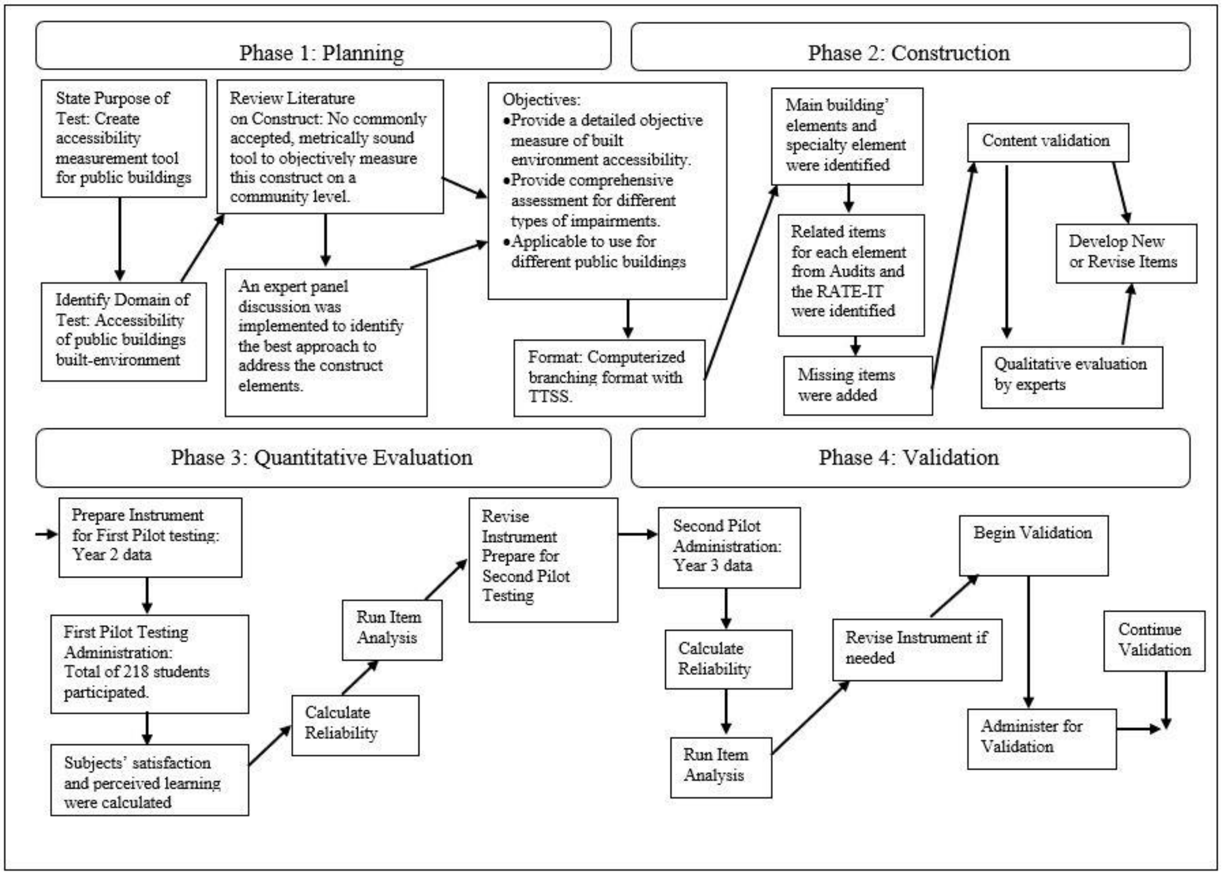


Figure 3: Phases of AccessTools instrument development and validation

The development of an instrument using clinimetrics presents a number of implications for determining the reliability and validity of the data produced by the instruments created to measure the environment (Whiteneck & Dijkers, 2009; Wright & Feinsten, 1992). Psychrometric properties including content validity, sensitivity, responsiveness, and test-retest as well as interrater and intrarater reliability are important for clinimetric measures. However, assessments of construct validity and

internal consistency reliability that are based on interitem correlations are irrelevant (Whiteneck & Dijkers, 2009).

The overall goal of the AccessTools app is to create a comprehensive accessibility assessment tool, capable of identifying any physical accessibility barriers that might hinder the participation of individuals with physical, cognitive, visual, or auditory impairments. An assessment that is detailed but applicable, time efficient, reliable, and valid. To achieve this goal, the lead developer of the AccessTools Assessment and the director of the R_2D_2 Center at the University of Wisconsin-Milwaukee (UWM), Dr. Roger Smith, included experts from the occupational therapy programs in Florida International University (FIU), Texas Woman's University (TWU), and Columbia University (CU) to help with the development and validation process of the assessment, as well as developing a training program to educate students on accessibility issues and how to use the assessment, which was led by Dr. Jaclyn Schwartz.

The data collection for this project took place during the 2018 – 2019 (Year 1), 2019 – 2020 (Year 2), and 2020 – 2021 (Year 3) academic years. Data collected from Year 1 were used to study the feasibility of the training program including students' performance, perceived learning, and satisfaction, and to test and improve the AccessTools software and user interface.

On Year 2, the participants in the study completed the training protocol and performed on-site accessibility assessments using the AccessTools assessment. In Year 3, performing on-site accessibility assessments were prohibited due to the COVID-19 pandemic. In response to this situation, the research team decided to use video

recordings of restaurants to enable students to perform virtual assessments using the AccessTools app. Detailed video recording of three restaurants were created, which helped in identifying the detailed aspects and measurements that need to be included in the recordings. Although the use of video recordings for accessibility evaluation of buildings is not optimal, it represents a helpful option under the COVID-19 pandemic. Using recordings for accessibility assessments could also be of substantial importance for raters' training, by providing initial exposure to the assessment tool and defining standardized minimum requirements for interrater agreement to be considered a professional rater. More details about the study protocol for each year are provided later in the methodology section.

The focus of this study was to continue the previously made efforts to validate and test the interrater reliability of the assessment, as well as studying the effects of some aspects of the training protocol in order to improve the IRR of the AccessTools assessment.

III. METHODOLOGY

Quantitative Research

Aims and Research Questions

The aim of this project was to study interrater reliability (IRR) properties of the AccessTools assessment. To date, there has been no research conducted that has explored the IRR property of the AccessTools assessment. Three studies were conducted to address the following research questions:

Study 1: To study the IRR of AccessTools after performing on-site assessments, and the effects of training on the IRR of the tool.

Research Questions:

1.1 What is the IRR of the AccessTools assessment while performing on-site assessments of restaurants?

1.2 Are there significant differences between the trained and non-trained raters across the different collection sites?

Study 2: To study the IRR of AccessTools after performing video-simulated assessments, and the effects of training, raters' educational level, collection sites, and students' performance in the knowledge quiz on the IRR of the tool.

Research Questions:

2.1 What is the IRR of the AccessTools assessment while performing video-simulated assessments of restaurants after excluding questions that cannot be answered from the videos?

2.2 Are there significant differences between the following groups on the IRR of the tool?

a. Trained and non-trained raters?

b. Different raters' educational level?

c. Different collection sites?

d. Students' performance in the knowledge quiz?

Study 3: To examine how variations in answering parent-level questions in TTSS affects IRR of AccessTools.

Research Questions:

3.1 How much leaf level unreliability is associated with unreliability at the root level?

3.2 What is the effect of the contingent, multi-level TTSS structure on reliability?

Hypotheses

It was hypothesized that the overall and the individual element IRR of the AccessTools assessment to show at least ‘Moderate’ level of agreement (0.41 – 0.60), based on the Landis and Koch Kappa's Benchmark Scale (Gwet, 2018), for both the on-site and the video-simulated assessments. It was anticipated that the trained group and the students who had a better performance in the knowledge quiz would have a significantly higher agreement coefficient. No differences were expected when comparing the agreement coefficient between collection sites and students’ educational background after receiving the training.

In the TTSS methodology, branching questions provide more details about an element, and thus, the likelihood of having more accurate answers increases as a rater answers questions closer to the leaf level. However, branching down to the leaf level increases the time demand for completing an assessment. It was hypothesized that reliability would decrease amongst questions/items with a larger number of TTSS branches, but the extent of change was unknown. This analysis provided recommendations for the level of branching required to maintain an acceptable level of agreement.

Study Design

For Study 1 and Study 2, a cross-over design was used (Maxwell & Delaney, 2003). This design compares two or more conditions, with each experimental group receiving all interventions in a random sequence. The design is illustrated in Figure 4, in which in phase I, the first experimental group (Group A) completes condition X and in phase II they complete condition Y; whereas the second experimental group (Group B) completes condition Y first and later completes condition X (Dinu et al., 2019).

This design was mainly used to assess the effects of a training module on users' (students') performance while using the AccessTools assessment for restaurant evaluation. Participants were randomly assigned to take either the training first or to perform the restaurant evaluation first, then complete the other condition.

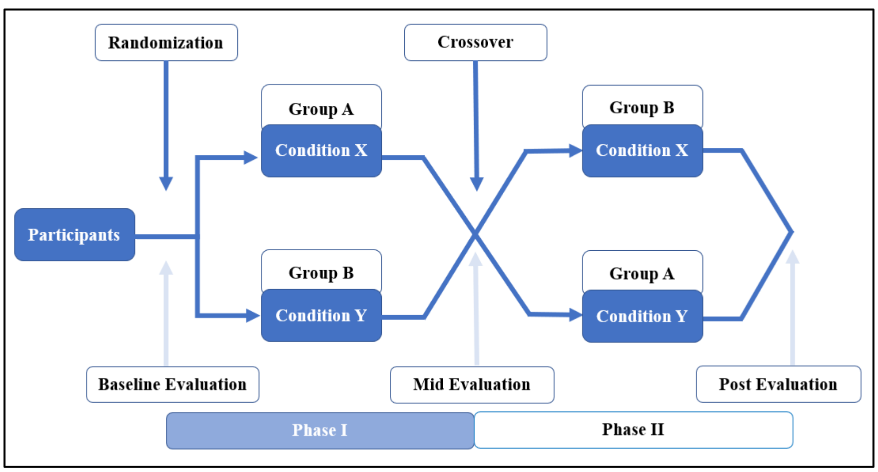


Figure 4: Crossover Design

Procedures:

Location:

For this study, the data collection took place in two academic years. Year 2 (2019 – 2020), and Year 3 (2020 – 2021). For Year 2, casual counter-service type restaurants

were targeted in the cities of Milwaukee-Wisconsin, Miami-Florida, New York City-New York, Denton and Houston-Texas. Table 4 illustrates the number of restaurants that were identified for data collection in the different cities.

In Year 3, because of the COVID-19 pandemic, performing on-site accessibility assessments were prohibited. Thus, video-simulated assessments were used. Detailed video recording of three casual counter-service type restaurants were created.

The restaurants were selected to represent different accessibility levels, with Restaurant A being the least accessible. The videos included detailed measurements of the main four elements from AccessTools (Main Entrance, Indoor Routes, Seating, Restrooms), such as dimensions, slope measurements, door handles height. For example, the main entrance door height and width (using yard sticks) were recorded in the video with static closeup pictures of the measurements. Figure 5 provides some screenshots from the recorded videos for the different restaurants (See Appendix C for recording protocol).

Table 4: Number of restaurants assessed in each city during Year 2

City	Number of restaurants
Milwaukee-Wisconsin	16
Miami-Florida	4
New York City-New York	5
Denton-Texas	3
Houston-Texas	3

Sample

After obtaining permission from all restaurants for this study, participants were recruited from students taking Assistive Technology related courses from UWM, CU, FIU, and TWU. The number of participants from each university for each data collection

year are illustrated in Table 5. For both Year 2 and 3, participants in the study from FIU, CU, and TWU were students in the entry-level Master or Doctoral programs in Occupational Therapy. Participants from TWU were from three different campuses in Houston, Denton, and Dallas. At UWM, participants educational levels and backgrounds were mixed. Table 6 lists the students' educational levels and the courses where the data collection took place. For Year 3, an additional three Masters' students in the OT program at UWM were recruited to perform a reliability study on the three recorded videos of the restaurants that were used in Study 2.

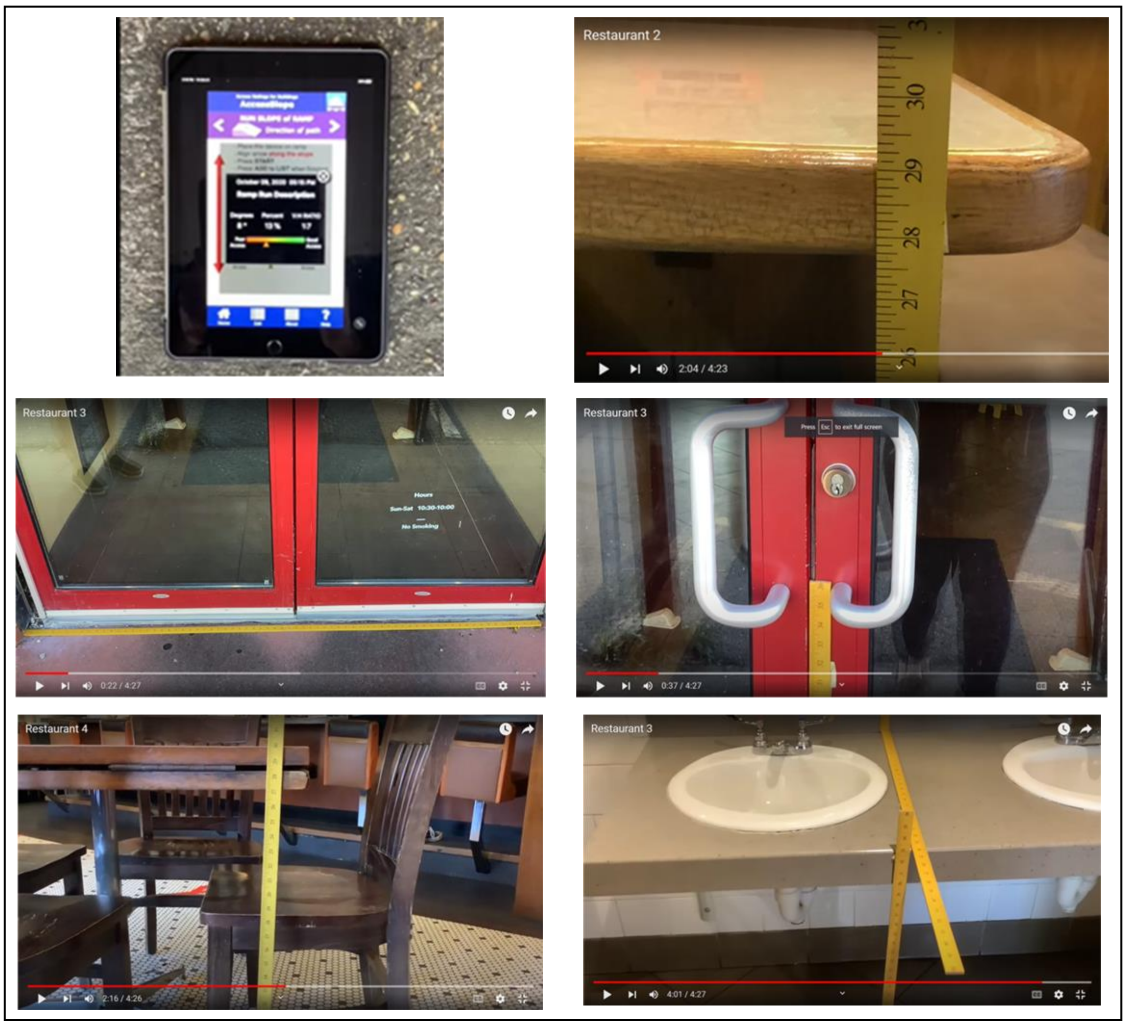


Figure 5: Screenshots from the recorded videos for the different restaurants

Table 5: Number of Participants in Year 2 & 3

Site	Number of students	
	Year 2	**Year 3**
UWM	32	98
FIU	46	41
TWU	91	163
CU	50	53
Total	**218**	**355**

Table 6: Description of Participants from UWM

Course	Data collection Year	Number of Students	Educational level
Evidence for Practice II OCCTHPY – 542	2	32	Graduate MSOT
Design and Disability OCCTHPY – 625	3	30	Mixed graduate and undergraduate students from different disciplines
Introduction to Assistive and Rehabilitation Technologies OCCTHPY – 620 & 521	3	47	Mixed graduate and undergraduate students from different disciplines
Gizmos and Gadgets: Introduction to Assistive Technology OCCTHPY – 220	3	21	Undergraduate students

Instrumentation

In Study 1 and Study 2, students completed four study instruments: demographics questionnaire, two-part knowledge quiz, a satisfaction and self-perceived learning survey, and a building assessment tool. For Year 2, students only used AccessTools assessment, while in Year 3, students either used AccessTools assessment or the ADA Checklist. Table 3 provides a description about each instrument.

Table 7: Instruments' description

Instrument	Description
Demographics questionnaire	Students described their age, gender, race/ethnicity, and current GPA.
Two-part knowledge quiz	Part 1: 20 multiple choice questions evaluating students' knowledge of community accessibility. Part 2: two short answer questions where students were asked to list the accessibility issues present in a picture of a bathroom and an entrance. Students completed the knowledge quiz on 3 different times (Pre-test, Post-lecture, and Post-lab). No feedback were provided after completing the quiz at the three timepoints. Figure 6 provides a sample of the questions that were included in the quiz.
Satisfaction and self-perceived learning survey	After completing each module in the on-line training, students were asked to select an answer for the following questions: How much did you learn in this module? (Answers: Very little; Little; Much; Very much) How satisfied were you with this module? (Answers: Not satisfied; Satisfied; Very satisfied)
Building assessment tool	**AccessTools assessment:** **Year 2:** AccessTools app, version 4 (build 72): 10 elements with 1177 questions (Did not include the "Health and Safety Measures" element, and the "Stairs & Elevator(s)" were added as a main element). **Year 3:** AccessTools app, version 4 (build 80): 10 elements with a total of 2,612 questions/items (The "Health and Safety Measures" element was added to the main elements, and the "Stairs & Elevator(s)" were removed from main elements and implemented as "Level Changes" sub-element). For both years, only 4 elements were assessed: "Main Entrances/Exterior Doorway (s)"; "Indoor Routes"; "Seating"; "Restroom (s)". The taxonomy for the assess elements in AccessTools app, are included in the Appendices: • Build 72: See Appendix A • Built 80: See Appendix B 4 answers are provided for each question/item: "Accessible", "Somewhat Accessible", "Not Accessible", and "Not Applicable". **ADA Checklist:** The ADA Checklist for Existing Facilities was used (ADAChecklist.org, 2021). The Checklist was converted to a Qualtrics survey for ease of distribution and use.

	The survey includes a total of 316 questions/items. 4 answers are provided for each question/item: “Yes”, “NO”, “Not Applicable”, and “Not Examined”.

Question 1 pts

Below is an image of a staircase, with arrows and letters pointing to specific features. Which of the following matches the correct names to the letter associated with that feature?

- A=Nosing, B=Riser, C=Tread
- A=Riser, B= Tread, C=Nosing
- A=Tread, B=Nosing, C= Riser
- A=Riser, B=Nosing, C=Tread

Question 1 pts

Why is it important to use a standardized assessment to evaluate the environment?

- All of the above
- To ensure a thorough assessment
- To be able to compare findings between buildings
- To ensure results are valid and reliable

Figure 6: Sample questions of the Knowledge quiz.

On-Line Training

The training included the completion of a self-directed learning module which was hosted on the learning management system Canvas (Schwartz et al., n.d.). It provided general accessibility knowledge and instructions on using the evaluation tools. The training consisted of narrated presentations, videos of people with disabilities experiencing environmental barriers, pictures, reflective questions, and links to key resources. After completing the required materials for each topic, students were asked to answer related practice questions to the topic in hand. The following topics were discussed:

- **Key Terms in Community Accessibility Evaluation:** students were presented with a video discussing the common key terms used in inclusive community spaces. Figure 7 depicts an example of one of the questions that were presented after completing the instructional materials of the key terms' module.

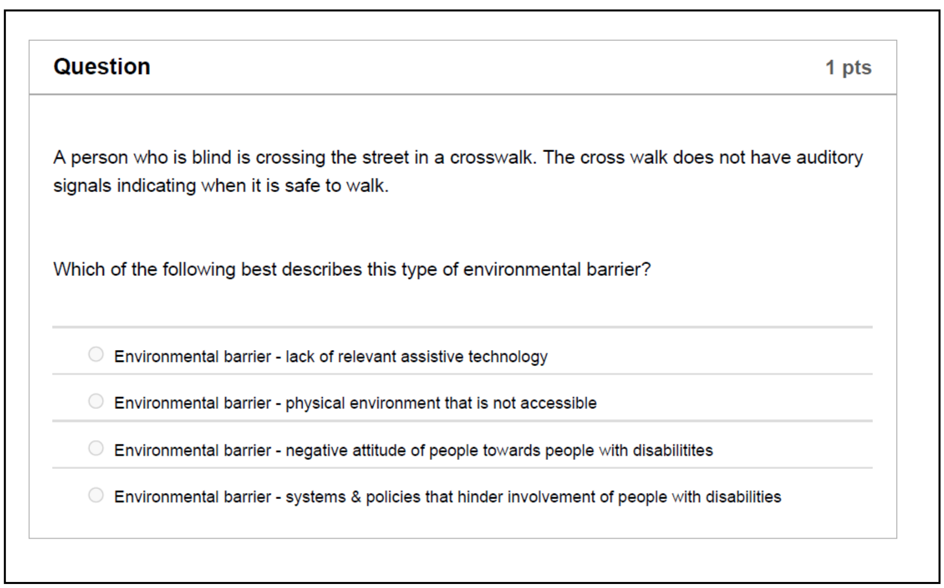
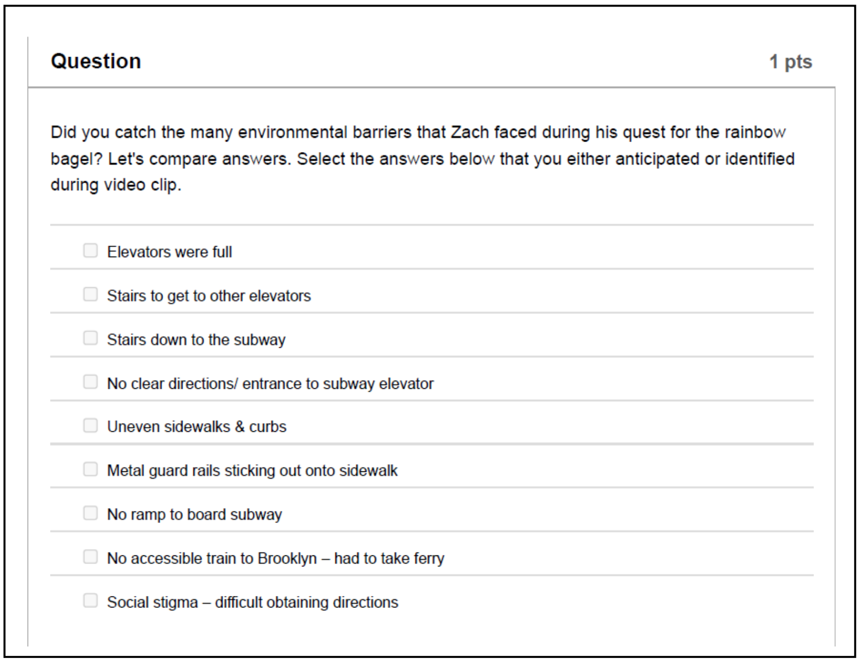


Figure 7: Sample of practice questions from the Key Terms in Community Accessibility Evaluation topic.

- **Importance of Community Accessibility:** Two videos of a person with a disability were presented, in order to prompt students to think about the importance of inclusive community spaces for PWD. Figure 8 depicts an example of one of the questions that were presented after completing the instructional materials of the importance module.



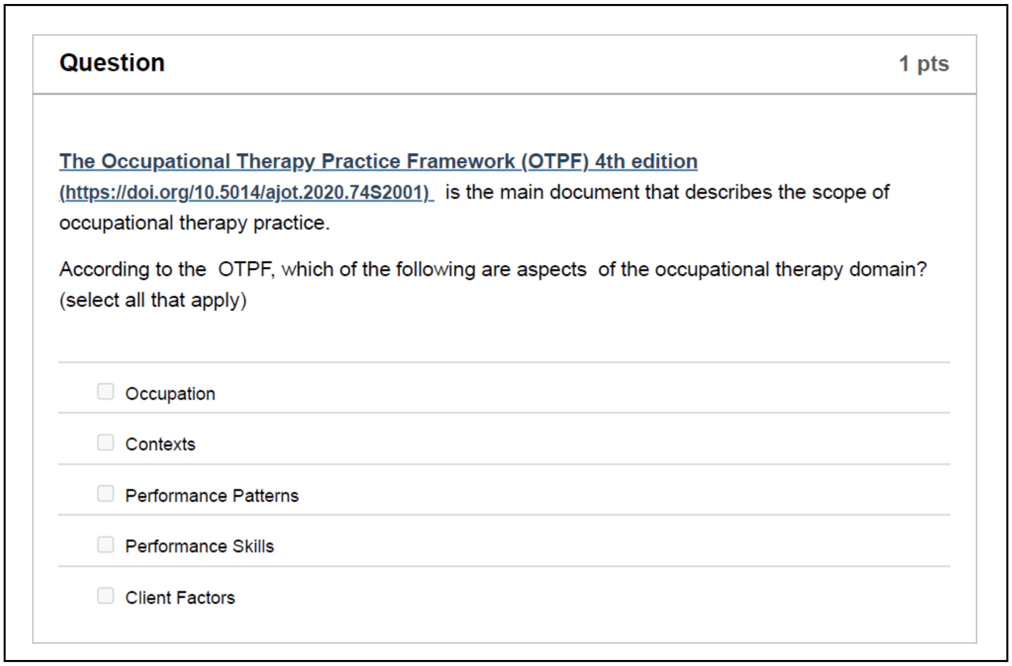
Question 1 pts

Did you catch the many environmental barriers that Zach faced during his quest for the rainbow bagel? Let's compare answers. Select the answers below that you either anticipated or identified during video clip.

- ☐ Elevators were full
- ☐ Stairs to get to other elevators
- ☐ Stairs down to the subway
- ☐ No clear directions/ entrance to subway elevator
- ☐ Uneven sidewalks & curbs
- ☐ Metal guard rails sticking out onto sidewalk
- ☐ No ramp to board subway
- ☐ No accessible train to Brooklyn – had to take ferry
- ☐ Social stigma – difficult obtaining directions

Figure 8: Sample of practice questions from the Importance of Community Accessibility topic

- **Occupational Therapy Role:** This module described the scope of practice of the occupational therapist in creating accessible and inclusive community spaces. Students were presented with several link to AOTA website to review documents that describes the role of occupational therapy, as well as a link to the Occupational Therapy Practice Framework (OTPF) 4th edition. Figure 9 depicts an example of one of the questions that were presented after completing the instructional materials of this module.


Question 1 pts

The Occupational Therapy Practice Framework (OTPF) 4th edition (https://doi.org/10.5014/ajot.2020.74S2001) is the main document that describes the scope of occupational therapy practice.

According to the OTPF, which of the following are aspects of the occupational therapy domain? (select all that apply)

- Occupation
- Contexts
- Performance Patterns
- Performance Skills
- Client Factors

Figure 9: Sample of practice questions from the Occupational Therapy Role topic

- **Policy Impacting Community Accessibility:** This module described the policies that affect the accessibility of buildings in the US. Students were presented with link, videos, and information about the Civil Rights Act, the ABA, the Rehabilitation Act, and the ADA. Figure 10 depicts an example of one of the questions that were presented after completing the instructional materials of this module.
- **Tools to Evaluate the Accessibility of Community Spaces:** This module described different tools to evaluate the presence of barriers in the community environment, including the ADA Checklist, the CHEC, the CHIEF and AccessTools. Students were presented with link to review each tool before responding to practice questions. Figure 11 depicts an example of one of the practice questions that were presented after completing the instructional materials of this module.

Question 8 1 pts

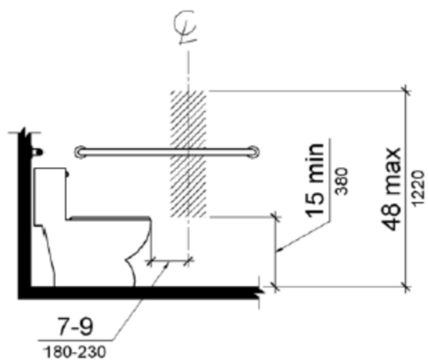
What does it mean to be "covered" by the ADA?

This means that the building and services needs to be accessible.

Building

To ensure that the building is accessible, the government (specifically the United States Access Board) maintains standards called the 2010 Americans with Disabilities Act Standards for Accessible Design. These are very specific standards that describe acceptable dimensions of common building elements.

Here is an example of standards related to the toilet paper dispenser.



This image describes that the toilet paper dispenser (specifically where the paper comes out) must be installed...

1. 7-9 inches from the front toilet
2. 15 - 48 inches off of the ground

Services

Services means that the activities in the building need to be accessible.

Here is an example. A wheelchair user goes to a bar and is prevented from ordering at tall bar designed for standing people. Therefore the bartender should make the reasonable accommodation of taking the wheelchair users order in another manner, such as serving the wheelchair user at a table instead of a bar.

What do you think is required of a public accommodation where the building was built prior to 1990? (select all that apply)

- [ ] Services need to be accessible
- [ ] The building needs to be fully compliant to the ADA
- [ ] Easily removed barriers should be removed

Figure 10: Sample of practice questions from the Policy Impacting Community Accessibility topic

Question 1 pts

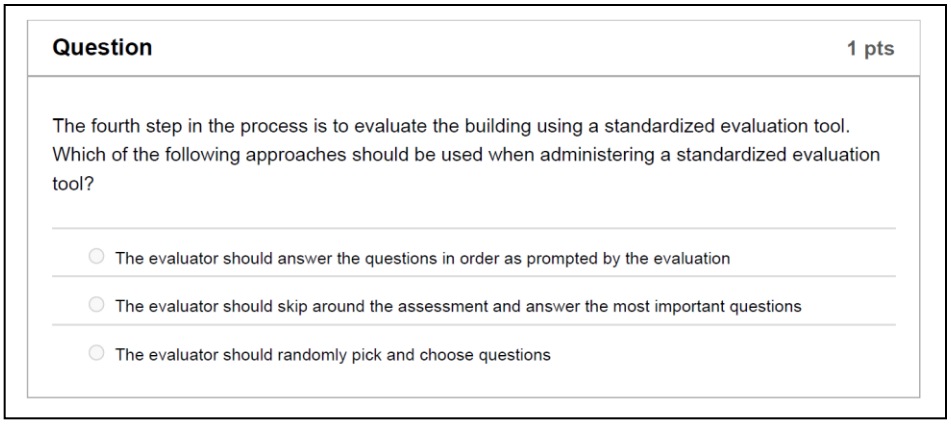
Below are a list of tools and their descriptions. Please match the name of the tool to the description that best matches the assessment.

Assessment tool based on the legal standards of accessible design	Americans with Disabilities Act Checklist
Assessment tool that measures the impact of the environment on a specific person	Craig Hospital Inventory of Environmental Factors
Identifes if a person with a mobility impairment can get in and out of the building and do what they need to do	Community Health Environment Checklist
App-based measurement of building accessibility for people with various disabilitites	AccessTools

Figure 11: Sample of practice questions from the Tools to Evaluate the Accessibility of Community Spaces topic

- **Community Accessibility Evaluation Process:** This module introduced the students to how to conduct an evaluation of a community space. The different steps that an evaluator would go through to evaluate the accessibility and inclusion of community environments were listed, as well as some examples of the needed tools to evaluate the accessibility of a building, such as levels, tape measures, and pressure gauges. Figure 12 depicts an example of one of the practice questions that were presented after completing the instructional materials of this module.
- **Building Elements and Features:** In this module, students were introduced to the different building elements and the factors affecting their accessibility. Elements such as parking, doorways, floor & ground surfaces, and routes were discussed. Additionally, considerations regarding the importance of accessibility

features to key populations including wheelchair users, people with low vision, people who are blind, and people who are deaf were discussed. Figure 13 depicts an example of one of the practice questions that were presented after completing the instructional materials of this module.



Question 1 pts

The fourth step in the process is to evaluate the building using a standardized evaluation tool. Which of the following approaches should be used when administering a standardized evaluation tool?

- The evaluator should answer the questions in order as prompted by the evaluation
- The evaluator should skip around the assessment and answer the most important questions
- The evaluator should randomly pick and choose questions

Figure 12: Sample of practice questions from the Community Accessibility Evaluation Process topic

- **Using AccessTools:** In this module, students were presented with three videos in order to teach them how to use the AccessTools assessment to evaluate a building. The included videos were specifically targeting how to create a new evaluation, how to administer and score questions/items, and an introduction about the helpful features and icons within the app. Figure 14 depicts an example of one of the practice questions that were presented after completing the instructional materials of this module.
- **Using the ADA Checklist:** In this module, students were presented with a video in order to teach them how to use the ADA Checklist assessment to evaluate a building. Figure 15 depicts an example of one of the practice questions that were presented after completing the instructional materials of this module.

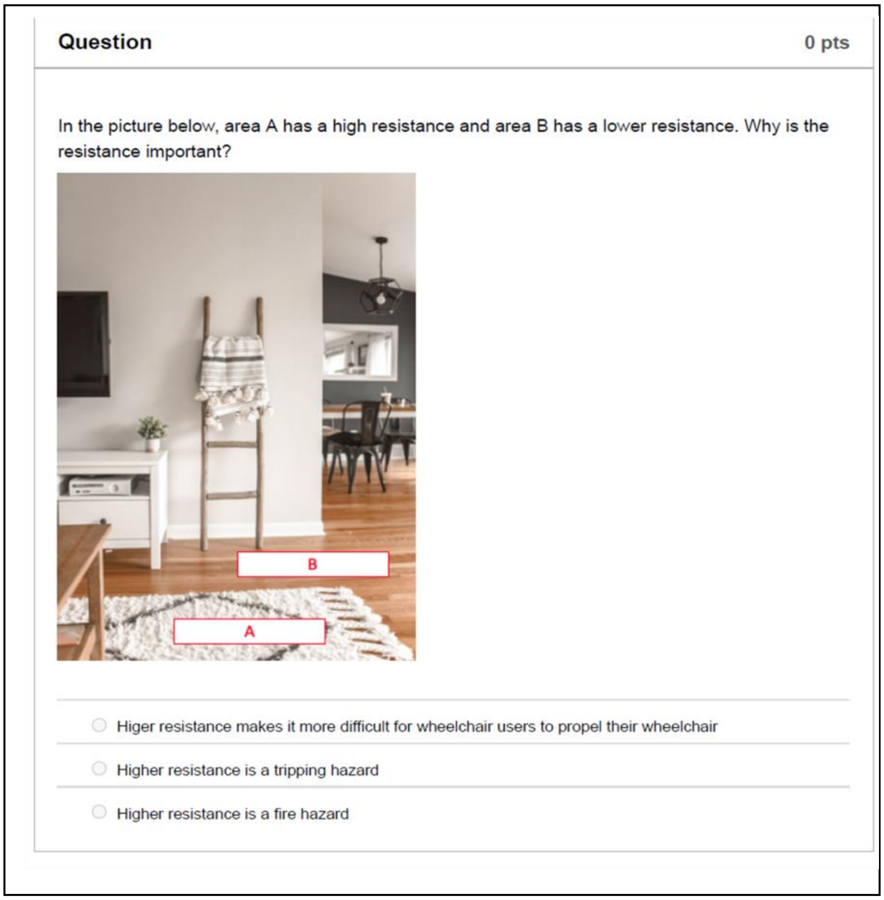


Figure 13: Sample of practice questions from the Building Elements and Features topic

Building Evaluation

Year 2: Students were assigned to perform an on-site evaluation of two restaurants in pairs using the AccessTools app. Restaurants were casual counter-service type restaurants. Only one pair of students evaluated a building at any given time.

Year 3: Students were assigned to perform virtual evaluations of restaurants using either the AccessTools app or the ADA Checklist, depending on their assigned

group using the recorded videos. Each student was assigned to evaluate two restaurants.

Data Collection

For Study 1 and Study 2, this research study was added as a part of a course assignments. Only students who consented to participate in the study and filled out the consent form approved by the UWM IRB, under protocol number 20.006, completed the research study. Students who did not consent to participate were asked to write a reflection for accessibility related questions and life experiences. Study 3 did not require any additional data collection.

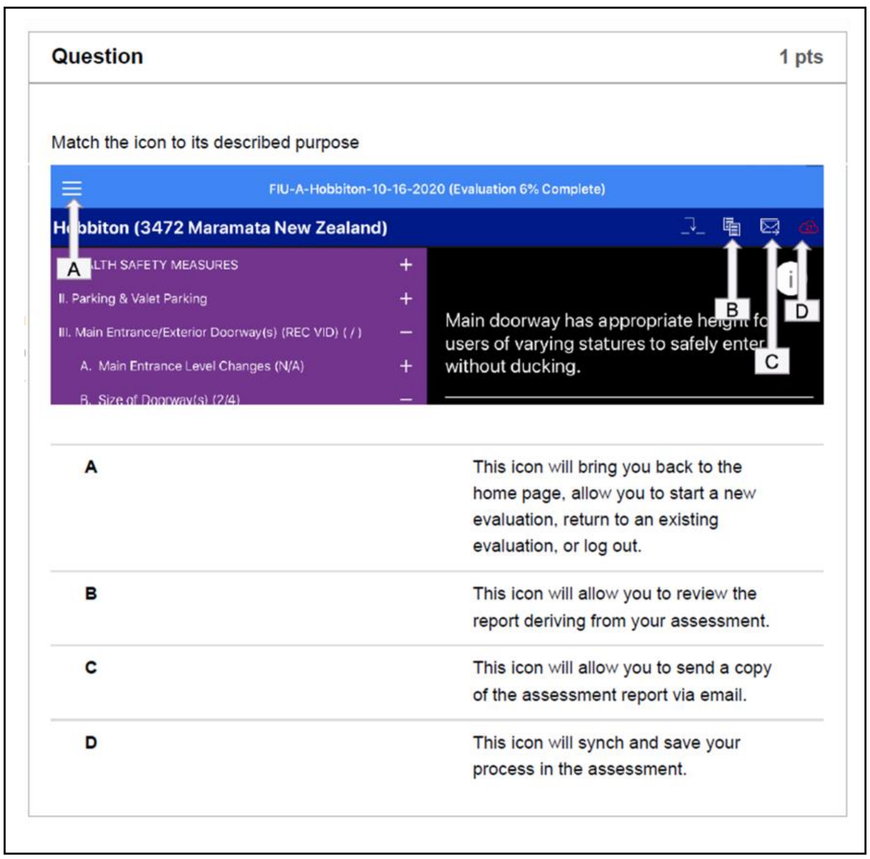


Figure 14: Sample of practice questions from the Using AccessTools topic

In Study 1 and Study 2, students who consented to participate were randomly assigned into two groups to fit a cross-over design. The first group (Group 1) completed the on-line training first while the second group (Group 2) completed the building evaluation first. After completing the first condition, the students completed the second condition. Students were instructed to complete the demographics questionnaire and the knowledge quiz (Pre-test) to determine their baseline knowledge of community accessibility before completing the first condition.

After completion of the first portion of the study protocol, students completed the second knowledge quiz. Finally, students completed the final knowledge quiz after completing the other condition (either the on-line training or building evaluation). The overall design and group assignment is illustrated in Figure 16. Overall, students took the knowledge quiz three times, however, students did not receive feedback or learn the correct answers.

Question 1 pts

Below are the 4 answer criteria for the ADA Checklist. Match the criteria to its description.

Yes	The criteria is met and accessibility is indicated.
No	The criteria is not met and accessibility is not indicated.
Not applicable	The feature noted in the question is not relevant (e.g. an elevator in a 1-story building)
Not examined	The criteria is unable to be answered based on the photo or video provided

Figure 15: Sample of practice questions from Using the ADA Checklist topic

All training materials and assignment instructions were provided in Canvas in separate modules. Students' assigned groups and the sequence of the required tasks

information were also included. Module completion requirement were added in Canvas in order to guarantee the right sequential order for the different assignments across the two group. Instructions on how to download the AccessTools app were included, as well as the instructions for downloading and save evaluations in AccessTools (AccessTools uses a .csv file format to save the ratings in each evaluation).

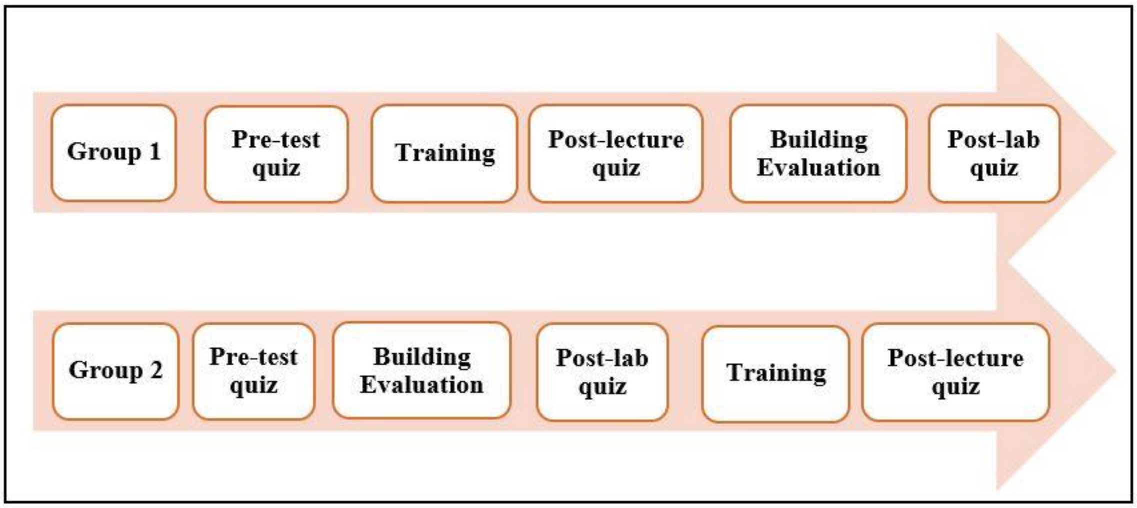


Figure 16: Cross-over design and group assignment

Students who were assigned to use the ADA Checklist were provided with the link for the created Qualtrics survey. After completing the building evaluation part, students who used AccessTools assessment were instructed to save a copy of each completed evaluation and to upload their evaluations into a designated Dropbox in Canvas. Unique deidentified codes were assigned to students in order to use them for naming the completed evaluations. The uploaded files were then collected by the corresponding research partners in each collection site and shared with the research team through secure cloud sharing host. Only research team members had access to the deidentified .csv files. The number of collected assessments per site in Year 2 and Year 3 are listed in Table 8.

Table 8: Year 2 & 3 Submitted Assessments

Site	**Year 2:** ***On-site assessments***	**Year 3:** ***Video assessments***	
	AccessTools	AccessTools	ADA-Checklist
CU	50	50	56
FIU	89	34	48
TWU	41	126	200
UWM	31	108	88
Total	**211**	**318**	**392**

Data analysis

Prior to starting the data analysis, all collected AccessTools evaluations from Study 1 and Study 2 were screened in order to identify corrupted files, evaluation completeness, and the correct taxonomy was used. Since AccessTools was not released yet on the iOS app store, it was only available through TestFlight. It was found that updating the AccessTools app without uninstalling it first resulted in duplicating the taxonomy within the app. Thus, the number of questions/items was checked for each collected evaluation. The screened evaluations were then merged into several master spreadsheets in Excel, depending on the year, restaurant, and collection site. After that, several spreadsheets were created with the relevant data for each of the studies.

For all calculations involving the agreement between raters, the Gwet's AC1 agreement coefficient (Gwet, 2008) was used. The decision to use this agreement coefficient over the commonly used Kappa coefficient (κ) was made because the AC1 is more stable than the κ (Honda & Ohyama, 2020; Walsh et al., 2014). This is noted in the literature and described as the 'κ paradox' (Walsh et al., 2014). The κ paradox is a disadvantage to using the κ statistic as it results in lower values the further the prevalence of the outcome being studied deviates from 0.5 in the margins distribution

(Feinstein & Cicchetti, 1990; Gwet, 2008). The AC1 coefficient was developed specifically to address this limitation (Gwet, 2008) and has been recommended for use (Honda & Ohyama, 2020; Kanık et al., 2012; McCray, 2013; Walsh et al., 2014; Wongpakaran et al., 2013).

Study 1:

1.1 The AC1 agreement coefficients across all raters for each of the assessed restaurants were calculated. These calculations included the overall agreement for all questions, and for each element separately. The calculations were performed based on the answers to the leaf level questions of the four elements that were assessed, which resulted in a total of 468 questions (subjects).

1.2 The agreement coefficients between the trained and the non-trained groups were calculated, and the difference between the correlated agreement coefficients were tested for statistical significance (Gwet, 2016).

Study 2:

Prior the analysis, a sub-study was conducted in order to evaluate the reliability of the three recorded videos that were used. For this sub-study, three Masters' students in the OT program at UWM performed virtual assessments using the video recordings of the three restaurants. The students completed a training protocol first, and then each student completed three assessments using the AccessTools assessment (one for each restaurant).

Students evaluated the three restaurants using the video recordings and identified problematic questions/items in the AccessTools assessment that cannot be answered from the current videos. A training protocol was created to identify the questions/items that cannot be answered from the current videos (See Appendix D).

The initial AC1 coefficients were calculated across the three raters for each of the three restaurant videos. Then, a group discussion was conducted to get an understanding and a consensus on the problematic questions. The identified problematic questions were removed from all analyses in Study 2.

2.1 The AC1 agreement coefficients across all raters for each of the three assessed restaurants were calculated. These calculations included the overall agreement for all questions, and for each element separately. The calculations were performed based on the answers to the leaf level questions of the four elements that were assessed, after excluding the identified problematic questions from the sub-study.

2.2 The agreement coefficients were calculated for the following groups, and the difference between the correlated agreement coefficients were tested for statistical significance across all groups (Gwet, 2016):

   a. Trained vs non-trained raters
   b. Graduate vs undergraduate raters
   c. Collection sites: raters' answers were grouped based on the collection sites.
   d. Students' performance in the knowledge quiz: raters were grouped into high and low achieving groups based on their score improvement in the

knowledge quizzes between baseline and final quizzes. The students' scores were divided into quartiles, and the AC1 coefficient for the completed assessments from the lower quartile were compared to the fourth quartile AC1 coefficient.

Study 3

3.1 Reliability of leaf level items involving root questions with multiple (e.g., 0, 1, 2, 3, 4, 5+) branches were computed and reported.

3.2 For each branching level, two agreement coefficients were calculated, using the leaf level answers, representing the lowest and highest agreement coefficient that would be produced if 1-4 questions or if 10% of the questions were answered incorrectly in a root level question.

Data Processing

The data preprocessing were conducted in Microsoft Excel®, the AC1 agreement coefficient calculations were performed using the MAGREE macro in SAS® 9.4 (SAS Institute Inc, Cary, NC), and the statistical significance testing for the correlated agreement coefficients were performed using the AgreeTest® software.

IV. RESULTS

Study 1: IRR of AccessTools for On-site Assessments

For this study, assessments that were identified as incomplete were removed from the analysis. Also, restaurants that did not reach the target of at least 3 assessments for trained and 3 assessments for non-trained groups were excluded from

the analysis. Table 9 illustrates the final number of assessments that were included in the analysis after excluding uncompleted assessments.

Table 9: Number of included assessments for per site

Site	Restaurant	Included Assessments	Total
CU	NY-1	11	30
	NY-2	9	
	NY-5	10	
FIU	Miami-1	11	43
	Miami-2	10	
	Miami-3	10	
	Miami-4	12	
TWU	Denton-1	9	15
	Denton-2	6	

1.1 All Raters:

The agreement coefficients for each of the assessed elements are presented in Table 10. The average AC1 agreement coefficient across all raters, elements, and restaurants was 0.504. The average AC1 agreement coefficients for each assessed element (Main Entrance, Indoor Routes, Seating, Restrooms) were 0.423, 0.632, 0.504, and 0.325, consecutively. The overall agreement coefficients varied across restaurants (from 0.325 to 0.701), and across elements (from 0.254 to 0.700 for Main Entrance, from 0.360 to 0.916 for Indoor Routes, from 0.293 to 0.780 for Seating, and from 0.052 to 0.527 for the Restrooms element).

1.2 Trained vs Non-Trained Raters:

The AC1 agreement coefficients for trained and non-trained raters were compared across all restaurants (Table 11). Surprisingly, the trained group achieved a slightly lower average agreement coefficient (0.466) than the non-trained group (0.522). Seven of the nine restaurants were found to have a statistically significant difference

between the trained and non-trained groups, while the remaining two did not. Among the seven restaurants, the non-trained group had higher AC1 coefficients in four of the restaurants, while the trained grouped had higher AC1 coefficients in the remaining three.

Table 10: Overall AC1 agreement coefficients across restaurants and per element in Study 1

Restaurant	Overall AC1	Main Entrance	Indoor Routes	Seating	Restrooms
NY-1	0.383	0.311	0.588	0.419	0.226
NY-2	0.325	0.447	0.605	0.293	0.052
NY-3	0.642	0.512	0.360	0.342	N/A
Miami-1	0.429	0.303	0.566	0.544	0.336
Miami-2	0.661	0.355	0.916	0.780	0.295
Miami-3	0.500	0.405	0.518	0.534	0.463
Miami-4	0.464	0.519	0.518	0.295	0.371
Denton-1	0.435	0.254	0.655	0.691	0.326
Denton-2	0.701	0.700	0.960	0.640	0.527
Average	**0.504**	**0.423**	**0.632**	**0.504**	**0.325**

Table 11: AC1 agreement coefficients for trained and non-trained groups

Restaurant	Overall AC1		Sig Difference
	Trained	Non-Trained	
NY-1	0.308	0.505	<0.001
NY-2	0.290	0.274	0.310
NY-3	0.686	0.609	<0.001
Miami-1	0.419	0.381	0.006
Miami-2	0.626	0.667	<0.001
Miami-3	0.368	0.555	<0.001
Miami-4	0.444	0.485	0.206
Denton-1	0.496	0.454	0.034
Denton-2	0.560	0.769	<0.001
Average	**0.466**	**0.522**	

After breaking down the elements, the average AC1 agreement coefficients for the 'Main Entrance' element were 0.385 for the trained group, and 0.464 for the non-trained. For the 'Indoor Routes' element, they were 0.644 for the trained, and 0.632 for the non-trained group. For the 'Seating' element, the trained group achieved an

agreement coefficient of 0.408, while the non-trained group achieved an agreement coefficient of 0.550. Lastly, the average AC1 agreement coefficients for the 'Restrooms' element were 0.245 for the trained group, and 0.346 for the non-trained group. Table 12 illustrates the AC1 agreement coefficients per restaurant and element.

Table 12: AC1 coefficients per element for trained and non-trained groups

	Element							
	Main Entrance		Indoor Routes		Seating		Restrooms	
Restaurant	**Trained**	**Non-Trained**	**Trained**	**Non-Trained**	**Trained**	**Non-Trained**	**Trained**	**Non-Trained**
NY-1	0.224	0.579	0.706	0.421	0.265	0.601	0.007	0.412
NY-2	0.393	0.408	0.647	0.564	0.231	0.223	-0.019	0.073
NY-3	0.692	0.421	0.186	0.382	0.222	0.455	N/A	N/A
Miami-1	0.300	0.225	0.502	0.720	0.513	0.558	0.295	-0.200
Miami-2	0.469	0.169	0.873	0.958	0.635	0.834	0.497	0.629
Miami-3	0.405	0.403	0.566	0.488	0.415	0.603	0.100	0.538
Miami-4	0.413	0.640	0.688	0.530	0.121	0.485	0.286	0.391
Denton-1	0.244	0.463	0.684	0.660	0.773	0.500	0.430	0.319
Denton-2	0.327	0.868	0.941	0.967	0.495	0.687	0.360	0.603
Average	**0.385**	**0.464**	**0.644**	**0.632**	**0.408**	**0.550**	**0.245**	**0.346**

Study 2: IRR of AccessTools for Video-simulated Assessments

For this study, assessments that were identified as incomplete were removed from the analysis. Table 13 illustrates the final number of assessments that were included in the analysis after excluding uncompleted assessments.

Table 13: Number of included assessments for per site in Study 2

	Site				
Restaurant	**CU**	**FIU**	**TWU**	**UWM**	Total
A	16	10	29	23	79
B	15	11	39	38	103
C	16	12	29	31	88

Video Reliability

Before performing the analyses for this study, the problematic questions in each video-recording were identified and removed from the datasets. In this sub-study, three trained Masters' students in the OT program at UWM performed virtual assessments using the video recordings of the three restaurants. The students evaluated the three restaurants using the video recordings and identified problematic questions/items in the AccessTools assessment that cannot be answered from the current videos.

The initial AC1 agreement coefficients between the three raters were 0.834, 0.920, and 0.911 for restaurants A, B, and C. Then, an open discussion between the students was conducted to reach a consensus for the problematic questions for the three restaurants. The number of problematic questions for each restaurant are listed in Table 14.

Table 14: Number of removed problematic questions

Restaurant	Problematic Questions	Remaining Questions
A	53	1499
B	39	1513
C	69	1483

2.1 All Raters:

The data from the different sites were combined for each restaurant, as shown in Table 15. The overall AC1 agreement coefficients were 0.461, 0.559, and 0.574 for restaurants A, B, and C. On the elements level, the average AC1 coefficients across the three restaurants were 0.477, 0.479, 0.887, and 0.523, for the 'Main Entrance', 'Indoor Routes', 'Seating', and 'Restrooms' elements consecutively.

Table 15: AC1 coefficients per restaurant and element

Element	Restaurant A	Restaurant B	Restaurant C	Average
Main Entrance	0.444	0.472	0.516	**0.477**
Indoor Routes	0.442	0.497	0.497	**0.479**
Seating	0.898	0.843	0.918	**0.887**
Restrooms	0.358	0.603	0.608	**0.523**
Overall	**0.461**	**0.559**	**0.574**	**0.531**

2.2 IRR Differences between Groups

a. Trained vs Non-Trained Raters:

The AC1 agreement coefficients for trained and non-trained raters were compared across the three restaurants (Table 16). On average, the trained group achieved a slightly lower agreement coefficient (0.519) compared to the non-trained group (0.544). This difference in agreement between the trained and non-trained groups was statistically significant across the three restaurants.

Table 16: AC1 agreement coefficients between trained and non-trained raters in Study 2

Restaurant	Overall AC1		Sig Difference
	Trained	Non-Trained	
A	0.441	0.490	<0.001
B	0.553	0.561	<0.001
C	0.562	0.581	<0.001
Average	**0.519**	**0.544**	

At the element level, the average AC1 agreement coefficients for the ‘Main Entrance’ element were 0.463 for the trained group, and 0.491for the non-trained. For the ‘Indoor Routes’ element, they were 0.453 for the trained, and 0.487 for the non-trained group. For the ‘Seating’ element, the trained group achieved an agreement coefficient of 0.885, while the non-trained group achieved an agreement coefficient of

0.888. Lastly, the average AC1 agreement coefficients for the ‘Restrooms’ element were 0.511 for the trained group, and 0.527 for the non-trained group. Table 17 presents the AC1 agreement coefficients per restaurant and element.

Table 17: AC1 coefficients per restaurant and element for training groups

	Element							
	Main Entrance		Indoor Routes		Seating		Restrooms	
Restaurant	**Traine d**	**Non-Traine d**	**Traine d**	**Non-Traine d**	**Trained**	**Non-Trained**	**Trained**	**Non-Trained**
A	0.454	0.428	0.391	0.473	0.906	0.886	0.315	0.415
B	0.460	0.481	0.486	0.508	0.829	0.864	0.612	0.584
C	0.476	0.564	0.481	0.480	0.919	0.915	0.607	0.583
Average	**0.463**	**0.491**	**0.453**	**0.487**	**0.885**	**0.888**	**0.511**	**0.527**

b. Raters’ Educational Level

Agreement levels of undergraduate versus graduate students were compared (Table 18). Due to the small sample size of the undergraduate group, only restaurant B and restaurant C IRR were analyzed. Interestingly, the trained undergraduate group had a higher IRR than the graduate students (average AC1= 0.651 compared to 0.538). For restaurant B, the AC1 agreement coefficient of 0.666 for the undergraduate trained group was significantly higher than the AC1 coefficient of 0.524 for the graduate trained group ($p<0.001$). The same pattern was repeated for restaurant C, with an AC1 of 0.635 for the undergraduate group and 0.551 for the graduate group ($p<0.001$).

Table 18: AC1 coefficient for graduate and undergraduate raters

Restaurant	**Overall AC1**		**Sig Difference**
	Grad	**Under-Grad**	
B	0.524	0.666	<0.001
C	0.551	0.635	<0.001
Average	**0.538**	**0.651**	

c. Different collection sites

Degree of agreement (AC1) amongst student ratings in different collection sites are presented in Table 19. The TWU-Dallas site had the highest AC1 coefficients on average (0.681) and across each of the three video recordings of the restaurants. In contrast, the CU site had the lowest AC1 coefficients on average (0.434) and across the three restaurants.

Table 19: AC1 coefficients across collection sites

Site	Restaurant A	Restaurant B	Restaurant C	Average
CU	0.360	0.444	0.498	**0.434**
FIU	0.477	0.516	0.618	**0.537**
TWU-Dallas	0.723	0.639	0.680	**0.681**
TWU-Denton	0.415	0.594	0.573	**0.527**
TWU-Houston	0.558	0.634	0.564	**0.585**
UWM	0.454	0.538	0.558	**0.517**

Tables 20, 21, and 22 present the observed differences in the AC1 agreement coefficient and the statistical significance testing results for the correlated agreement coefficients between each pair (pairwise comparisons) of the raters' collection sites for the video-recordings of restaurants A, B, and C.

Statistically significant differences were found across all pairwise comparisons of restaurants A. For restaurants B and C, almost all the pairwise comparisons were found to be significantly different, with the exception of TWU-Houston and TWU-Dallas collection sites for restaurant B ($p = 0.372$), and between TWU-Houston and Denton ($p = 0.195$) and TWU-Houston and UWM ($p = 0.277$) for restaurant C.

Table 20: Differences in AC1 agreement coefficient between pairs of raters' sites for restaurant A

Site		FIU	TWU-Dallas	TWU-Denton	TWU-Houston	UWM
CU	AC1 Diff.	0.117	0.363	0.055	0.198	0.094
	p-value	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
FIU	AC1 Diff.		0.246	-0.062	0.082	-0.022
	p-value		*<0.001*	*<0.001*	*<0.001*	*<0.001*
TWU-Dallas	AC1 Diff.			-0.308	-0.165	-0.269
	p-value			*<0.001*	*<0.001*	*<0.001*
TWU-Denton	AC1 Diff.				0.144	0.040
	p-value				*<0.001*	*<0.001*
TWU-Houston	AC1 Diff.					-0.104
	p-value					*<0.001*

Table 21: Differences in AC1 agreement coefficient between pairs of raters' sites for restaurant B

Site		FIU	TWU-Dallas	TWU-Denton	TWU-Houston	UWM
CU	AC1 Diff.	0.072	0.195	0.150	0.190	0.094
	p-value	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
FIU	AC1 Diff.		0.123	0.078	0.118	0.022
	p-value		*<0.001*	*<0.001*	*<0.001*	*<0.001*
TWU-Dallas	AC1 Diff.			-0.045	-0.005	-0.101
	p-value			*<0.001*	*0.372*	*<0.001*
TWU-Denton	AC1 Diff.				0.040	-0.056
	p-value				*<0.001*	*<0.001*
TWU-Houston	AC1 Diff.					-0.096
	p-value					*<0.001*

Table 22: Differences in AC1 agreement coefficient between pairs of raters' sites for restaurant C

Site		FIU	TWU-Dallas	TWU-Denton	TWU-Houston	UWM
CU	AC1 Diff.	0.119	0.181	0.075	0.066	0.059
	p-value	*<0.001*	*<0.001*	*<0.001*	*<0.001*	*<0.001*
FIU	AC1 Diff.		0.062	-0.045	-0.053	-0.060
	p-value		*<0.001*	*<0.001*	*<0.001*	*<0.001*
TWU-Dallas	AC1 Diff.			-0.107	-0.116	-0.122
	p-value			*<0.001*	*<0.001*	*<0.001*
TWU-Denton	AC1 Diff.				-0.009	-0.015
	p-value				*0.195*	*<0.001*
TWU-Houston	AC1 Diff.					-0.007
	p-value					*0.277*

d. Relation of Students' Performance in the Knowledge Quiz to AC1 Agreement

Students' scores in the knowledge quiz were divided into quartiles in order to define the high and low achievement groups. Then, the AC1 coefficient for the completed assessments from the first quartile group were compared against the assessments from the fourth quartile for each restaurant. The high achievement group had a significantly higher AC1 agreement coefficient across all three restaurants. Table 23 lists the AC1 agreement coefficients for both groups across the three restaurants.

Table 23: AC1 coefficients for high and low achievement groups

Restaurant	**High**	**Low**	**Difference**	**Sig.**
A	0.481	0.453	0.028	***<0.001***
B	0.639	0.626	0.013	***0.009***
C	0.627	0.533	0.094	***<0.001***

Study 3: The Effects of TTSS Branching on IRR of AccessTools

3.1 The Reliability between Leaf and Root Levels

The leaf level items of AccessTools from the datasets collected in Year 3 were sorted based on the number of branching levels included. The sorting was done on the leaf level questions/items for each restaurant separately and the problematic questions identified in study 2 were removed. The AC1 agreement coefficient amongst leaf level questions that include 1, 2, 3, 4, 5+ branches are listed in Table 24.

A follow up analysis was performed on the data from Year 3 to find the average percentage of selecting the "Somewhat Accessible" answer for branching levels 0, 1, and 2. The "Somewhat Accessible" answer for the root level questions were counted and averaged across raters for each restaurant. Then, the percentage was calculated

as ratio between the average number of the “Somewhat Accessible” answer divided by the average count of the applicable question (“Accessible”, “Not Accessible”, and “Somewhat Accessible”) answers that were answered on the same branching level. The leaf level answers were not included in the percentage calculations. Figure 17 illustrates the results of this analysis.

Table 24: AC1 agreement for leaf level items with 1 to 5+ branches

Branches	Restaurant A		Restaurant B		Restaurant C	
	Questions	AC1	Questions	AC1	Questions	AC1
1	54	0.460	58	0.550	55	0.544
2	129	0.329	126	0.599	124	0.577
3	166	0.335	170	0.531	158	0.557
4	437	0.470	481	0.550	471	0.563
5+	677	0.510	678	0.570	675	0.588
Total	1499		1513		1483	

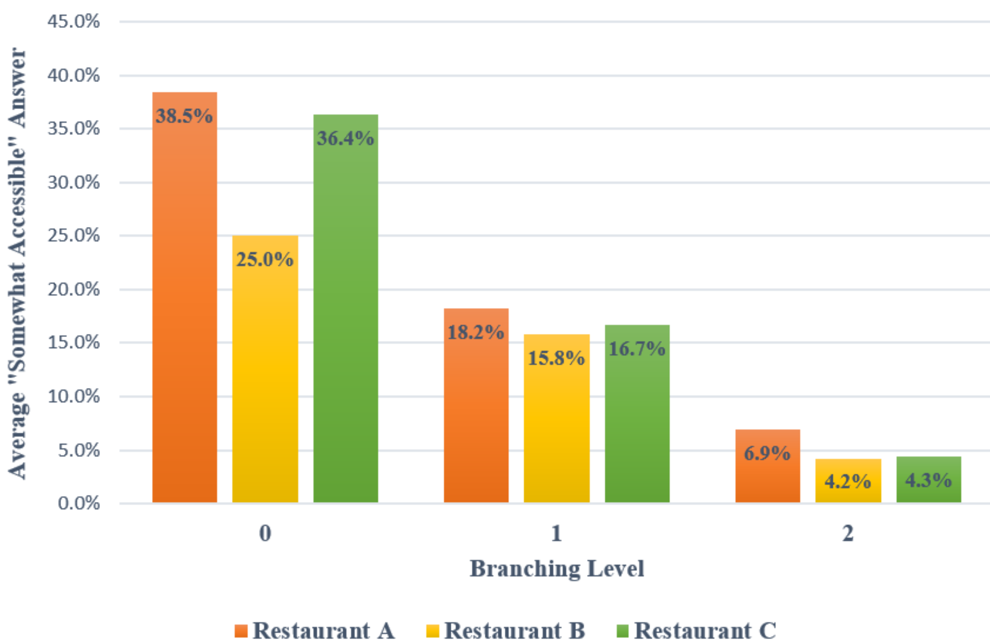


Figure 17: Average “Somewhat Accessible” answer to applicable questions

3.2 Estimating the Effect of TTSS Branching on IRR of AccessTools

In this study the questions/items from AccessTools taxonomy for the four main elements (Main Entrance, Indoor Routes, Seating, and Restrooms) were sorted based on levels of branching. Then the number of questions included within each branching level including root and leaf questions were found.

Multiple simulations were performed to observe the effect on leaf level agreement based on incorrectly answering 1-4 questions or incorrectly answering 10% of the questions within each branching level, thereby finding the highest and lowest number of impacted leaf level questions that would be affected from each simulation scenario. AC1 coefficients for the highest and lowest impacted number of questions for each simulation scenario and branching level were then calculated. For instance, on the first branching level, there are a total of 22 root questions and 0 leaf level questions. If two questions were incorrectly answered, the highest and lowest number of impacted leaf level questions (incorrectly answered) that would result would be 324 and 4 questions. This would produce an AC1 coefficient of 0.743 for the highest impacted number of questions and 0.997 for the low category.

Table 25 summarizes the simulation scenarios for each branching level and lists the number of root and leaf level questions, as well as the AC1 coefficients resulted from the highest and lowest impacted number of questions for each simulation scenario.

Table 25: AC1 coefficients for simulation scenarios per branching level

Branching Level	Root Total Questions	Leaf Questions	Incorrect Answers	High Impact		Low Impact	
				# of Items	AC1	# of Items	AC1
0	22	0	1	162	0.884	2	0.999
			2	324	0.743	4	0.997
			3	481	0.580	7	0.995
			4	631	0.399	11	0.993
			10%	324	0.743	4	0.997
1	119	70	1	120	0.916	1	0.999
			2	240	0.820	2	0.999
			3	360	0.708	3	0.998
			4	480	0.581	4	0.997
			10%	1056	-0.235	12	0.992
2	221	149	1	61	0.959	1	0.999
			2	122	0.915	2	0.999
			3	183	0.867	3	0.998
			4	244	0.816	4	0.997
			10%	941	-0.050	22	0.986
3	309	177	1	29	0.981	1	0.999
			2	58	0.961	2	0.999
			3	87	0.940	3	0.998
			4	116	0.919	4	0.997
			10%	408	0.659	31	0.980
4	634	487	1	15	0.990	1	0.999
			2	30	0.980	2	0.999
			3	45	0.970	3	0.998
			4	60	0.959	4	0.997
			10%	128	0.910	63	0.958
5	546	498	1	6	0.996	1	0.999
			2	12	0.992	2	0.999
			3	18	0.988	3	0.998
			4	28	0.981	4	0.997
			10%	70	0.953	55	0.963
6	171	171	1	1	0.999	1	0.999
			2	2	0.999	2	0.999
			3	3	0.998	3	0.998
			4	4	0.997	4	0.997
			10%	17	0.989	17	0.989
Total	2022	1552					

V. DISCUSSION

After over three decades of the enactment of the ADA, PWD are still facing accessibility challenges to public buildings. The complex nature of the relationship between the environment and community participation, as well as the lack of proper conceptual and operational definitions has created confusion in defining the best approach to measure the accessibility of the built environment on a community level. Several approaches were used to address this issue, however, most of the developed accessibility assessment tools tend to use a subjective approach. Although the subjective reports from PWD on building accessibility is of great importance, they are not sufficient to provide the necessary accessibility information that is needed to address accessibility barriers faced by the wide variety of disabilities (Dickinson & Colver, 2010). Both subjective and objective approaches are equally important, and multimodal approaches that integrate both self-reported and objective measures are most appropriate to comprehensively assess the accessibility of the built environment (Garcia et al., 2015; Magasi et al., 2015; Mosca & Capolongo, 2018; Rimmer et al., 2017; Umeda et al., 2017).

Objective measures of public buildings are required to be extensive and assess each element of the built environment against a wide range of needs of users and their unique capabilities and disabilities. Therefore, such instruments are lengthy and time consuming, and their development requires a team of experts that understand the different needs of PWD. This could explain the paucity in objective assessments and the lack of commonly accepted assessments for public building accessibility (Alvarelhão et al., 2012; Whiteneck & Dijkers, 2009).

The newly developed AccessTools assessment was specifically created to tackle this issue. However, as any other assessment tool, AccessTools needs to be tested, validated, and its psychrometric properties must be investigated first. This project was the initial attempt to study and establish the IRR property of the tool.

The results of Study 1 and Study 2 revealed that the AC1 reliability coefficients for both studies were found to be of ‘Moderate’ strength when averaging across the restaurants (AC1 for Study 1 was 0.504, and 0.531 for Study 2). However, the interpretation of these results are not simple, due to the involvement of several factors that could affect them. Thus, a deeper consideration of the factors and their effects on the strength of agreement are discussed.

In Study 1, the average AC1 agreement coefficients on an element level were found to be of ‘Moderate’ strength for both the ‘Main Entrance’ and the ‘Seating’ elements, and of ‘Substantial’ strength for the ‘Indoor Routes’ element. While the ‘Restrooms’ element had a ‘Fair’ strength on average, with the lowest AC1 of 0.052 for one of the restaurants. As these results were not expected, they revealed a flaw in the data collection protocol that was used for the ‘Restrooms’ element. There are three types of restrooms included in the AccessTools taxonomy, female, male and Alternative Restroom(s), and the data collection took place in normal operation hours of the restaurants. Thus, the raters’ gender could have prevented them from assessing the opposite gender’s restroom and the type of restroom that was assessed was not reported. This could explain the variability in the collected data for this element. To further support this finding, the AC1 coefficients for the “Restrooms’ element that were

calculated in Study 2 were 0.358, 0.603, and 0.608, representing a ‘Moderate’ level of strength.

Another factor to consider when explaining the variability in the results of Study 1, is the effect of the restaurants’ built environment. While this is true for almost all buildings, the design and layout of a building can facilitate the assessment process or make it harder. This could explain some of the variability that was observed across the different elements in Study 1. The results showed that four of the nine assessed restaurants had a ‘Fair’ agreement for the ‘Main Entrance’ element, while four of them had a ‘Moderate’ agreement, and one had a ‘Substantial’ agreement. This variability was also found when looking at the ‘Indoor Routes’ and ‘Seating’ elements. The variability observed in Study 2 results could also support this finding, as Restaurant A, the least accessible restaurant, had the lowest AC1 coefficients in most of the elements when compared to the more accessible Restaurants B and C.

Training was another factor that needs to be considered. Originally, it was assumed that the training will have a positive impact on the reliability of the AccessTools assessment. Surprisingly, the results from Study 1 and Study 2 showed that training had a negative effect on the IRR of the tool. The results of Study 1 revealed that the non-trained group had a higher AC1 coefficient on average (0.522) compared to the trained group (0.466). Specifically, the AC1 coefficients for the non-trained group were significantly higher in four of the nine restaurants, while the trained group had significantly higher AC1 coefficients in three restaurants, and no significant differences were found between the remaining two restaurants. The same results were found in Study 2, where the non-trained group had a higher AC1 coefficient on average (0.544),

compared to the trained group (0.519). The non-trained group also had significantly higher AC1 coefficients across restaurants A, B, and C. Although these results imply that the training had a negative impact on the students' IRR agreement, the cross-over design of the studies might contribute to this finding. The trained group was assigned to complete the online training module first, then completed the building evaluation assignment, and since the vast majority of the subjects included in these studies were graduate students, time allocation and availability could have been an issue. Similar observations were found after analyzing the different educational background groups, and these results are discussed next.

The results of the different raters' educational level showed that the undergraduate raters achieved a significantly higher AC1 coefficients for restaurants. In Restaurant B, the trained undergraduate group achieved an AC1 coefficient of 0.666, which was significantly higher than the AC1 coefficient of 0.524 that was achieved by the trained graduate group ($p< 0.001$). The same results were found in Restaurant C, where the undergraduate group had an AC1 coefficient of 0.635, while the graduate group had a significantly lower AC1 of 0.551 ($p<0.001$). Originally, we were not expecting a significance difference between these two groups. However, these finding might support the theory that time allocation could had an effect on the achieved agreement coefficient, since graduate studies are more time demanding. It is also important to highlight that the graduate group had more raters, which means increased variability.

The results of Study 2 revealed several differences across the multiple collection sites. It was unexpected to find differences in the agreement coefficients

between collection sites considering that the same study protocol was implemented in all sites and the same restaurants (video-recordings) were assessed. Interestingly, the results showed that the CU site had the lowest AC1 agreement coefficients across all three restaurants (0.360, 0.444, and 0.498, for restaurants A, B, and C, respectively), while the Dallas site had the highest coefficients across all three restaurants (0.723, 0.639, and 0.680, for restaurants A, B, and C, respectively). Several factors could have attributed to the differences including instruction style of the instructors that introduced the assignment, students' expectations on how well they should perform in the assignment, or the weight that was assigned to this assignment on the class grade since the credit weight of the assignment was not standardized across the collection sites (Trautwein et al., 2009; Trautwein & Lüdtke, 2007).

Comparing the achieved agreement coefficients between the two defined achievement groups showed that the high achievement group had significantly higher AC1 coefficients across all three assessed restaurants. These results are in agreement with the proposed hypothesis that students who showed better performance in the knowledge quiz would have a significantly higher agreement coefficients and could indicate that the scores from the knowledge quiz are indicative of students' reliability.

The results of the TTSS branching analysis revealed mixed results for the calculated AC1 coefficients across the different branching levels. We anticipated that the AC1 coefficient would decrease as number of branches increase, since more branching will result in more questions to answer, and thus produce more variability in the data. However, this hypothesis would only be true if the raters selected the "Somewhat Accessible" answer on the root level questions, in order for the branching to

occur. The follow up analysis for the average selection of the “Somewhat Accessible” answer across raters showed that it was only selected for 38.5%, 25.0%, and 36.4% for restaurant A, B, and C on the first branching level. This indicates that several root and leaf level questions were autoscored, and the raters did not answer them.

The implementation of the TTSS methodology is of great importance to minimize the time demand to perform such comprehensive building assessment. Particularly when expert raters are performing the assessment, as the TTSS methodology will allow them to auto advance through several questions that are not applicable for the building or if they are confident that all the related features of a specific root question are accessible or not. However, novice raters should be careful when answering root level questions, as these questions will have a tremendous impact on the reliability of their assessment.

The results of the simulation analysis provide some insight to the consequences of answering a root question on the reliability of the data. The results show that incorrectly answering 10% of the questions on the first branching level could result in a high impact of dropping the AC1 coefficient to 0.743, depending on which questions were answered incorrectly. Incorrectly answering 10% of the questions on the second and third branching levels could result in lowering the corresponding AC1 coefficients to below chance level. Thus, it is recommended that novice raters should at least avoid answering root level questions on the first three branching levels, and the training should focus on addressing this issue.

The results of both branching studies also bring into consideration some needed changes on the scoring system of the tool. Instead of allowing raters to answer higher

root level questions with a trichotomous approach, changing the scoring system into a dichotomous system, where raters are only allowed to score a higher root level with either ‘Applicable’ or ‘Not Applicable’ options. The ‘Applicable’ option then can allow the branching of the subsequent questions, then trichotomous options can be provided.

Study Limitations

This study may have been limited by factors including raters’ selection, training, and data collection protocol. Raters are the most important factor to consider when looking at the reliability of a measurement tool (Atkinson & Murray, 1987). By definition, AccessTools assessment was created to be used by professional accessibility experts. Therefore, the sample of raters that were included in this study do not represent the perfect fit for this tool and might have affected the results of the IRR of the tool.

Although a training protocol was created and a group of raters went through the training before completing the restaurant evaluations, the findings of the study suggest that the training is still limited and needs some improvement. The training module was mainly focusing on providing raters with general accessibility knowledge. Although students showed significant improvement in their gained knowledge on general accessibility issues (Burns, Schwartz, et al., 2021; Obiedat et al., 2021; Obiedat, Schwartz, Burns, et al., 2022; Obiedat, Schwartz, Mendonca, et al., 2022; Schwartz et al., n.d.), a more comprehensive tool-specific training module is needed. The findings suggest that some novice raters who had received the training developed in this study may not have an appropriate understanding of the definitions and meaning for each value of the rating scale and need more training to properly handle the expanding nature of the TTSS methodology.

The cross-over data collection design was implemented to study the training effects on raters, but these findings suggest that it had a negative impact on the reliability of the tool. Although this effect could be situational, considering the raters being students, it highlights the importance of considering the time demands for completing the training and the evaluations. Atkinson & Murray (1987) noted the importance of training and rating sessions to be short in order to maximize the reliability. Completing a comprehensive accessibility assessment will always be time demanding, especially for novice raters. Another factor to consider is the different incentives that were provided for the students, as these were not standardized across collection sites.

Implications of This Study

The findings of this study provide some evidence that the AccessTools assessment may reach acceptable IRR levels even when utilized by novice raters in both on-site and virtual settings. Although no direct comparison between the two settings was conducted, the results produced some evidence that the tool reached an acceptable IRR in both settings. It is expected that the use of AccessTools assessment will enhance the background knowledge of OT students regarding public building accessibility in general, and restaurant accessibility in particular. Additionally, this study may facilitate a greater understanding of the several factors that need to be addressed and considered when training novice raters on using the tool. Particularly, tool-specific training and scoring options.

VI. CONCLUSION

Accessibility assessment of the built environment, especially of public buildings, is complex and multifaceted due to the wide variety of abilities and disabilities that the users bring to the equation. Although no single profession is solely responsible for making these assessments, occupational therapy practitioners (OTP) may stand as key role players in the process due to the distinct training that they receive to be able to provide their services to people with all types of impairments across the lifespan and across most settings and environments (Mendonca et al., 2022). Public buildings and spaces are one of these environments that falls under the scope of OT practice (AOTA, 2020; Layton & Steel, 2015; McColl, 1998). However, before we ask OTP to take the lead on public building accessibility assessments, we should ask ourselves, Do OTP receive enough education regarding this topic? Or do they have enough knowledge about the ADA and its Accessibility guidelines? Are we providing the right tools to perform such assessments?

McColl (1998) argued that there is a need to evaluate the knowledge base in OTP for applicability to community practice, and to identify areas for knowledge development before OTP shift to community practice. Although this argument is not specifically addressing the issue of community building accessibility, it is still relevant. Therefore, providing proper training and tools is fundamental to promote OTP as key stakeholders in the evaluation process of community buildings. AccessTools and the associated training could be the missing piece of the puzzle.

The results of this study provide evidence that novice OT students were able to achieve a ‘Moderate’ agreement strength after using AccessTools. Other studies found

that students gained significantly higher knowledge on general accessibility issues after completing the related training and performing building accessibility assessments using the AccessTools assessment (Obiedat et al., 2021; Obiedat, Schwartz, Burns, et al., 2022; Obiedat, Schwartz, Mendonca, et al., 2022; Schwartz et al., n.d.). AccessTools appears to be useful for training raters on accessibility. However, training for using AccessTools needs some development.

Although the video-simulated assessments were created in response to the COVID-19 pandemic, the findings of this study showed that novice raters were able to achieve a 'Moderate' level of reliability while performing video-simulated assessments using AccessTools. Another study that compared the gained knowledge on general accessibility issues found that students who received the training and performed building evaluations in both mediums (on-site and virtual) had significantly increased gained knowledge, and the medium of performing the building evaluation did not have an impact on their gained accessibility knowledge (Obiedat, Schwartz, Mendonca, et al., 2022). Although using videos for building assessments is not optimal, these findings suggest that using video-simulations could be an effective approach as part of raters' training to measure community building accessibility. Using video-simulated evaluations provides an access to a standardize location which enables testing of trainees' performance and reliability through comparing their answers to the various accessibility questions within the AccessTools app with expert answers.

Suggestions for Future Research

The suggestions for future research fall into two main categories, tool-related and training-related suggestions. Psychrometric properties of the AccessTools assessment

including content validity, sensitivity, responsiveness, convergent validity, and test-retest as well as interrater and intrarater reliability are important to be studied and established for typical users. In Year 3, part of the sample used the ADA Checklist to perform accessibility evaluations on restaurants' recorded videos. A study to cross-validate AccessTools against the ADA Checklist is needed to elucidate the strengths and weaknesses of both tools.

Currently, the AccessTools assessment is using a summative arbitrary scoring system, and a validated additive scaling method needs to be defined and developed to improve use of the tool. This system should reflect the comprehensive nature of the tool, as it assesses related physical, sensory, and cognitive accessibility barriers, and should contain a weighted scoring system to represent the accessibility measures of these impairment categories. Accessibility depends on disability type, so the correct result of a comprehensive accessibility assessment would be multidimensional and would provide accessibility rating for major types of disability rather than mixing them together. The validity of this system need to be studied and correlated with the subjective experiences of PWD. Cut points could be established to determine whether the building is sufficiently accessible for the vast majority of PWD likely to use the building. Such a building could simply be described as "accessible."

Changing the scoring options for higher root level questions into dichotomous options (Applicable or Not Applicable) and keeping the trichotomous options for the subsequent branching questions might increase reliability. Specifically, questions that branch into multiple root level questions. For example, "Main Entrance Level Changes" expands into two root questions (Steps and Staircases). Thus, if there were level

changes, raters may mistakenly answer the questions as “Accessible” on that level, which indicates that the main entrance has both “Steps” and “Staircases” and both are accessible.

For the training category, a tool-specific training module needs to be created and tested. The tool-specific training is critical to provide the needed knowledge to use the tool and enhance its overall reliability and validity for both novice and expert users. Specifically, the training needs to provide clear definitions and practical examples on the correct use and interpretation of the scoring criteria, as well as providing clear instructions on how to properly use the expanding TTSS methodology implemented in the AccessTools assessment.

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APPENDICES

Appendix A: AccessTools Taxonomy for version 4 (build 72)

II. Main Entrance/Exterior Doorway(s) (VIDEO)

- A. Size of Doorway(s)
    1. Width of Doorway(s)
    2. Height of Doorway(s)
- B. Floor
    1. Clear Floor Space
    2. Slope
    3. Surface
    4. Doorway(s) Threshold
- C. Opening & Closing
    1. Required Force
    2. Use of Hands
    3. Sitting & Standing Position
    4. Door Safety
    5. Handle of Door
    6. Door Intuitiveness
- D. Ease of Lock
    1. Required Force
    2. Required Dexterity
    3. Lock Location
    4. One Hand
    5. Detection
- E. Visibility
    1. Distinct from Wall
    2. Distinct Door Features
    3. Lighting
- F. Automatic Doors
    1. Door Opening Speed
    2. Opening Force
    3. Detect Short & Seated People
    4. Door Timing
- G. Automatic Door Switch
    1. Height
    2. Dexterity
    3. Distinct
    4. Intuitive Operation
    5. Proximity to Door
    6. Door Prediction
    7. Switch Speed

H. Door Stops
    1. Sitting & Standing
    2. Required Force
I. Main Entrance Ramp
    1. Run Accessibility
        i. Run Slope of Ramp
        ii. Cross Slope of Ramp
        iii. Consistent Slope
        iv. Run Total Rise
        v. Landings
        vi. Ramp Width
    2. Landing Accessibility
        i. Landing Flatness
        ii. Landing Width
        iii. Landing Length
    3. Surface Properties
        i. Surface Material
        ii. Surface Condition
        iii. Grating Accessibility
    4. Edge Protection
        i. No Drop Off
        ii. Sufficient Edge Protection
    5. Handrails
        i. Location
            A. Handrail Placement
            B. Along Ramp
            C. Continuous at Landings
        ii. Accessible Ends
            A. Handrail Extension at Top
            B. Handrail Extension at Bottom
            C. Curved Handrail Extensions
        iii. Accessible Mounting
            A. Comfortable Height
            B. Consistent Height
            C. Second Handrail
            D. Space between Rail & Wall
            E. Fixed Mounting
            F. Mounting Bracket Positioning
        iv. Accessible Gripping Surface
            A. Grasp of Circular Handrail
            B. Grasp of Non-Circular Handrail
            C. Gripping Surface
J. Signage
    1. Exit Signage

i. Visual Signs (VIDEO)
    A. Glare
    B. Contrast
    C. Sans Serif Font
    D. Standard Font
    E. Easy to Locate
    F. Pictograms & Icons
    G. Content
ii. Tactile Signs (VIDEO)
    A. Easy to Find Location
    B. Safe Location
    C. Easy to Read Text
    D. Easy to Read Tactile Text
    E. Braille
    F. Text Separate from Borders
    G. Pictograms & Icons
    H. Content

V. Indoor Routes

A. Main Hallway Route (VIDEO)
1. Connects Building Elements
2. Efficient Route
3. Walking & Rolling Surface
    i. Surface
    ii. Resistance for Wheeled Mobility
    iii. Free of Trip Hazards
    iv. Easily Discriminated
4. Route Dimensions
    i. Route Width
    ii. Turning Radius
    iii. Passing & Resting Areas
    iv. Head Clearance
    v. Hazards from the Side
5. Changes in Elevation
    i. Run Slope of Ramps
    ii. Cross Slope of Ramps
    iii. Large Level Changes
    iv. Small Elevation Changes
    v. Limit Vertical Change
6. Signage
    i. Route Marked by Signs
    ii. Features Marked
    iii. Accessible Map
    iv. Interior Signage
        A. Visual Signs (VIDEO)

1. Glare
2. Contrast
3. Sans Serif Font
4. Standard Font
5. Easy to Locate
6. Pictograms & Icons
7. Content

B. Tactile Signs (VIDEO)
1. Easy to Find Location
2. Safe Location
3. Easy to Read Text
4. Easy to Read Tactile Text
5. Braille
6. Text Separate from Borders
7. Pictograms & Icons
8. Content

B. Route to Elevators (VIDEO)
1. Connects Building Elements
2. Efficient Route
3. Walking & Rolling Surface
    - i. Surface
        - A. Firm
        - B. Stable
    - ii. Resistance for Wheeled Mobility
    - iii. Free of Trip Hazards
    - iv. Easily Discriminated
4. Route Dimensions
    - i. Route Width
    - ii. Turning Radius
    - iii. Passing & Resting Areas
    - iv. Head Clearance
    - v. Hazards from the Side
5. Change in Elevation
    - i. Run Slope of Ramps
    - ii. Cross Slope of Ramp
    - iii. Large Level Changes
    - iv. Small Elevation Changes
    - v. Limit Vertical Change
6. Signage
    - i. Route Marked by Signs
    - ii. Features Marked
    - iii. Accessible Map
    - iv. Interior Signage
        - A. Visual Signs (VIDEO)

1. Glare
2. Contrast
3. Sans Serif Font
4. Standard Font
5. Easy to Locate
6. Pictograms & Icons
7. Content

B. Tactile Signs (VIDEO)
    1. Easy to Find Location
    2. Safe Location
    3. Easy to Read Text
    4. Easy to Read Tactile Text
    5. Braille
    6. Text Separate from Borders
    7. Pictograms & Icons
    8. Content

C. Route to Most Used Restroom (VIDEO)
    1. Connects Building Elements
    2. Efficient Route
    3. Walking & Rolling Surface
        i. Surface
        ii. Resistance for Wheeled Mobility
        iii. Free of Trip Hazards
        iv. Easily Discriminated
    4. Route Dimensions
        i. Route Width
        ii. Turning Radius
        iii. Passing & Resting Areas
        iv. Head Clearance
        v. Hazards from the Side
    5. Change in Elevation
        i. Run Slope of Ramps
        ii. Cross Slope of Ramps
        iii. Large Level Changes
        iv. Small Elevation Changes
        v. Limit Vertical Change
    6. Signage
        i. Route Marked by Signs
        ii. Features Marked
        iii. Accessible Map
        iv. Interior Signage
            A. Visual Signs (VIDEO)
                1. Glare
                2. Contrast

3. Sans Serif Font
4. Standard Font
5. Easy to Locate
6. Pictograms & Icons
7. Content

B. Tactile Signs (VIDEO)
1. Easy to Find Location
2. Safe Location
3. Easy to Read Text
4. Easy to Read Tactile Text
5. Braille
6. Text Separate from Borders
7. Pictograms & Icons
8. Content

D. Exit Route (VIDEO)

1. Connects Essential Features
2. Efficient Route
3. Walking & Rolling Surface
    - i. Surface
        - A. Firm
        - B. Stable
    - ii. Resistance for Wheeled Mobility
    - iii. Free of Trip Hazards
    - iv. Easily Discriminated
4. Route Dimensions
    - i. Route Width
    - ii. Turning Radius
    - iii. Passing & Resting Areas
    - iv. Head Clearance
    - v. Hazards from the Side
5. Elevation Changes
    - i. Run Slope of Ramps
    - ii. Cross Slope of Ramps
    - iii. Large Level Changes
    - iv. Small Elevation Changes
    - v. Limit Vertical Change
6. Signage
    - i. Route Marked by Signs
    - ii. Features Marked
    - iii. Accessible Map
    - iv. Exit Signage
        - A. Visual Signs (VIDEO)
            1. Glare
            2. Contrast

3. Sans Serif Font
4. Standard Font
5. Easy to Locate
6. Pictograms & Icons
7. Content

B. Tactile Signs (VIDEO)

1. Easy to Find Location
2. Safe Location
3. Easy to Read Text
4. Easy to Read Tactile Text
5. Braille
6. Text Separate from Borders
7. Pictograms & Icons
8. Content

VII. Seating

A. General Seating Area (VIDEO)

1. Designated Seating
2. Route
3. Separate from Main Route
4. Visibility
5. Companion Seating
6. Storage for Equipment
7. Open Seating Area
8. Fixed Seating
9. Comfortable Surroundings

B. Table Seating (VIDEO)

1. Primary Space under Table
2. Foot & Extended Space
3. Accessible Seating Signage
4. Storage for Equipment

C. Free Standing Chairs (VIDEO)

1. Area around the chair
2. Stability
3. Size
4. Ease of Transfer
5. Storage for Equipment

D. Auditorium/Lecture Seating (VIDEO)

1. Sight Line
2. Companion Seating
3. Marked Accessible Seating
4. Open Seating Space
5. Fixed Seating
6. Storage for Equipment
7. Floor & Ground

- i. Ground Surface (VIDEO)
  - A. Walking & Rolling Surface
    1. Firm
    2. Stable
    3. Slip Resistant
  - B. Free of Trip Hazards
  - C. Gratings
- ii. Level Changes (VIDEO)
  - A. Small Level Changes
  - B. Large Level Changes

VIII. Restroom(s)

- A. Female Restroom(s) (VIDEO)
  1. Doorway
     - i. Size of Doorway
       - A. Width
       - B. Height
     - ii. Floor
       - A. Clear Floor Space
       - B. Slope
       - C. Surface
       - D. Doorway threshold
     - iii. Opening & Closing
       - A. Required Force
       - B. Use of Hands
       - C. Sitting & Standing Position
       - D. Door Safety
       - E. Handle of Door
       - F. Door Intuitiveness
     - iv. Ease of Lock
       - A. Required Force
       - B. Required Dexterity
       - C. Lock Location
       - D. One Hand
       - E. Detection
     - v. Visibility
       - A. Distinct from Wall
       - B. Distinct Door Features
       - C. Lighting
     - vi. Automatic Doors
       - A. Speed of Door
       - B. Opening Force
       - C. Detect Short Seated People
       - D. Door Timing
     - vii. Automatic Door Switch

        A. Reachable
        B. Dexterity
        C. Distinct
        D. Intuitive Operations
        E. Proximity to Door
        F. Door Prediction
        G. Switch Speed
    viii. Door Stops
        A. Sitting & Standing
        B. Force

2. General Features
    i. Restroom Size
    ii. Lighting
    iii. Floor Surface
        A. Firm
        B. Stable
        C. Slip Resistant
        D. Free of Trip Hazards
        E. Level Changes (VIDEO)
            1. Small Level Changes
            2. Large Level Changes
    iv. Floor Surface> Gratings
3. Toilet Stalls
    i. Stall Size
    ii. Stall Door
    iii. Stall Lock Mechanism
    iv. Stall Lock Location
    v. Toilet Paper Reach
    vi. Toilet Paper Dispensing
    vii. Hooks & Shelves
4. Toilet
    i. Grab Bar Position
    ii. Grab Bar Mounting
    iii. Toilet Height
    iv. Flush Function
    v. Flush Location
    vi. Flush Dexterity
    vii. Flush Timing
5. Sink
    i. Knee & Toe Space
    ii. Faucet Location
    iii. Faucet Dexterity
    iv. Soap Dispenser Location
    v. Soap Dispenser Dexterity

- vi. Automatic Sink
- vii. Hand Dryer Location
- viii. Hand Drying Device Dexterity
- ix. Shelving Location
- x. Paper Waste Disposal
- xi. Sharps Disposal

6. Mirror
7. Tub & Shower
   - i. Clear Floor Space
   - ii. Grab Bars Position
   - iii. Grab Bars Installation
   - iv. Transfers
   - v. Shower Size
   - vi. Shower Chair/Bench
   - vii. Rolling Shower Chair
   - viii. Shower Controls
   - ix. Shower Control Dexterity
   - x. Hand-held Shower
8. Signage
   - i. Interior Signage
     - A. Visual Signs (VIDEO)
       1. Glare
       2. Contrast
       3. Sans Serif Font
       4. Standard Font
       5. Easy to Locate
       6. Pictograms & Icons
       7. Content
     - B. Tactile Signs (VIDEO)
       1. Easy to Find Location
       2. Safe Location
       3. Easy to Read Text
       4. Easy to Read Tactile Text
       5. Braille
       6. Text Separate from Borders
       7. Pictograms & Icons
       8. Content
   - ii. Exit Signage
     - A. Visual Signs (VIDEO)
       1. Glare
       2. Contrast
       3. Sans Serif Font
       4. Standard Font
       5. Easy to Locate

6. Pictograms & Icons
7. Content

B. Tactile Signs (VIDEO)
1. Easy to Find Location
2. Safe Location
3. Easy to Read Text
4. Easy to Read Tactile Text
5. Braille
6. Text Separate from Borders
7. Pictograms & Icons
8. Content

B. Male Restroom(s) (VIDEO)

1. Doorway

i. Size of Doorway
A. Width
B. Height

ii. Floor
A. Clear Floor Space
B. Slope
C. Floor Surface
D. Doorway threshold

iii. Opening & Closing
A. Required Force
B. Use of Hands
C. Sitting & Standing Position
D. Door Safety
E. Handle of Door
F. Door Intuitiveness

iv. Ease of Lock
A. Required Force
B. Required Dexterity
C. Lock Location
D. One Hand
E. Detection

v. Visibility
A. Distinct from Wall
B. Distinct Door Features
C. Lighting

vi. Automatic Doors
A. Speed of Door
B. Opening Force
C. Detect Short Seated People
D. Door Timing

vii. Automatic Door Switch

            - A. Reachable
            - B. Dexterity
            - C. Distinct
            - D. Intuitive Operations
            - E. Proximity to Door
            - F. Door Prediction
            - G. Switch Speed
        - viii. Door Stops
            - A. Sitting & Standing
            - B. Force
2. General Features
    - i. Restroom Size
    - ii. Lighting
    - iii. Floor Surface
        - A. Firm
        - B. Stable
        - C. Slip Resistant
        - D. Free of Trip Hazards
        - E. Gratings
        - F. Level Changes (VIDEO)
        - G. Small Level Changes
        - H. Large Level Changes
3. Toilet Stalls
    - i. Stall Size
    - ii. Stall Door
    - iii. Stall Lock Mechanism
    - iv. Stall Lock Location
    - v. Toilet Paper Reach
    - vi. Toilet Paper Dispensing
    - vii. Hooks & Shelves
4. Toilet
    - i. Grab Bar Position
    - ii. Grab Bar Mounting
    - iii. Toilet Height
    - iv. Flush Function
    - v. Flush Location
    - vi. Flush Dexterity
    - vii. Flush Timing
5. Urinals
    - i. Privacy
    - ii. Urinal Height
    - iii. Clear Floor Space
    - iv. Flush Location
    - v. Flush Dexterity

6. Sink
    - i. Knee & Toe Space
    - ii. Faucet Location
    - iii. Faucet Dexterity
    - iv. Soap Dispenser Location
    - v. Soap Dispenser Dexterity
    - vi. Automatic Sink
    - vii. Hand Dryer Location
    - viii. Hand Drying Device Dexterity
    - ix. Shelving Height
    - x. Paper Waste Disposal
    - xi. Sharps Disposal
7. Mirror
8. Tub & Shower
    - i. Clear Floor Space
    - ii. Grab Bars Position
    - iii. Grab Bars Installation
    - iv. Transfers
    - v. Shower Size
    - vi. Shower Chair/Bench
    - vii. Rolling Shower Chair
    - viii. Shower Controls
    - ix. Shower Control Dexterity
    - x. Hand-held Shower
9. Signage
    - i. Interior Signage
        - A. Visual Signs (VIDEO)
            1. Glare
            2. Contrast
            3. Sans Serif Font
            4. Standard Font
            5. Easy to Locate
            6. Pictograms & Icons
            7. Content
        - B. Tactile Signs (VIDEO)
            1. Easy to Find Location
            2. Safe Location
            3. Easy to Read Text
            4. Easy to Read Tactile Text
            5. Braille
            6. Text Separate from Borders
            7. Pictograms & Icons
            8. Content
    - ii. Exit Signage

- A. Visual Signs (VIDEO)
  1. Glare
  2. Contrast
  3. Sans Serif Font
  4. Standard Font
  5. Easy to Locate
  6. Pictograms & Icons
  7. Content
- B. Tactile Signs (VIDEO)
  1. Easy to Find Location
  2. Safe Location
  3. Easy to Read Text
  4. Easy to Read Tactile Text
  5. Braille
  6. Text Separate from Borders
  7. Pictograms & Icons
  8. Content

C. Alternative Restroom(s) (VIDEO)

1. Doorway
   - i. Size of Doorway
     - A. Width
     - B. Height
   - ii. Floor
     - A. Clear Floor Space
     - B. Slope
     - C. Surface
     - D. Doorway threshold
   - iii. Opening & Closing
     - A. Required Force
     - B. Use of Hands
     - C. Sitting & Standing Position
     - D. Door Safety
     - E. Handle of Door
     - F. Door Intuitiveness
   - iv. Ease of Lock
     - A. Required Force
     - B. Required Dexterity
     - C. Lock Location
     - D. One Hand
     - E. Detection
   - v. Visibility
     - A. Distinct from Wall
     - B. Distinct Door Features
     - C. Lighting

- vi. Automatic Doors
  - A. Speed of Door
  - B. Opening Force
  - C. Detect Short Seated People
  - D. Door Timing
- vii. Automatic Door Switch
  - A. Reachable
  - B. Dexterity
  - C. Distinct
  - D. Intuitive Operations
  - E. Proximity to Door
  - F. Door Prediction
  - G. Switch Speed
- viii. Door Stops
  - A. Sitting & Standing
  - B. Force

2. General Features
   - i. Restroom Size
   - ii. Lighting
   - iii. Floor Surface
     - A. Firm
     - B. Stable
     - C. Slip Resistant
     - D. Free of Trip Hazards
     - E. Gratings
     - F. Level Changes (VIDEO)
       1. Small Level Changes
       2. Large Level Changes
3. Toilet Stalls
   - i. Stall Size
   - ii. Stall Door
   - iii. Stall Lock Mechanism
   - iv. Stall Lock Location
   - v. Toilet Paper Reach
   - vi. Toilet Paper Dispensing
   - vii. Hooks & Shelves
4. Toilet
   - i. Grab Bar Position
   - ii. Grab Bar Mounting
   - iii. Toilet Height
   - iv. Flush Location
   - v. Flush Instructions
   - vi. Flush Dexterity
   - vii. Flush Timing

5. Urinals
    - i. Privacy
    - ii. Urinal Height
    - iii. Clear Floor Space
    - iv. Flush Location
    - v. Flush Dexterity
6. Sink
    - i. Knee & Toe Space
    - ii. Faucet Location
    - iii. Faucet Dexterity
    - iv. Soap Dispenser Location
    - v. Soap Dispenser Dexterity
    - vi. Automatic Sink
    - vii. Hand Drying Location
    - viii. Hand Drying Device Dexterity
    - ix. Shelving Height
    - x. Paper Waste Disposal
    - xi. Sharps Disposal
7. Mirror
8. Tub & Shower
    - i. Clear Floor Space
    - ii. Grab Bars Position
    - iii. Grab Bars Installation
    - iv. Transfers
    - v. Shower Size
    - vi. Shower Chair/Bench
    - vii. Rolling Shower Chair
    - viii. Shower Controls
    - ix. Shower Control Dexterity
    - x. Hand-held Shower
9. Signage
    - i. Interior Signage
        - A. Visual Signs (VIDEO)
            1. Glare
            2. Contrast
            3. Sans Serif Font
            4. Standard Font
            5. Easy to Locate
            6. Pictograms & Icons
            7. Content
        - B. Tactile Signs (VIDEO)
            1. Easy to Find Location
            2. Safe Location
            3. Easy to Read Text

4. Easy to Read Tactile Text
5. Braille
6. Text Separate from Borders
7. Pictograms & Icons
8. Content

ii. Exit Signage

A. Visual Signs (VIDEO)
   1. Glare
   2. Contrast
   3. Sans Serif Font
   4. Standard Font
   5. Easy to Locate
   6. Pictograms & Icons
   7. Content
B. Tactile Signs (VIDEO)
   1. Easy to Find Location
   2. Safe Location
   3. Easy to Read Text
   4. Easy to Read Tactile Text
   5. Braille
   6. Text Separate from Borders
   7. Pictograms & Icons
   8. Content

Appendix B: AccessTools Taxonomy for version 4 (build 80)

- III. Main Entrance/Exterior Doorway(s) (REC VID)
  - A. Main Entrance Level Changes
    - 1. Steps
      - i. Treads & Risers
        - A. Tread Size
        - B. Riser Height
        - C. Tread & Riser Consistency
        - D. Closed Risers
      - ii. Nosings
        - A. Nosing Extension
        - B. Nosing Tread Surface
      - iii. Surface
        - A. Water Accumulation
        - B. Level Stair Surface
        - C. Level Landing Surface
        - D. Firm
        - E. Stable
        - F. Slip Resistant
        - G. Free of Trip Hazards
        - H. Gratings
        - I. Glare Free
      - iv. Visual Access
        - A. Stairwell Lighting
        - B. Differentiation of Stairs
      - v. Handrails
        - A. Location
          - 1. Handrail Placement
          - 2. Along Ramp
          - 3. Continuous at Landings
        - B. Accessible Ends
          - 1. Handrail Extension at Top
          - 2. Handrail Extension at Bottom
          - 3. Curved Handrail Extensions
        - C. Accessible Mounting
          - 1. Comfortable Height
          - 2. Consistent Height
          - 3. Second Handrail
          - 4. Space between Rail & Wall
          - 5. Handrail Mounting
          - 6. Mounting Bracket Position
        - D. Accessible Gripping Surface
          - 1. Grasp of Circular Handrail

2. Grasp of Non-Circular Handrail
3. Gripping Surface

vi. Ramps

A. Run Accessibility
1. Run Slope of Ramp
2. Cross Slope of Ramp
3. Consistent Slope
4. Run Total Rise
5. Landings
6. Ramp Width

B. Landing Accessibility
1. Landing Flatness
2. Landing Width
3. Landing Length

C. Surface Properties
1. Surface Material
2. Surface Condition
3. Grating Accessibility

D. Edge Protection
1. No Drop Off
2. Sufficient Edge Protection

E. Handrails
1. Location
   i. Handrail Placement
   ii. Along Ramp
   iii. Continuous at Landings
2. Accessible Ends
   i. Handrail Extension at Top
   ii. Handrail Extension at Bottom
   iii. Curved Handrail Extensions
3. Accessible Mounting
   i. Comfortable Height
   ii. Consistent Height
   iii. Second Handrail
   iv. Space between Rail & Wall
   v. Fixed Mounting
   vi. Mounting Bracket Positioning
4. Accessible Gripping Surface
   i. Grasp of Circular Handrail
   ii. Grasp of Non-Circular Handrail
   iii. Gripping Surface

2. Staircases

i. Treads & Risers

A. Tread Size

    - B. Riser Height
    - C. Tread & Riser Consistency
    - D. Closed Risers
- ii. Nosings
    - A. Nosing Extension
    - B. Nosing Tread Surface
- iii. Surface
    - A. Water Accumulation
    - B. Level Stair Surface
    - C. Level Landing Surface
    - D. Firm
    - E. Stable
    - F. Slip Resistant
    - G. Free of Trip Hazards
    - H. Gratings
    - I. Glare Free
- iv. Visual Access
    - A. Stairwell Lighting
    - B. Differentiation of Staircases
- v. Handrails
    - A. Location
        1. Handrail Placement
        2. Along Ramp
        3. Continuous at Landings
    - B. Accessible Ends
        1. Handrail Extension at Top
        2. Handrail Extension at Bottom
        3. Curved Handrail Extensions
    - C. Accessible Mounting
        1. Comfortable Height
        2. Consistent Height
        3. Second Handrail
        4. Space between Rail & Wall
        5. Handrail Mounting
        6. Mounting Bracket Position
    - D. Accessible Gripping Surface
        1. Grasp of Circular Handrail
        2. Grasp of Non-Circular Handrail
        3. Gripping Surface
- vi. Elevators
    - A. Elevator Lobby (REC VID)
        1. Floor Space
        2. Floor Gap
    - B. Lobby Signals (REC VID)

    1. Auditory Cues
    2. Visual Cues
    3. Indicator Timing
  C. Lobby Call Buttons (REC VID)
    1. Location
      i. Detectable
      ii. Reach
      iii. Near Elevator
    2. Easy to Use
      i. Easy to Activate
      ii. Button Size
      iii. Button Arrangement
  D. Elevator Car (REC VID)
    1. Re-Opens When Obstructed
    2. Car Door Size
    3. Car Size
    4. Handrails
    5. Surface
    6. Car Lighting
    7. Car Sound Level
    8. Emergency Communication System
  E. Elevator Car Buttons (REC VID)
    1. Location
    2. Logical Order
    3. Easy to Activate
    4. Alternative Communication
  F. Car Position Indicators (REC VID)
    1. Location
    2. Auditory Cues
    3. Visual Cues
B. Size of Doorway(s)
  1. Width of Doorway(s)
  2. Height of Doorway(s)
C. Floor
  1. Clear Floor Space
  2. Slope
  3. Surface
  4. Doorway(s) Threshold
D. Opening & Closing
  1. Required Force
  2. Use of Hands
  3. Sitting & Standing Position
  4. Door Safety
  5. Handle of Door

6. Door Intuitiveness

E. Ease of Lock
    1. Required Force
    2. Required Dexterity
    3. Lock Location
    4. One Hand
    5. Detection

F. Visibility
    1. Distinct from Wall
    2. Distinct Door Features
    3. Lighting

G. Automatic Doors
    1. Door Opening Speed
    2. Opening Force
    3. Detect Short & Seated People
    4. Door Timing

H. Automatic Door Switch
    1. Height
    2. Dexterity
    3. Distinct
    4. Intuitive Operation
    5. Proximity to Door
    6. Door Prediction
    7. Switch Speed

I. Door Stops
    1. Sitting & Standing
    2. Required Force

J. Signage
    1. Exit Signage
        i. Visual Signs (REC VID)
            A. Glare
            B. Contrast
            C. Sans Serif Font
            D. Standard Font
            E. Easy to Locate
            F. Pictograms & Icons
            G. Content
        ii. Tactile Signs (REC VID)
            A. Easy to Find Location
            B. Safe Location
            C. Easy to Read Text
            D. Easy to Read Tactile Text
            E. Braille
            F. Text Separate from Borders

G. Pictograms & Icons
H. Content
2. Exterior Signage (REC VID)
i. Visual Signs
A. Glare
B. Contrast
C. Sans Serif Font
D. Standard Font
E. Easy to Locate
F. Pictograms & Icons
G. Content

VI. Indoor Routes
- A. Main Hallway Route (REC VID)
  - 1. Level Changes in Route to Seating
    - i. Steps
      - A. Treads & Risers
        - 1. Tread Size
        - 2. Riser Height
        - 3. Tread & Riser Consistency
        - 4. Closed Risers
      - B. Nosings
        - 1. Nosing Extension
        - 2. Nosing Tread Surface
      - C. Surface
        - 1. Water Accumulation
        - 2. Level Stair Surface
        - 3. Level Landing Surface
        - 4. Firm
        - 5. Stable
        - 6. Slip Resistant
        - 7. Free of Trip Hazards
        - 8. Gratings
        - 9. Glare Free
      - D. Visual Access
        - 1. Stairwell Lighting
        - 2. Differentiation of Stairs
      - E. Handrails
        - 1. Location
          - i. Handrail Placement
          - ii. Along Ramp
          - iii. Continuous at Landings
        - 2. Accessible Ends
          - i. Handrail Extension at Top
          - ii. Handrail Extension at Bottom

iii. Curved Handrail Extensions

3. Accessible Mounting
    i. Comfortable Height
    ii. Consistent Height
    iii. Second Handrail
    iv. Space between Rail & Wall
    v. Handrail Mounting
    vi. Mounting Bracket Position
4. Accessible Gripping Surface
    i. Grasp of Circular Handrail
    ii. Grasp of Non-Circular Handrail
    iii. Gripping Surface

F. Ramps
1. Run Accessibility
    i. Run Slope of Ramp
    ii. Cross Slope of Ramp
    iii. Consistent Slope
    iv. Run Total Rise
    v. Landings
    vi. Ramp Width
2. Landing Accessibility
    i. Landing Flatness
    ii. Landing Width
    iii. Landing Length
3. Surface Properties
    i. Surface Material
    ii. Surface Condition
    iii. Grating Accessibility
4. Edge Protection
    i. No Drop Off
    ii. Sufficient Edge Protection
5. Handrails
    i. Location
        A. Handrail Placement
        B. Along Ramp
        C. Continuous at Landings
    ii. Accessible Ends
        A. Handrail Extension at Top
        B. Handrail Extension at Bottom
        C. Curved Handrail Extensions
    iii. Accessible Mounting
        A. Comfortable Height
        B. Consistent Height
        C. Second Handrail

            D. Space between Rail & Wall
            E. Fixed Mounting
            F. Mounting Bracket Positioning
        iv. Accessible Gripping Surface
            A. Grasp of Circular Handrail
            B. Grasp of Non-Circular Handrail
            C. Gripping Surface

ii. Staircases

- A. Treads & Risers
  1. Tread Size
  2. Riser Height
  3. Tread & Riser Consistency
  4. Closed Risers
- B. Nosings
  1. Nosing Extension
  2. Nosing Tread Surface
- C. Surface
  1. Water Accumulation
  2. Level Stair Surface
  3. Level Landing Surface
  4. Firm
  5. Stable
  6. Slip Resistant
  7. Free of Trip Hazards
  8. Gratings
  9. Glare Free
- D. Visual Access
  1. Stairwell Lighting
  2. Differentiation of Staircases
- E. Handrails
  1. Location
     - i. Handrail Placement
     - ii. Along Ramp
     - iii. Continuous at Landings
  2. Accessible Ends
     - i. Handrail Extension at Top
     - ii. Handrail Extension at Bottom
     - iii. Curved Handrail Extensions
  3. Accessible Mounting
     - i. Comfortable Height
     - ii. Consistent Height
     - iii. Second Handrail
     - iv. Space between Rail & Wall
     - v. Handrail Mounting

vi. Mounting Bracket Position

4. Accessible Gripping Surface
   - i. Grasp of Circular Handrail
   - ii. Grasp of Non-Circular Handrail
   - iii. Gripping Surface

F. Elevators

1. Elevator Lobby (REC VID)
   - i. Signage
   - ii. Floor Space
   - iii. Floor Gap
2. Lobby Signals (REC VID)
   - i. Auditory Cues
   - ii. Visual Cues
   - iii. Indicator Timing
3. Lobby Call Buttons (REC VID)
   - i. Location
     - A. Detectable
     - B. Reach
     - C. Near Elevator
   - ii. Easy to Use
     - A. Easy to Activate
     - B. Button Size
     - C. Button Arrangement
4. Elevator Car (REC VID)
   - i. Re-Opens When Obstructed
   - ii. Car Door Size
   - iii. Car Size
   - iv. Handrails
   - v. Surface
   - vi. Car Lighting
   - vii. Car Sound Level
   - viii. Emergency Communication System
5. Elevator Car Buttons (REC VID)
   - i. Location
   - ii. Logical Order
   - iii. Easy to Activate
   - iv. Alternative Communication
6. Car Position Indicators (REC VID)
   - i. Location
   - ii. Auditory Cues
   - iii. Visual Cues

2. Connects Building Elements
3. Efficient Route
4. Walking & Rolling Surface

- i. Surface
- ii. Resistance for Wheeled Mobility
- iii. Free of Trip Hazards
- iv. Easily Discriminated

5. Route Dimensions
    - i. Route Width
    - ii. Turning Radius
    - iii. Passing & Resting Areas
    - iv. Head Clearance
    - v. Hazards from the Side
6. Signage
    - i. Route Marked by Signs
    - ii. Features Marked
    - iii. Accessible Map
    - iv. Interior Signage
        - A. Visual Signs (REC VID)
            1. Glare
            2. Contrast
            3. Sans Serif Font
            4. Standard Font
            5. Easy to Locate
            6. Pictograms & Icons
            7. Content
        - B. Tactile Signs (REC VID)
            1. Easy to Find Location
            2. Safe Location
            3. Easy to Read Text
            4. Easy to Read Tactile Text
            5. Braille
            6. Text Separate from Borders
            7. Pictograms & Icons
            8. Content

B. Route to Restroom (REC VID)

1. Level Changes in Route to Restroom
    - i. Steps
        - A. Treads & Risers
            1. Tread Size
            2. Riser Height
            3. Tread & Riser Consistency
            4. Closed Risers
        - B. Nosings
            1. Nosing Extension
            2. Nosing Tread Surface
        - C. Surface

1. Water Accumulation
2. Level Stair Surface
3. Level Landing Surface
4. Firm
5. Stable
6. Slip Resistant
7. Free of Trip Hazards
8. Gratings
9. Glare Free

D. Visual Access
   1. Stairwell Lighting
   2. Differentiation of Stairs

E. Handrails
   1. Location
      i. Handrail Placement
      ii. Along Ramp
      iii. Continuous at Landings
   2. Accessible Ends
      i. Handrail Extension at Top
      ii. Handrail Extension at Bottom
      iii. Curved Handrail Extensions
   3. Accessible Mounting
      i. Comfortable Height
      ii. Consistent Height
      iii. Second Handrail
      iv. Space between Rail & Wall
      v. Handrail Mounting
      vi. Mounting Bracket Position
   4. Accessible Gripping Surface
      i. Grasp of Circular Handrail
      ii. Grasp of Non-Circular Handrail
      iii. Gripping Surface

F. Ramps
   1. Run Accessibility
      i. Run Slope of Ramp
      ii. Cross Slope of Ramp
      iii. Consistent Slope
      iv. Run Total Rise
      v. Landings
      vi. Ramp Width
   2. Landing Accessibility
      i. Landing Flatness
      ii. Landing Width
      iii. Landing Length

3. Surface Properties
    i. Surface Material
    ii. Surface Condition
    iii. Grating Accessibility
4. Edge Protection
    i. No Drop Off
    ii. Sufficient Edge Protection
5. Handrails
    i. Location
        A. Handrail Placement
        B. Along Ramp
        C. Continuous at Landings
    ii. Accessible Ends
        A. Handrail Extension at Top
        B. Handrail Extension at Bottom
        C. Curved Handrail Extensions
    iii. Accessible Mounting
        A. Comfortable Height
        B. Consistent Height
        C. Second Handrail
        D. Space between Rail & Wall
        E. Fixed Mounting
        F. Mounting Bracket Positioning
    iv. Accessible Gripping Surface
        A. Grasp of Circular Handrail
        B. Grasp of Non-Circular Handrail
        C. Gripping Surface

ii. Staircases
- A. Treads & Risers
    1. Tread Size
    2. Riser Height
    3. Tread & Riser Consistency
    4. Closed Risers
- B. Nosings
    1. Nosing Extension
    2. Nosing Tread Surface
- C. Surface
    1. Water Accumulation
    2. Level Stair Surface
    3. Level Landing Surface
    4. Firm
    5. Stable
    6. Slip Resistant
    7. Free of Trip Hazards

8. Gratings
9. Glare Free

D. Visual Access
1. Stairwell Lighting
2. Differentiation of Staircases

E. Handrails
1. Location
    i. Handrail Placement
    ii. Along Ramp
    iii. Continuous at Landings
2. Accessible Ends
    i. Handrail Extension at Top
    ii. Handrail Extension at Bottom
    iii. Curved Handrail Extensions
3. Accessible Mounting
    i. Comfortable Height
    ii. Consistent Height
    iii. Second Handrail
    iv. Space between Rail & Wall
    v. Handrail Mounting
    vi. Mounting Bracket Position
4. Accessible Gripping Surface
    i. Grasp of Circular Handrail
    ii. Grasp of Non-Circular Handrail
    iii. Gripping Surface

F. Elevators
1. Elevator Lobby (REC VID)
    i. Signage
    ii. Floor Space
    iii. Floor Gap
2. Lobby Signals (REC VID)
    i. Auditory Cues
    ii. Visual Cues
    iii. Indicator Timing
3. Lobby Call Buttons (REC VID)
    i. Location
        A. Detectable
        B. Reach
        C. Near Elevator
    ii. Easy to Use
        A. Easy to Activate
        B. Button Size
        C. Button Arrangement
4. Elevator Car (REC VID)

- i. Re-Opens When Obstructed
- ii. Car Door Size
- iii. Car Size
- iv. Handrails
- v. Surface
- vi. Car Lighting
- vii. Car Sound Level
- viii. Emergency Communication System

5. Elevator Car Buttons (REC VID)
   - i. Location
   - ii. Logical Order
   - iii. Easy to Activate
   - iv. Alternative Communication
6. Car Position Indicators (REC VID)
   - i. Location
   - ii. Auditory Cues
   - iii. Visual Cues

2. Connects Building Elements
3. Efficient Route
4. Walking & Rolling Surface
   - i. Surface
   - ii. Resistance for Wheeled Mobility
   - iii. Free of Trip Hazards
   - iv. Easily Discriminated
5. Route Dimensions
   - i. Route Width
   - ii. Turning Radius
   - iii. Passing & Resting Areas
   - iv. Head Clearance
   - v. Hazards from the Side
6. Signage
   - i. Route Marked by Signs
   - ii. Features Marked
   - iii. Accessible Map
   - iv. Interior Signage
     - A. Visual Signs (REC VID)
       1. Glare
       2. Contrast
       3. Sans Serif Font
       4. Standard Font
       5. Easy to Locate
       6. Pictograms & Icons
       7. Content
     - B. Tactile Signs (REC VID)

1. Easy to Find Location
2. Safe Location
3. Easy to Read Text
4. Easy to Read Tactile Text
5. Braille
6. Text Separate from Borders
7. Pictograms & Icons
8. Content

C. Route to Elevators (REC VID)
   1. Level Changes in Route to Elevators
      i. Steps
         A. Treads & Risers
            1. Tread Size
            2. Riser Height
            3. Tread & Riser Consistency
            4. Closed Risers
         B. Nosings
            1. Nosing Extension
            2. Nosing Tread Surface
         C. Surface
            1. Water Accumulation
            2. Level Stair Surface
            3. Level Landing Surface
            4. Firm
            5. Stable
            6. Slip Resistant
            7. Free of Trip Hazards
            8. Gratings
            9. Glare Free
         D. Visual Access
            1. Stairwell Lighting
            2. Differentiation of Stairs
         E. Handrails
            1. Location
               i. Handrail Placement
               ii. Along Ramp
               iii. Continuous at Landings
            2. Accessible Ends
               i. Handrail Extension at Top
               ii. Handrail Extension at Bottom
               iii. Curved Handrail Extensions
            3. Accessible Mounting
               i. Comfortable Height
               ii. Consistent Height

iii. Second Handrail
iv. Space between Rail & Wall
v. Handrail Mounting
vi. Mounting Bracket Position

4. Accessible Gripping Surface
   i. Grasp of Circular Handrail
   ii. Grasp of Non-Circular Handrail
   iii. Gripping Surface

F. Ramps

1. Run Accessibility
   i. Run Slope of Ramp
   ii. Cross Slope of Ramp
   iii. Consistent Slope
   iv. Run Total Rise
   v. Landings
   vi. Ramp Width
2. Landing Accessibility
   i. Landing Flatness
   ii. Landing Width
   iii. Landing Length
3. Surface Properties
   i. Surface Material
   ii. Surface Condition
   iii. Grating Accessibility
4. Edge Protection
   i. No Drop Off
   ii. Sufficient Edge Protection
5. Handrails
   i. Location
      A. Handrail Placement
      B. Along Ramp
      C. Continuous at Landings
   ii. Accessible Ends
      A. Handrail Extension at Top
      B. Handrail Extension at Bottom
      C. Curved Handrail Extensions
   iii. Accessible Mounting
      A. Comfortable Height
      B. Consistent Height
      C. Second Handrail
      D. Space between Rail & Wall
      E. Fixed Mounting
      F. Mounting Bracket Positioning
   iv. Accessible Gripping Surface

A. Grasp of Circular Handrail
B. Grasp of Non-Circular Handrail
C. Gripping Surface

ii. Staircases

- A. Treads & Risers
  1. Tread Size
  2. Riser Height
  3. Tread & Riser Consistency
  4. Closed Risers
- B. Nosings
  1. Nosing Extension
  2. Nosing Tread Surface
- C. Surface
  1. Water Accumulation
  2. Level Stair Surface
  3. Level Landing Surface
  4. Firm
  5. Stable
  6. Slip Resistant
  7. Free of Trip Hazards
  8. Gratings
  9. Glare Free
- D. Visual Access
  1. Stairwell Lighting
  2. Differentiation of Staircases
- E. Handrails
  1. Location
     - i. Handrail Placement
     - ii. Along Ramp
     - iii. Continuous at Landings
  2. Accessible Ends
     - i. Handrail Extension at Top
     - ii. Handrail Extension at Bottom
     - iii. Curved Handrail Extensions
  3. Accessible Mounting
     - i. Comfortable Height
     - ii. Consistent Height
     - iii. Second Handrail
     - iv. Space between Rail & Wall
     - v. Handrail Mounting
     - vi. Mounting Bracket Position
  4. Accessible Gripping Surface
     - i. Grasp of Circular Handrail
     - ii. Grasp of Non-Circular Handrail

                iii. Gripping Surface

F. Elevators
    1. Elevator Lobby (REC VID)
        i. Signage
        ii. Floor Space
        iii. Floor Gap
    2. Lobby Signals (REC VID)
        i. Auditory Cues
        ii. Visual Cues
        iii. Indicator Timing
    3. Lobby Call Buttons (REC VID)
        i. Location
            A. Detectable
            B. Reach
            C. Near Elevator
        ii. Easy to Use
            A. Easy to Activate
            B. Button Size
            C. Button Arrangement
    4. Elevator Car (REC VID)
        i. Re-Opens When Obstructed
        ii. Car Door Size
        iii. Car Size
        iv. Handrails
        v. Surface
        vi. Car Lighting
        vii. Car Sound Level
        viii. Emergency Communication System
    5. Elevator Car Buttons (REC VID)
        i. Location
        ii. Logical Order
        iii. Easy to Activate
        iv. Alternative Communication
    6. Car Position Indicators (REC VID)
        i. Location
        ii. Auditory Cues
        iii. Visual Cues

2. Connects Building Elements
3. Efficient Route
4. Walking & Rolling Surface
    i. Surface
        A. Firm
        B. Stable
    ii. Resistance for Wheeled Mobility

iii. Free of Trip Hazards
iv. Easily Discriminated

5. Route Dimensions
   i. Route Width
   ii. Turning Radius
   iii. Passing & Resting Areas
   iv. Head Clearance
   v. Hazards from the Side
6. Signage
   i. Route Marked by Signs
   ii. Features Marked
   iii. Accessible Map
   iv. Interior Signage
      A. Visual Signs (REC VID)
         1. Glare
         2. Contrast
         3. Sans Serif Font
         4. Standard Font
         5. Easy to Locate
         6. Pictograms & Icons
         7. Content
      B. Tactile Signs (REC VID)
         1. Easy to Find Location
         2. Safe Location
         3. Easy to Read Text
         4. Easy to Read Tactile Text
         5. Braille
         6. Text Separate from Borders
         7. Pictograms & Icons
         8. Content

D. Exit Route (REC VID)
   1. Exit Route Level Changes
      i. Steps
         A. Treads & Risers
            1. Tread Size
            2. Riser Height
            3. Tread & Riser Consistency
            4. Closed Risers
         B. Nosings
            1. Nosing Extension
            2. Nosing Tread Surface
         C. Surface
            1. Water Accumulation
            2. Level Stair Surface

3. Level Landing Surface
4. Firm
5. Stable
6. Slip Resistant
7. Free of Trip Hazards
8. Gratings
9. Glare Free

D. Visual Access
1. Stairwell Lighting
2. Differentiation of Stairs

E. Handrails
1. Location
    - i. Handrail Placement
    - ii. Along Ramp
    - iii. Continuous at Landings
2. Accessible Ends
    - i. Handrail Extension at Top
    - ii. Handrail Extension at Bottom
    - iii. Curved Handrail Extensions
3. Accessible Mounting
    - i. Comfortable Height
    - ii. Consistent Height
    - iii. Second Handrail
    - iv. Space between Rail & Wall
    - v. Handrail Mounting
    - vi. Mounting Bracket Position
4. Accessible Gripping Surface
    - i. Grasp of Circular Handrail
    - ii. Grasp of Non-Circular Handrail
    - iii. Gripping Surface

F. Ramps
1. Run Accessibility
    - i. Run Slope of Ramp
    - ii. Cross Slope of Ramp
    - iii. Consistent Slope
    - iv. Run Total Rise
    - v. Landings
    - vi. Ramp Width
2. Landing Accessibility
    - i. Landing Flatness
    - ii. Landing Width
    - iii. Landing Length
3. Surface Properties
    - i. Surface Material

        ii. Surface Condition
        iii. Grating Accessibility
    4. Edge Protection
        i. No Drop Off
        ii. Sufficient Edge Protection
    5. Handrails
        i. Location
            A. Handrail Placement
            B. Along Ramp
            C. Continuous at Landings
        ii. Accessible Ends
            A. Handrail Extension at Top
            B. Handrail Extension at Bottom
            C. Curved Handrail Extensions
        iii. Accessible Mounting
            A. Comfortable Height
            B. Consistent Height
            C. Second Handrail
            D. Space between Rail & Wall
            E. Fixed Mounting
            F. Mounting Bracket Positioning
        iv. Accessible Gripping Surface
            A. Grasp of Circular Handrail
            B. Grasp of Non-Circular Handrail
            C. Gripping Surface

ii. Staircases
- A. Treads & Risers
    1. Tread Size
    2. Riser Height
    3. Tread & Riser Consistency
    4. Closed Risers
- B. Nosings
    1. Nosing Extension
    2. Nosing Tread Surface
- C. Surface
    1. Water Accumulation
    2. Level Stair Surface
    3. Level Landing Surface
    4. Firm
    5. Stable
    6. Slip Resistant
    7. Free of Trip Hazards
    8. Gratings
    9. Glare Free

D. Visual Access
    1. Stairwell Lighting
    2. Differentiation of Staircases
E. Handrails
    1. Location
        i. Handrail Placement
        ii. Along Ramp
        iii. Continuous at Landings
    2. Accessible Ends
        i. Handrail Extension at Top
        ii. Handrail Extension at Bottom
        iii. Curved Handrail Extensions
    3. Accessible Mounting
        i. Comfortable Height
        ii. Consistent Height
        iii. Second Handrail
        iv. Space between Rail & Wall
        v. Handrail Mounting
        vi. Mounting Bracket Position
    4. Accessible Gripping Surface
        i. Grasp of Circular Handrail
        ii. Grasp of Non-Circular Handrail
        iii. Gripping Surface
F. Elevators
    1. Elevator Lobby (REC VID)
        i. Signage
        ii. Floor Space
        iii. Floor Gap
    2. Lobby Signals (REC VID)
        i. Auditory Cues
        ii. Visual Cues
        iii. Indicator Timing
    3. Lobby Call Buttons (REC VID)
        i. Location
            A. Detectable
            B. Reach
            C. Near Elevator
        ii. Easy to Use
            A. Easy to Activate
            B. Button Size
            C. Button Arrangement
    4. Elevator Car (REC VID)
        i. Re-Opens When Obstructed
        ii. Car Door Size

            iii. Car Size
            iv. Handrails
            v. Surface
            vi. Car Lighting
            vii. Car Sound Level
            viii. Emergency Communication System
        5. Elevator Car Buttons (REC VID)
            i. Location
            ii. Logical Order
            iii. Easy to Activate
            iv. Alternative Communication
        6. Car Position Indicators (REC VID)
            i. Location
            ii. Auditory Cues
            iii. Visual Cues
2. Connects Essential Features
3. Efficient Route
4. Walking & Rolling Surface
    i. Surface
        A. Firm
        B. Stable
    ii. Resistance for Wheeled Mobility
    iii. Free of Trip Hazards
    iv. Easily Discriminated
5. Route Dimensions
    i. Route Width
    ii. Turning Radius
    iii. Passing & Resting Areas
    iv. Head Clearance
    v. Hazards from the Side
6. Signage
    i. Route Marked by Signs
    ii. Features Marked
    iii. Accessible Map
    iv. Exit Signage
        A. Visual Signs (REC VID)
            1. Glare
            2. Contrast
            3. Sans Serif Font
            4. Standard Font
            5. Easy to Locate
            6. Pictograms & Icons
            7. Content
        B. Tactile Signs (REC VID)

1. Easy to Find Location
2. Safe Location
3. Easy to Read Text
4. Easy to Read Tactile Text
5. Braille
6. Text Separate from Borders
7. Pictograms & Icons
8. Content

E. Route to Other (REC VID)
   1. Level Changes in Route to Other
      i. Steps
         A. Treads & Risers
            1. Tread Size
            2. Riser Height
            3. Tread & Riser Consistency
            4. Closed Risers
         B. Nosings
            1. Nosing Extension
            2. Nosing Tread Surface
         C. Surface
            1. Water Accumulation
            2. Level Stair Surface
            3. Level Landing Surface
            4. Firm
            5. Stable
            6. Slip Resistant
            7. Free of Trip Hazards
            8. Gratings
            9. Glare Free
         D. Visual Access
            1. Stairwell Lighting
            2. Differentiation of Stairs
         E. Handrails
            1. Location
               i. Handrail Placement
               ii. Along Ramp
               iii. Continuous at Landings
            2. Accessible Ends
               i. Handrail Extension at Top
               ii. Handrail Extension at Bottom
               iii. Curved Handrail Extensions
            3. Accessible Mounting
               i. Comfortable Height
               ii. Consistent Height

iii. Second Handrail
iv. Space between Rail & Wall
v. Handrail Mounting
vi. Mounting Bracket Position

4. Accessible Gripping Surface
   i. Grasp of Circular Handrail
   ii. Grasp of Non-Circular Handrail
   iii. Gripping Surface

F. Ramps
1. Run Accessibility
   i. Run Slope of Ramp
   ii. Cross Slope of Ramp
   iii. Consistent Slope
   iv. Run Total Rise
   v. Landings
   vi. Ramp Width
2. Landing Accessibility
   i. Landing Flatness
   ii. Landing Width
   iii. Landing Length
3. Surface Properties
   i. Surface Material
   ii. Surface Condition
   iii. Grating Accessibility
4. Edge Protection
   i. No Drop Off
   ii. Sufficient Edge Protection
5. Handrails
   i. Location
      A. Handrail Placement
      B. Along Ramp
      C. Continuous at Landings
   ii. Accessible Ends
      A. Handrail Extension at Top
      B. Handrail Extension at Bottom
      C. Curved Handrail Extensions
   iii. Accessible Mounting
      A. Comfortable Height
      B. Consistent Height
      C. Second Handrail
      D. Space between Rail & Wall
      E. Fixed Mounting
      F. Mounting Bracket Positioning
   iv. Accessible Gripping Surface

A. Grasp of Circular Handrail
B. Grasp of Non-Circular Handrail
C. Gripping Surface

ii. Staircases

- A. Treads & Risers
  1. Tread Size
  2. Riser Height
  3. Tread & Riser Consistency
  4. Closed Risers
- B. Nosings
  1. Nosing Extension
  2. Nosing Tread Surface
- C. Surface
  1. Water Accumulation
  2. Level Stair Surface
  3. Level Landing Surface
  4. Firm
  5. Stable
  6. Slip Resistant
  7. Free of Trip Hazards
  8. Gratings
  9. Glare Free
- D. Visual Access
  1. Stairwell Lighting
  2. Differentiation of Staircases
- E. Handrails
  1. Location
     - i. Handrail Placement
     - ii. Along Ramp
     - iii. Continuous at Landings
  2. Accessible Ends
     - i. Handrail Extension at Top
     - ii. Handrail Extension at Bottom
     - iii. Curved Handrail Extensions
  3. Accessible Mounting
     - i. Comfortable Height
     - ii. Consistent Height
     - iii. Second Handrail
     - iv. Space between Rail & Wall
     - v. Handrail Mounting
     - vi. Mounting Bracket Position
  4. Accessible Gripping Surface
     - i. Grasp of Circular Handrail
     - ii. Grasp of Non-Circular Handrail

            - iii. Gripping Surface
    - F. Elevators
        1. Elevator Lobby (REC VID)
            - i. Signage
            - ii. Floor Space
            - iii. Floor Gap
        2. Lobby Signals (REC VID)
            - i. Auditory Cues
            - ii. Visual Cues
            - iii. Indicator Timing
        3. Lobby Call Buttons (REC VID)
            - i. Location
                - A. Detectable
                - B. Reach
                - C. Near Elevator
            - ii. Easy to Use
                - A. Easy to Activate
                - B. Button Size
                - C. Button Arrangement
        4. Elevator Car (REC VID)
            - i. Re-Opens When Obstructed
            - ii. Car Door Size
            - iii. Car Size
            - iv. Handrails
            - v. Surface
            - vi. Car Lighting
            - vii. Car Sound Level
            - viii. Emergency Communication System
        5. Elevator Car Buttons (REC VID)
            - i. Location
            - ii. Logical Order
            - iii. Easy to Activate
            - iv. Alternative Communication
        6. Car Position Indicators (REC VID)
            - i. Location
            - ii. Auditory Cues
            - iii. Visual Cues
2. Connects Essential Features
3. Efficient Route
4. Walking & Rolling Surface
    - i. Surface
        - A. Firm
        - B. Stable
    - ii. Resistance for Wheeled Mobility

    - iii. Free of Trip Hazards
    - iv. Easily Discriminated
  5. Route Dimensions
    - i. Route Width
    - ii. Turning Radius
    - iii. Passing & Resting Areas
    - iv. Head Clearance
    - v. Hazards from the Side
  6. Signage
    - i. Route Marked by Signs
    - ii. Features Marked
    - iii. Accessible Map
    - iv. Exit Signage
      - A. Visual Signs (REC VID)
        1. Glare
        2. Contrast
        3. Sans Serif Font
        4. Standard Font
        5. Easy to Locate
        6. Pictograms & Icons
        7. Content
      - B. Tactile Signs (REC VID)
        1. Easy to Find Location
        2. Safe Location
        3. Easy to Read Text
        4. Easy to Read Tactile Text
        5. Braille
        6. Text Separate from Borders
        7. Pictograms & Icons
        8. Content

VII. Seating
- A. General Seating Area (REC VID)
  1. Designated Seating
  2. Multiple Routes
  3. Separate from Main Route
  4. Visibility
  5. Companion Seating
  6. Storage for Equipment
  7. Open Seating Area
  8. Fixed Seating
  9. Comfortable Surroundings
- B. Table Seating (REC VID)
  1. Primary Space under Table
  2. Foot & Extended Space

3. Accessible Seating Signage
4. Storage for Equipment

C. Free Standing Chairs (REC VID)
1. Area around the chair
2. Stability
3. Size
4. Ease of Transfer
5. Storage for Equipment

D. Auditorium/Lecture Seating (REC VID)
1. Auditorium/Lecture Seating Level Changes
   - i. Steps
     - A. Treads & Risers
       1. Tread Size
       2. Riser Height
       3. Tread & Riser Consistency
       4. Closed Risers
     - B. Nosings
       1. Nosing Extension
       2. Nosing Tread Surface
     - C. Surface
       1. Water Accumulation
       2. Level Stair Surface
       3. Level Landing Surface
       4. Firm
       5. Stable
       6. Slip Resistant
       7. Free of Trip Hazards
       8. Gratings
       9. Glare Free
     - D. Visual Access
       1. Stairwell Lighting
       2. Differentiation of Stairs
     - E. Handrails
       1. Location
          - i. Handrail Placement
          - ii. Along Ramp
          - iii. Continuous at Landings
       2. Accessible Ends
          - i. Handrail Extension at Top
          - ii. Handrail Extension at Bottom
          - iii. Curved Handrail Extensions
       3. Accessible Mounting
          - i. Comfortable Height
          - ii. Consistent Height

- iii. Second Handrail
- iv. Space between Rail & Wall
- v. Handrail Mounting
- vi. Mounting Bracket Position

4. Accessible Gripping Surface
   - i. Grasp of Circular Handrail
   - ii. Grasp of Non-Circular Handrail
   - iii. Gripping Surface

F. Ramps

1. Run Accessibility
   - i. Run Slope of Ramp
   - ii. Cross Slope of Ramp
   - iii. Consistent Slope
   - iv. Run Total Rise
   - v. Landings
   - vi. Ramp Width
2. Landing Accessibility
   - i. Landing Flatness
   - ii. Landing Width
   - iii. Landing Length
3. Surface Properties
   - i. Surface Material
   - ii. Surface Condition
   - iii. Grating Accessibility
4. Edge Protection
   - i. No Drop Off
   - ii. Sufficient Edge Protection
5. Handrails
   - i. Location
     - A. Handrail Placement
     - B. Along Ramp
     - C. Continuous at Landings
   - ii. Accessible Ends
     - A. Handrail Extension at Top
     - B. Handrail Extension at Bottom
     - C. Curved Handrail Extensions
   - iii. Accessible Mounting
     - A. Comfortable Height
     - B. Consistent Height
     - C. Second Handrail
     - D. Space between Rail & Wall
     - E. Fixed Mounting
     - F. Mounting Bracket Positioning
   - iv. Accessible Gripping Surface

A. Grasp of Circular Handrail
B. Grasp of Non-Circular Handrail
C. Gripping Surface

ii. Staircases

- A. Treads & Risers
  1. Tread Size
  2. Riser Height
  3. Tread & Riser Consistency
  4. Closed Risers
- B. Nosings
  1. Nosing Extension
  2. Nosing Tread Surface
- C. Surface
  1. Water Accumulation
  2. Level Stair Surface
  3. Level Landing Surface
  4. Firm
  5. Stable
  6. Slip Resistant
  7. Free of Trip Hazards
  8. Gratings
  9. Glare Free
- D. Visual Access
  1. Stairwell Lighting
  2. Differentiation of Staircases
- E. Handrails
  1. Location
     - i. Handrail Placement
     - ii. Along Ramp
     - iii. Continuous at Landings
  2. Accessible Ends
     - i. Handrail Extension at Top
     - ii. Handrail Extension at Bottom
     - iii. Curved Handrail Extensions
  3. Accessible Mounting
     - i. Comfortable Height
     - ii. Consistent Height
     - iii. Second Handrail
     - iv. Space between Rail & Wall
     - v. Handrail Mounting
     - vi. Mounting Bracket Position
  4. Accessible Gripping Surface
     - i. Grasp of Circular Handrail
     - ii. Grasp of Non-Circular Handrail

iii. Gripping Surface

F. Elevators
   1. Elevator Lobby (REC VID)
      i. Signage
      ii. Floor Space
      iii. Floor Gap
   2. Lobby Signals (REC VID)
      i. Auditory Cues
      ii. Visual Cues
      iii. Indicator Timing
   3. Lobby Call Buttons (REC VID)
      i. Location
         A. Detectable
         B. Reach
         C. Near Elevator
      ii. Easy to Use
         A. Easy to Activate
         B. Button Size
         C. Button Arrangement
   4. Elevator Car (REC VID)
      i. Re-Opens When Obstructed
      ii. Car Door Size
      iii. Car Size
      iv. Handrails
      v. Surface
      vi. Car Lighting
      vii. Car Sound Level
      viii. Emergency Communication System
   5. Elevator Car Buttons (REC VID)
      i. Location
      ii. Logical Order
      iii. Easy to Activate
      iv. Alternative Communication
   6. Car Position Indicators (REC VID)
      i. Location
      ii. Auditory Cues
      iii. Visual Cues

2. Sight Line
3. Companion Seating
4. Marked Accessible Seating
5. Open Seating Space
6. Fixed Seating
7. Storage for Equipment
8. Floor & Ground

i. Ground Surface (REC VID)
  - A. Walking & Rolling Surface
    - 1. Firm
    - 2. Stable
    - 3. Slip Resistant
  - B. Free of Trip Hazards
  - C. Gratings

VIII. Restroom(s)
- A. Female Restroom(s) (REC VID)
  - 1. Female Restroom(s) Level Changes
    - i. Steps
      - A. Treads & Risers
        - 1. Tread Size
        - 2. Riser Height
        - 3. Tread & Riser Consistency
        - 4. Closed Risers
      - B. Nosings
        - 1. Nosing Extension
        - 2. Nosing Tread Surface
      - C. Surface
        - 1. Water Accumulation
        - 2. Level Stair Surface
        - 3. Level Landing Surface
        - 4. Firm
        - 5. Stable
        - 6. Slip Resistant
        - 7. Free of Trip Hazards
        - 8. Gratings
        - 9. Glare Free
      - D. Visual Access
        - 1. Stairwell Lighting
        - 2. Differentiation of Stairs
      - E. Handrails
        - 1. Location
          - i. Handrail Placement
          - ii. Along Ramp
          - iii. Continuous at Landings
        - 2. Accessible Ends
          - i. Handrail Extension at Top
          - ii. Handrail Extension at Bottom
          - iii. Curved Handrail Extensions
        - 3. Accessible Mounting
          - i. Comfortable Height
          - ii. Consistent Height

- iii. Second Handrail
- iv. Space between Rail & Wall
- v. Handrail Mounting
- vi. Mounting Bracket Position

4. Accessible Gripping Surface
   - i. Grasp of Circular Handrail
   - ii. Grasp of Non-Circular Handrail
   - iii. Gripping Surface

F. Ramps

1. Run Accessibility
   - i. Run Slope of Ramp
   - ii. Cross Slope of Ramp
   - iii. Consistent Slope
   - iv. Run Total Rise
   - v. Landings
   - vi. Ramp Width
2. Landing Accessibility
   - i. Landing Flatness
   - ii. Landing Width
   - iii. Landing Length
3. Surface Properties
   - i. Surface Material
   - ii. Surface Condition
   - iii. Grating Accessibility
4. Edge Protection
   - i. No Drop Off
   - ii. Sufficient Edge Protection
5. Handrails
   - i. Location
     - A. Handrail Placement
     - B. Along Ramp
     - C. Continuous at Landings
   - ii. Accessible Ends
     - A. Handrail Extension at Top
     - B. Handrail Extension at Bottom
     - C. Curved Handrail Extensions
   - iii. Accessible Mounting
     - A. Comfortable Height
     - B. Consistent Height
     - C. Second Handrail
     - D. Space between Rail & Wall
     - E. Fixed Mounting
     - F. Mounting Bracket Positioning
   - iv. Accessible Gripping Surface

- A. Grasp of Circular Handrail
- B. Grasp of Non-Circular Handrail
- C. Gripping Surface

2. Doorway
   - i. Size of Doorway
     - A. Width
     - B. Height
   - ii. Floor
     - A. Clear Floor Space
     - B. Slope
     - C. Surface
     - D. Doorway threshold
   - iii. Opening & Closing
     - A. Required Force
     - B. Use of Hands
     - C. Sitting & Standing Position
     - D. Door Safety
     - E. Handle of Door
     - F. Door Intuitiveness
   - iv. Ease of Lock
     - A. Required Force
     - B. Required Dexterity
     - C. Lock Location
     - D. One Hand
     - E. Detection
   - v. Visibility
     - A. Distinct from Wall
     - B. Distinct Door Features
     - C. Lighting
   - vi. Automatic Doors
     - A. Speed of Door
     - B. Opening Force
     - C. Detect Short Seated People
     - D. Door Timing
   - vii. Automatic Door Switch
     - A. Reachable
     - B. Dexterity
     - C. Distinct
     - D. Intuitive Operations
     - E. Proximity to Door
     - F. Door Prediction
     - G. Switch Speed
   - viii. Door Stops
     - A. Sitting & Standing

        - B. Force
3. General Features
    - i. Restroom Size
    - ii. Lighting
    - iii. Floor Surface
        - A. Firm
        - B. Stable
        - C. Slip Resistant
        - D. Free of Trip Hazards
    - iv. Floor Surface> Gratings
4. Toilet Stalls
    - i. Stall Size
    - ii. Stall Door
    - iii. Stall Lock Mechanism
    - iv. Stall Lock Location
    - v. Toilet Paper Reach
    - vi. Toilet Paper Dispensing
    - vii. Hooks & Shelves
5. Toilet
    - i. Grab Bar Position
    - ii. Grab Bar Mounting
    - iii. Toilet Height
    - iv. Flush Function
    - v. Flush Location
    - vi. Flush Dexterity
    - vii. Flush Timing
6. Sink
    - i. Knee & Toe Space
    - ii. Faucet Location
    - iii. Faucet Dexterity
    - iv. Soap Dispenser Location
    - v. Soap Dispenser Dexterity
    - vi. Automatic Sink
    - vii. Hand Dryer Location
    - viii. Hand Dryer Device Dexterity
    - ix. Shelving Height
    - x. Paper Waste Disposal
    - xi. Sharps Disposal
7. Mirror
8. Signage
    - i. Interior Signage
        - A. Visual Signs (REC VID)
            1. Glare
            2. Contrast

3. Sans Serif Font
4. Standard Font
5. Easy to Locate
6. Pictograms & Icons
7. Content

B. Tactile Signs (REC VID)

1. Easy to Find Location
2. Safe Location
3. Easy to Read Text
4. Easy to Read Tactile Text
5. Braille
6. Text Separate from Borders
7. Pictograms & Icons
8. Content

ii. Exit Signage

A. Visual Signs (REC VID)

1. Glare
2. Contrast
3. Sans Serif Font
4. Standard Font
5. Easy to Locate
6. Pictograms & Icons
7. Content

B. Tactile Signs (REC VID)

1. Easy to Find Location
2. Safe Location
3. Easy to Read Text
4. Easy to Read Tactile Text
5. Braille
6. Text Separate from Borders
7. Pictograms & Icons
8. Content

B. Male Restroom(s) (REC VID)

1. Male Restroom(s) Level Changes

i. Steps

A. Treads & Risers

1. Tread Size
2. Riser Height
3. Tread & Riser Consistency
4. Closed Risers

B. Nosings

1. Nosing Extension
2. Nosing Tread Surface

C. Surface

1. Water Accumulation
2. Level Stair Surface
3. Level Landing Surface
4. Firm
5. Stable
6. Slip Resistant
7. Free of Trip Hazards
8. Gratings
9. Glare Free

D. Visual Access
    1. Stairwell Lighting
    2. Differentiation of Stairs

E. Handrails
    1. Location
        i. Handrail Placement
        ii. Along Ramp
        iii. Continuous at Landings
    2. Accessible Ends
        i. Handrail Extension at Top
        ii. Handrail Extension at Bottom
        iii. Curved Handrail Extensions
    3. Accessible Mounting
        i. Comfortable Height
        ii. Consistent Height
        iii. Second Handrail
        iv. Space between Rail & Wall
        v. Handrail Mounting
        vi. Mounting Bracket Position
    4. Accessible Gripping Surface
        i. Grasp of Circular Handrail
        ii. Grasp of Non-Circular Handrail
        iii. Gripping Surface

F. Ramps
    1. Run Accessibility
        i. Run Slope of Ramp
        ii. Cross Slope of Ramp
        iii. Consistent Slope
        iv. Run Total Rise
        v. Landings
        vi. Ramp Width
    2. Landing Accessibility
        i. Landing Flatness
        ii. Landing Width
        iii. Landing Length

3. Surface Properties
    i. Surface Material
    ii. Surface Condition
    iii. Grating Accessibility
4. Edge Protection
    i. No Drop Off
    ii. Sufficient Edge Protection
5. Handrails
    i. Location
        A. Handrail Placement
        B. Along Ramp
        C. Continuous at Landings
    ii. Accessible Ends
        A. Handrail Extension at Top
        B. Handrail Extension at Bottom
        C. Curved Handrail Extensions
    iii. Accessible Mounting
        A. Comfortable Height
        B. Consistent Height
        C. Second Handrail
        D. Space between Rail & Wall
        E. Fixed Mounting
        F. Mounting Bracket Positioning
    iv. Accessible Gripping Surface
        A. Grasp of Circular Handrail
        B. Grasp of Non-Circular Handrail
        C. Gripping Surface

2. Doorway
    i. Size of Doorway
        A. Width
        B. Height
    ii. Floor
        A. Clear Floor Space
        B. Slope
        C. Floor Surface
        D. Doorway threshold
    iii. Opening & Closing
        A. Required Force
        B. Use of Hands
        C. Sitting & Standing Position
        D. Door Safety
        E. Handle of Door
        F. Door Intuitiveness
    iv. Ease of Lock

        A. Required Force
        B. Required Dexterity
        C. Lock Location
        D. One Hand
        E. Detection
    v. Visibility
        A. Distinct from Wall
        B. Distinct Door Features
        C. Lighting
    vi. Automatic Doors
        A. Speed of Door
        B. Opening Force
        C. Detect Short Seated People
        D. Door Timing
    vii. Automatic Door Switch
        A. Reachable
        B. Dexterity
        C. Distinct
        D. Intuitive Operations
        E. Proximity to Door
        F. Door Prediction
        G. Switch Speed
    viii. Door Stops
        A. Sitting & Standing
        B. Force
3. General Features
    i. Restroom Size
    ii. Lighting
    iii. Floor Surface
        A. Firm
        B. Stable
        C. Slip Resistant
        D. Free of Trip Hazards
        E. Gratings
4. Toilet Stalls
    i. Stall Size
    ii. Stall Door
    iii. Stall Lock Mechanism
    iv. Stall Lock Location
    v. Toilet Paper Reach
    vi. Toilet Paper Dispensing
    vii. Hooks & Shelves
5. Toilet
    i. Grab Bar Position

ii. Grab Bar Mounting
iii. Toilet Height
iv. Flush Function
v. Flush Location
vi. Flush Dexterity
vii. Flush Timing

6. Urinals
    i. Privacy
    ii. Urinal Height
    iii. Clear Floor Space
    iv. Flush Location
    v. Flush Dexterity
7. Sink
    i. Knee & Toe Space
    ii. Faucet Location
    iii. Faucet Dexterity
    iv. Soap Dispenser Location
    v. Soap Dispenser Dexterity
    vi. Automatic Sink
    vii. Hand Dryer Location
    viii. Hand Dryer Device Dexterity
    ix. Shelving Height
    x. Paper Waste Disposal
    xi. Sharps Disposal
8. Mirror
9. Signage
    i. Interior Signage
        A. Visual Signs (REC VID)
            1. Glare
            2. Contrast
            3. Sans Serif Font
            4. Standard Font
            5. Easy to Locate
            6. Pictograms & Icons
            7. Content
        B. Tactile Signs (REC VID)
            1. Easy to Find Location
            2. Safe Location
            3. Easy to Read Text
            4. Easy to Read Tactile Text
            5. Braille
            6. Text Separate from Borders
            7. Pictograms & Icons
            8. Content

                ii. Exit Signage
                    A. Visual Signs (REC VID)
                        1. Glare
                        2. Contrast
                        3. Sans Serif Font
                        4. Standard Font
                        5. Easy to Locate
                        6. Pictograms & Icons
                        7. Content
                    B. Tactile Signs (REC VID)
                        1. Easy to Find Location
                        2. Safe Location
                        3. Easy to Read Text
                        4. Easy to Read Tactile Text
                        5. Braille
                        6. Text Separate from Borders
                        7. Pictograms & Icons
                        8. Content
C. Alternative Restroom(s) (REC VID)
    1. Alternative Restroom(s) Level Changes
        i. Steps
            A. Treads & Risers
                1. Tread Size
                2. Riser Height
                3. Tread & Riser Consistency
                4. Closed Risers
            B. Nosings
                1. Nosing Extension
                2. Nosing Tread Surface
            C. Surface
                1. Water Accumulation
                2. Level Stair Surface
                3. Level Landing Surface
                4. Firm
                5. Stable
                6. Slip Resistant
                7. Free of Trip Hazards
                8. Gratings
                9. Glare Free
            D. Visual Access
                1. Stairwell Lighting
                2. Differentiation of Stairs
            E. Handrails
                1. Location

- i. Handrail Placement
- ii. Along Ramp
- iii. Continuous at Landings

2. Accessible Ends
   - i. Handrail Extension at Top
   - ii. Handrail Extension at Bottom
   - iii. Curved Handrail Extensions
3. Accessible Mounting
   - i. Comfortable Height
   - ii. Consistent Height
   - iii. Second Handrail
   - iv. Space between Rail & Wall
   - v. Handrail Mounting
   - vi. Mounting Bracket Position
4. Accessible Gripping Surface
   - i. Grasp of Circular Handrail
   - ii. Grasp of Non-Circular Handrail
   - iii. Gripping Surface

F. Ramps

1. Run Accessibility
   - i. Run Slope of Ramp
   - ii. Cross Slope of Ramp
   - iii. Consistent Slope
   - iv. Run Total Rise
   - v. Landings
   - vi. Ramp Width
2. Landing Accessibility
   - i. Landing Flatness
   - ii. Landing Width
   - iii. Landing Length
3. Surface Properties
   - i. Surface Material
   - ii. Surface Condition
   - iii. Grating Accessibility
4. Edge Protection
   - i. No Drop Off
   - ii. Sufficient Edge Protection
5. Handrails
   - i. Location
     - A. Handrail Placement
     - B. Along Ramp
     - C. Continuous at Landings
   - ii. Accessible Ends
     - A. Handrail Extension at Top

                B. Handrail Extension at Bottom
                C. Curved Handrail Extensions
            iii. Accessible Mounting
                A. Comfortable Height
                B. Consistent Height
                C. Second Handrail
                D. Space between Rail & Wall
                E. Fixed Mounting
                F. Mounting Bracket Positioning
            iv. Accessible Gripping Surface
                A. Grasp of Circular Handrail
                B. Grasp of Non-Circular Handrail
                C. Gripping Surface

2. Doorway
    - i. Size of Doorway
        - A. Width
        - B. Height
    - ii. Floor
        - A. Clear Floor Space
        - B. Slope
        - C. Surface
        - D. Doorway threshold
    - iii. Opening & Closing
        - A. Required Force
        - B. Use of Hands
        - C. Sitting & Standing Position
        - D. Door Safety
        - E. Handle of Door
        - F. Door Intuitiveness
    - iv. Ease of Lock
        - A. Required Force
        - B. Required Dexterity
        - C. Lock Location
        - D. One Hand
        - E. Detection
    - v. Visibility
        - A. Distinct from Wall
        - B. Distinct Door Features
        - C. Lighting
    - vi. Automatic Doors
        - A. Speed of Door
        - B. Opening Force
        - C. Detect Short Seated People
        - D. Door Timing

vii. Automatic Door Switch

A. Reachable
B. Dexterity
C. Distinct
D. Intuitive Operations
E. Proximity to Door
F. Door Prediction
G. Switch Speed

viii. Door Stops

A. Sitting & Standing
B. Force

3. General Features
   i. Restroom Size
   ii. Lighting
   iii. Floor Surface
      A. Firm
      B. Stable
      C. Slip Resistant
      D. Free of Trip Hazards
      E. Gratings
4. Toilet Stalls
   i. Stall Size
   ii. Stall Door
   iii. Stall Lock Mechanism
   iv. Stall Lock Location
   v. Toilet Paper Reach
   vi. Toilet Paper Dispensing
   vii. Hooks & Shelves
5. Toilet
   i. Grab Bar Position
   ii. Grab Bar Mounting
   iii. Toilet Height
   iv. Flush Location
   v. Flush Instructions
   vi. Flush Dexterity
   vii. Flush Timing
6. Urinals
   i. Privacy
   ii. Urinal Height
   iii. Clear Floor Space
   iv. Flush Location
   v. Flush Dexterity
7. Sink
   i. Knee & Toe Space

ii. Faucet Location
iii. Faucet Dexterity
iv. Soap Dispenser Location
v. Soap Dispenser Dexterity
vi. Automatic Sink
vii. Hand Dryer Location
viii. Hand Dryer Device Dexterity
ix. Shelving Height
x. Paper Waste Disposal
xi. Sharps Disposal

8. Mirror
9. Signage
    - i. Interior Signage
        - A. Visual Signs (REC VID)
            1. Glare
            2. Contrast
            3. Sans Serif Font
            4. Standard Font
            5. Easy to Locate
            6. Pictograms & Icons
            7. Content
        - B. Tactile Signs (REC VID)
            1. Easy to Find Location
            2. Safe Location
            3. Easy to Read Text
            4. Easy to Read Tactile Text
            5. Braille
            6. Text Separate from Borders
            7. Pictograms & Icons
            8. Content
    - ii. Exit Signage
        - A. Visual Signs (REC VID)
            1. Glare
            2. Contrast
            3. Sans Serif Font
            4. Standard Font
            5. Easy to Locate
            6. Pictograms & Icons
            7. Content
        - B. Tactile Signs (REC VID)
            1. Easy to Find Location
            2. Safe Location
            3. Easy to Read Text
            4. Easy to Read Tactile Text

5. Braille
6. Text Separate from Borders
7. Pictograms & Icons
8. Content

Appendix C: Video Recording Protocol for Restaurants

The video should focus on capturing the following four main elements of a restaurant: 1. Main Entrance/Exterior Doorway, 2. Indoor Routes, 3. Seating, 4. Restrooms.

Record a short clip showing an overview of the element first, then record a more detailed clip capturing the element in use if applicable, and while providing measurement of the needed dimensions by using a yard stick or multiple sticks if needed. Use a colored masking tape to indicate the ends and the midpoint of each stick and a clear tape to connect the sticks if needed. For width measurement, lay the stick(s) on the floor, and for height, put it on the side of the measured object.

In case a route includes a ramp, use the AccessSlope mini-app to measure the slope. Make sure to zoom in to clearly capture the results of your measurements.

1. Main Entrance/Exterior Doorway:

   Your video should capture the following items:

   a. The route to the doorway and the presence of any level changes, including steps, stairs, or elevators
   b. The size of the doorway: width and height
   c. The floor: clear floor space, slope, surface, and doorway threshold.
   d. Opening and Closing: record one of the team members using the door to show required hand use to open/close, the door ca be opened safely without hitting another door or person, door handle type and height from floor.
   e. Visibility of the door: show the door and surrounding wall, door features, and the lighting of the area

f. Automatic door switches: record while in use, location, and height.

g. Signage: make sure to capture any signage, zoom in to show features such as tactile symbols, and record different angles to show if any glare is present.

2. Indoor routes:

Your video should capture all interior routes including main hallway route, route to seating area, route to restroom, route to elevators, exit route, and any other routes present. Make sure to capture the following items:

a. Level changes: steps, threshold, stairs, ramps

b. Surface and resistance to wheeled mobility

c. Presence of trip hazards

d. Routes dimensions: width, turning radius, passing and resting areas, head clearance, hazards from the sides.

e. Signage

3. Seating:

Your video should capture the following items:

a. Presence of designated accessible seating area

b. Seating area is accessible from entrance, exit, and restrooms.

c. Presence of appropriate companion seating next to accessible seating

d. Seating area has enough space to roll a wheelchair in it

e. Fixed seating has enough space for transfers

f. Table seating: measure table height and depth from table support

g. Accessible seating signage

h. Free standing chairs

4. Restrooms:

Record a video of one restroom in preference of alternative, male's, or female's, and capture the following items:

a. Level changes
b. Doorway: width, height, floor surface, opening and closing, ease of lock, lock height, visibility of the doorway, automatic door switches and height
c. Restroom size, lighting, floor surface
d. Toilet stalls: size, door dimensions, door lock mechanism and location, toilet paper reach and dispensing, presence of hooks and shelves and their height
e. Grab bar height and firm mounting.
f. Toilet seat height
g. Flushing mechanism, location, required dexterity, timing
h. Urinals: privacy, height, clear floor space, flush location and dexterity.
i. Sink: measure knee and toe space, faucet height, soap dispenser height and dexterity required
j. Hand dryer height and required dexterity
k. Paper waste and sharps disposal container's locations
l. Mirror placement (height)
m. Signage

Appendix D: Video Reliability Protocol

Aim: to identify questions that can't be answered from the recorded videos. Comments should indicate:

- Suggestions for missing details that should be included in a new video
- Identify items/details that can't be captured by video (only applicable to in-site assessment, such as slippery floor).

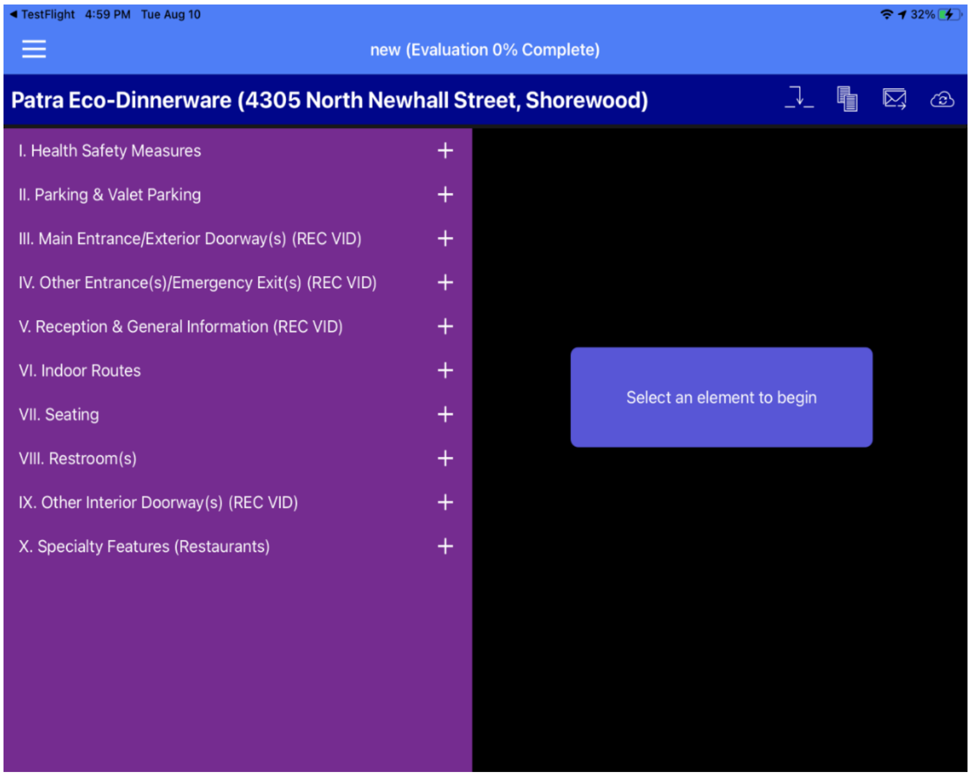
AccessTools Protocol:

Installing AccessTools:

If you already have AccessTools installed on your iPad, you need to uninstall it first (Don't Update it). Please follow these steps:

- Uninstalling the AccessTools app:
  - Close the app first, then locate the app icon on your iPad.
  - Keep tapping on the app icon until a list of options appears.
  - Select Delete/Uninstall option
- Reinstalling the app:
  - Open the TestFlight app on your iPad
  - You should be able to see the AccessTools app (Make sure that it says "Install" under the app not "Update")
  - If you can't find the AccessTools app (Build 80) in TestFlight, use the following link: https://testflight.apple.com/join/iwTQHwoH
  - Click on install
- Open the app and login using your account credentials or create a new account.

- Start a new evaluation and make sure that the order of the main 10 elements is the same as the screenshot below. This ensures that you are using the correct version of the app (Version 4.0 (80)).



Evaluation Protocol

1. Open YouTube video for the restaurant to be assessed

   Restaurant A: https://youtu.be/kNNPmU9BNUc

   Restaurant B: https://youtu.be/CHVktzGprxc

   Restaurant C: https://youtu.be/nSP4aoy19CI

2. Change Settings from “Auto” to 720p on the lower right corner of the YouTube video.
3. Open AccessTools app

4. Select new evaluation and enter address of location that you want to evaluate:
    - Restaurant A
    - Restaurant B
    - Restaurant C
5. Naming the evaluation: [UWM-880-Raters Code -Restaurant#-Date]
6. Evaluate the following elements for problematic questions/items:
    a. Main Entrance/Exterior doorways
    b. Indoor Routes
    c. Seating
    d. Restrooms
7. Scoring Criteria:

   The video must provide sufficient information to objectively answer a question: is it present or absent? If present, continue to sub-branches for further descriptors of the feature that can be answered based on what is shown in the video.

   For questions asking about features that are not present in the restaurant, please select “Not Applicable”. For example, all the restaurants that were recorded are in a single story building, therefore all questions regarding the elevator should be answered as “Not Applicable”.

   For applicable questions, leaf level questions (last branching questions for each element) should be answered (See figure below). Thus, all parent level questions should be answered as “Somewhat Accessible”, in order to sub-branch into the more detailed questions, until reaching the leaf level questions.

   For leaf level question, select the following:

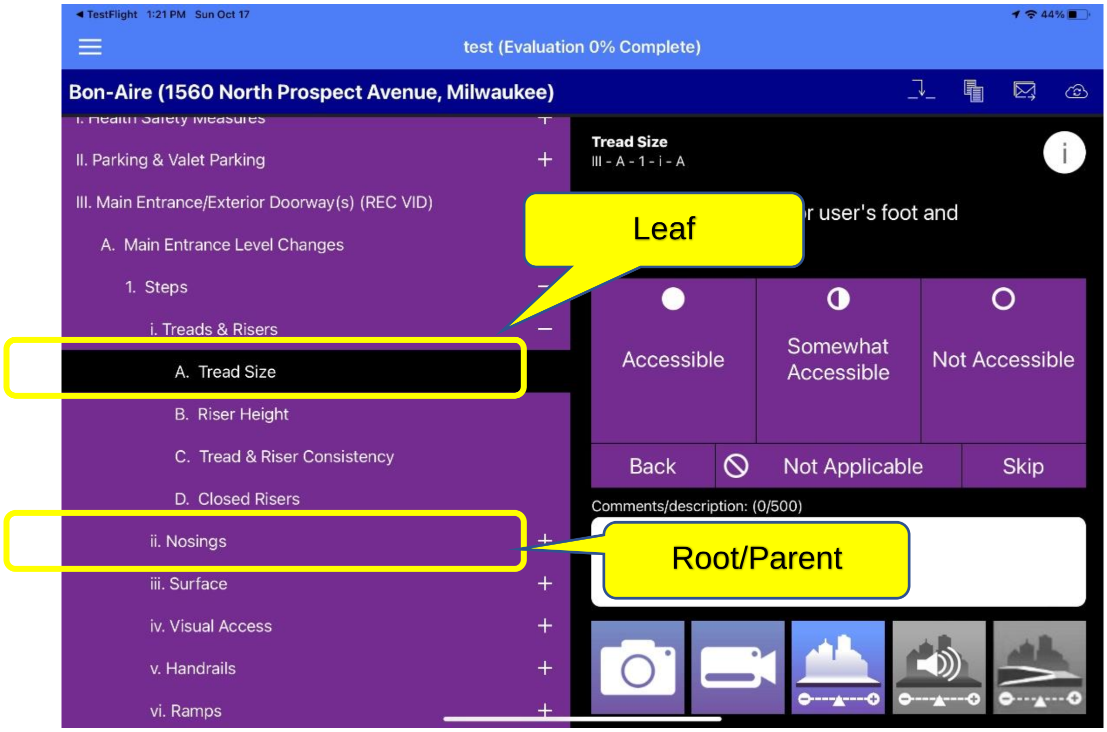
Accessible: if the video provides enough details to answer the question. The feature should not be rated based on whether or not the feature is accessible. For example, if the video provides a measurement of the “Tread Size” your answer should be “Accessible” even if the measurement does not match the required standards for accessibility.

Not Accessible: if the video doesn’t provide enough details to answer the question, if the video provides partial details, and you need to guess in order to answer it, or if the

question is asking about a feature that requires the rater to use his/her tactile senses to

answer it (such as: force required to open a door, or if the floor is slippery). For example, if no measurement was recorded in the video for “Tread Size” then the answer should be “Not Accessible”. Please provide comments/suggestions for what could be added to a new video in order to have enough details to answer the question.

8. When you are done with the assessment, tap the envelope icon on the top right corner of the screen, and send to yourself and to qobiedat@uwm.edu.
9. If you have any general questions or issues while completing the assessment, you can contact Qussai at qobiedat@uwm.edu.


test (Evaluation 0% Complete)
Bon-Aire (1560 North Prospect Avenue, Milwaukee)
II. Parking & Valet Parking
III. Main Entrance/Exterior Doorway(s) (REC VID)
A. Main Entrance Level Changes
1. Steps
i. Treads & Risers
A. Tread Size
B. Riser Height
C. Tread & Riser Consistency
D. Closed Risers
ii. Nosings
iii. Surface
iv. Visual Access
v. Handrails
vi. Ramps
Tread Size
III - A - 1 - i - A
Leaf
Accessible
Somewhat Accessible
Not Accessible
Back
Not Applicable
Skip
Comments/description: (0/500)
Root/Parent

Appendix E - Equivalent Text Descriptions

Figure 1: ICF disability model (World Health Organization, 2002)

Brief Description: Diagram illustrating the process of the ICF model.

Essential Description: The diagram illustrates the multi-dimensional concepts of the ICF model. The model conceptualizes a person's level of functioning as a dynamic interaction between his or her health conditions, environmental factors, and personal factors. Disability is viewed as multidimensional and interactive, and all components of disability are important and may interact with another. The model emphasizes the environmental factors as they affect everything and may need to be changed.

Detailed Description: The diagram lists three interactive layers with two sided arrows to represent the interactive nature of these layers. On the top, “Health Condition” is listed with “disorder or disease” in parentheses right underneath. The second layer includes three components listed side by side with two sided arrows. These components are “Body Functions and Structures”, “Activities”, and “Participation”, listed from left to right. The last layer on the bottom lists two “Contextual Factors” in side by side textboxes. The two contextual factors are “Environmental Factors” and “Personal Factors”. All text, textbox borders, and arrows are in black color with a white background.

Figure 2: Screenshot of the AccessTools app

Brief Description: Screenshot depicting the user interface of the AccessTools assessment.

Essential Description: The screenshot provides an example of the user interface of the AccessTools assessment as it appears on an iPad device. It shows the expanding structure of the AccessTools taxonomy, and the scoring options for the selected item/question from the taxonomy. It also provides several icons representing the different options that can be used to answer or collect specific measurements using the imbedded mini Tools apps.

Detailed Description: The screenshot's shape is rectangular with multiple background colors to define each area of information. Generally, at the top of the screen, two narrow rectangles run across the full width of the screenshot representing the headings for the evaluation. Underneath these headings, the remaining area of the screen is equally split into two side by side rectangles

The first rectangle from the top has a light blue background with white text centered listing the data and the completion percentage of the evaluation. In this screenshot, the presented text in the top rectangle is "2/6/19 (Evaluation 0% Complete)". To the left side on the top rectangle are three white lines stacked on top of each other.

The second narrow rectangle underneath has a dark blue background with white text that is aligned to the left, and four icons that are aligned to the right. The text represent the name of the evaluation and the location in paratheses. In this screenshot the name of the evaluation is "The Denemark Lounge" and the location is "Enderis Hall, 2400 East

Hartford Avenue, Milwaukee”. The four icons that appears to the right of this rectangle are white in color and listed side by side. The icons represent the available actions that the user can do with the evaluation. The first icon to the left is an arrow pointing down representing the download option. The next icon to the right is a two pages symbol representing the option to review the report deriving from the evaluation. The third icon is an envelope symbol representing the option to send a copy of the assessment report via email. The last icon to the right is a cloud symbol representing the option to synch and save the process in the evaluation.

The two main side by side rectangles underneath the narrow headings lists the taxonomy of the AccessTools assessment in the left rectangle, while the right rectangle provides the item/question that is being scored, the scoring options, a comment area, and five side by side buttons at the bottom.

The taxonomy rectangle has a dark violet background with white text, while the background of the selected item/question is black. The text is aligned left in multiple vertical lines. Indentation and different numerical formats are used to differentiate between the different level of branching in the taxonomy. The main root questions have Roman numerals with no indentation. The first branching level items have uppercase English letters and indented. The second branching level items have Arabic numerals with double indentation. On the right side of each text line a white “+” or “-” sign is shown if the item is a root level question, or no signs are presented if the item is a leaf level question. The “+” sign indicates that there are branching items that are not being shown, while the “-” sign indicates that the branching items are being viewed. The following items are presented in the screenshot:

I. HEALTH SAFETY MEASURES

II. Parking & Valet Parking

III. Main Entrance/Exterior Doorway(s) (REC VID)

- A. Main Entrance Level Changes
- B. Size of Doorway(s)
  1. Width of Doorway(s)
  2. Height of Doorway(s)
- C. Floor
- D. Opening & Closing
- E. Ease of Lock
- F. Visibility
- G. Automatic Doors
- H. Automatic Door Switch
- I. Door Stops
- J. Signage

IV. Other Entrance(s)/Emergency Exit(s) (REC VID)

V. Reception & General Information (REC VID)

VI. Indoor Routes

The second main rectangle to the right is divided into four main areas on top of each other. On the top, a rectangle with a black background and white text is presented. The numeral branching appears on the top and aliened left, and the item being viewed from the taxonomy appears underneath. In this screenshot, the numeral branching is (III – B – 2), and the item is “Height of Doorway(s)”. Below these two lines the corresponding question is viewed, and in this example, it is “Main doorway has appropriate height for users of varying statures to safely enter without ducking.” On the upper right corner of

this black box, there is a white icon. The icon is a circle with the “i” letter inside to represent information.

The next area underneath is the scoring options area. Three side by side buttons are presented. The buttons have a square shape with dark violet backgrounds and white text and symbols. The first button to the left provide the “Accessible” option, followed by “Somewhat Accessible” option in the middle, and the “Not Accessible” option to the right. Another three rectangular shaped buttons appears underneath providing the following option from left to right: “Back”, “Not Applicable”, and “Skip”. The third area is the comment area. A while rectangle is presented and allows the users to type in their comments.

The five side by side buttons at the bottom have different symbols and are presented in the following order from left to right: a camera symbol, a video-camera symbol, a building symbol with a measurement symbol, a building symbol with a volume symbol, and a building symbol with a ramp symbol. The color of these buttons depends on which options/actions are available for the item that is being scored. The available options have a colored buttons while the unavailable options are in greyscale. In this example, the first three buttons from the left are being colored, indicating that the user can take photos or videos of the doorway, and can use the laser ruler to measure the height of the main doorway. While the sound and ramp buttons appear in grayscale as these measurements are not required for the height of the doorway item.

Figure 3: Phases of AccessTools instrument development and validation

Brief Description: Flowchart illustrating the development and validation process of AccessTools.

Essential Description: The flowchart illustrates a modified version of the step-by-step guide for instrument development and validation by Benson and Clark (1982), and describes the process of development and validation of the AccessTools assessment.

Detailed Description: The flowchart presents the following four main phases as defined by Benson and Clark (1982): Phase 1: Planning, Phase 2: Construction, Phase 3: Quantitative Evaluation, Phase 4: Validation. The first two phases are displayed side by side on the top, followed by the last two phases right underneath. Generally, each one of the phases titles are presented on the top within a textbox and several textboxes underneath detailing the steps implemented within each phase. These textboxes are connected by arrows to illustrate the process in each phase and the connection to the next phase. The textboxes have a white background with black outline and text. Following is the text within each textbox by phase:

Phase 1: Planning

Textbox 1: State Purpose of Test: Create accessibility measurement tool for public buildings.

Textbox 2: Identify Domain of Test: Accessibility of public buildings built-environment.

Textbox 3: Review Literature on Construct: No commonly accepted, metrically sound tool to objectively measure this construct on a community level.

Textbox 4: An expert panel discussion was implemented to identify the best approach to address the construct elements.

Textbox 5: Objectives:

- Provide a detailed objective measure of built environment accessibility.
- Provide comprehensive assessment for different types of impairments.
- Applicable to use for different public buildings

Textbox 6: Format: Computerized branching format with TTSS.

Textboxes 5 and 6 are shared between phase 1 and 2.

Phase 2: Construction

Textbox 7: Main building' elements and specialty elements were identified

Textbox 8: Related items for each element from Audits and the RATE-IT were identified

Textbox 9: Missing items were added

Textbox 10: Content validation

Textbox 11: Qualitative evaluation by experts

Textbox 12: Develop New or Revise Items

Phase 3: Quantitative Evaluation

Textbox 13: Prepare Instrument for First Pilot testing: Year 2 data

Textbox 14: First Pilot Testing Administration: Total of 218 students participated.

Textbox 15: Subjects' satisfaction and perceived learning were calculated

Textbox 16: Calculate Reliability

Textbox 17: Run Item Analysis

Textbox 18: Revise Instrument Prepare for Second Pilot Testing

Phase 4: Validation

Textbox 19: Second Pilot Administration: Year 3 data

Textbox 20: Calculate Reliability

Textbox 21: Revise Instrument if needed

Textbox 22: Begin Validation

Textbox 23: Administer for Validation

Textbox 24: Continue Validation

Figure 4: Crossover Design

Brief Description: Diagram illustrating a cross-over design.

Essential Description: The diagram illustrates the generic process of implementing a cross-over design. The participants are divided into two groups where one group receive one condition while the other group receives the second condition in the first phase. Then, the cross-over happens where each of the groups receives the other condition in the second phase.

Detailed Description: The diagram presents a flowchart with textboxes connected with arrows representing the process of implementing a generic cross-over design. The flowchart displays a textbox with a blue background and the word “Participants” in white, to the left. Two arrows branches from the textbox into two textboxes on top of each other dividing the participants into two groups. The first textbox on the top for “Group A” indicates that this group receives “Condition X”, while the other textbox on the bottom for “Group B” which receives “Condition Y”. Each of these textboxes have the top half with a white background and black text, while the bottom half has a blue background with white text.

Before the branching of the two arrows from the “Participants” textbox, two textboxes on the top and bottom of the diagram with arrows pointing at the branching arrow are presented. The top textbox has the word “Randomization”, while the bottom one states, “Baseline Evaluation”. These textboxes have white background whit blue outline and black font.

An arrow comes out from each of the groups' textboxes and crosses the other arrow to point at another set of group textboxes. The first textbox on the top for "Group B" indicates that this group receives "Condition X" in this phase, while the other textbox on the bottom for "Group A" which receives "Condition Y". Each of these textboxes have the top half with a white background and black text, while the bottom half has a blue background with white text.

At the crossing point of the arrows, two textboxes on the top and bottom of the diagram with arrows pointing at the crossing point are presented. The top textbox has the word "Crossover", while the bottom one states, "Mid Evaluation". These textboxes have white background whit blue outline and black font.

Two lines come out from each of the second set of group textboxes and connect representing the final point of the process. A textbox at the bottom of the diagram with an arrow pointing at the final connection point is presented stating the "Post Evaluation".

At the bottom of the diagram, two connected side by side textboxes are displayed to identify "Phase I" and "Phase II". Phase I starts from the randomization point until the "Mid Evaluation" point, while Phase II starts from "Mid Evaluation" point until the final crossing point. The textbox for Phase I has a light blue background with white font, while the Phase II textbox has a white background with light blue outline and black font.

Figure 5: Screenshots from the recorded videos for the different restaurants

Brief Description: A sample of screenshots from the recorded videos of the three restaurants.

Essential Description: Six screenshots from the videos that were recorded for the video-simulated evaluations study are presented. These screenshots provide examples of the level of details that were included in the video recordings of the three restaurants.

Detailed Description: The screenshots are displayed in three rows where two screenshots are presented side by side in each row. On the top left, a screenshot showing an iPad placed on the floor while displaying the AccessSlope app on the screen is measuring the slope of the floor. The top right screenshot shows a dining table with a yard stick measuring its height. The middle left screenshot shows the main entrance of one of the restaurants with a yard stick placed on the floor to show the width of the entrance. The middle right screenshot shows the door handles of one of the restaurants main entrances with a yard stick measuring the height of the handles from the floor. The bottom left screenshot shows another example of measuring the height of a dining table from a different restaurant. The bottom right screenshot shows a bathroom sink in one of the restaurants with two yard sticks measuring the height and the depth of the sink countertop.

Figure 6: Sample questions of the Knowledge quiz.

Brief Description: A screenshot of two questions from the Knowledge quiz.

Essential Description: The figure shows a screenshot of two questions that were used in the Knowledge quiz to measure the students' accessibility knowledge.

Detailed Description: The screenshot shows two questions from the knowledge quiz. The screenshot was taken from the Canvas system and displays two boxes on top of each other. A question and its multiple choice answers are presented in each box. The first question states "Below is an image of a staircase, with arrows and letters pointing to specific features. Which of the following matches the correct names to the letter associated with that feature?". An image is presented below question. The image shows two steps in a staircase with three arrows pointing on the parts of one of the steps. Four answers are presented underneath the image with the following choices:

- A=Nosing, B=Riser, C=Tread
- A=Riser, B= Tread, C=Nosing
- A=Tread, B=Nosing, C= Riser
- A=Riser, B=Nosing, C=Tread

The second question asks, "Why is it important to use a standardized assessment to evaluate the environment?", and lists the following answers:

- All of the above
- To ensure a thorough assessment
- To be able to compare findings between buildings
- To ensure results are valid and reliable

Figure 7: Sample of practice questions from the Key Terms in Community Accessibility Evaluation topic.

Brief Description: A screenshot of a practice question from the “Key Terms in Community Accessibility Evaluation” topic.

Essential Description: The figure shows a screenshot of a practice question from the “Key Terms in Community Accessibility Evaluation” topic included in the online training module. This question is a sample of multiple choice question that the students were asked to answer after completing the required training materials for this topic.

Detailed Description: The screenshot shows an example of one of the practice questions that was presented in the “Key Terms in Community Accessibility Evaluation” topic. The question asks, “A person who is blind is crossing the street in a crosswalk. The cross walk does not have auditory signals indicating when it is safe to walk. Which of the following best describes this type of environmental barrier?” and lists the following answer options:

- Environmental barrier - lack of relevant assistive technology
- Environmental barrier - physical environment that is not accessible
- Environmental barrier - negative attitude of people towards people with disabilities
- Environmental barrier - systems & policies that hinder involvement of people with disabilities

Figure 8: Sample of practice questions from the Importance of Community Accessibility topic

Brief Description: A screenshot of a practice question from the "Importance of Community Accessibility" topic.

Essential Description: The figure shows a screenshot of a practice question from the "Importance of Community Accessibility" topic included in the online training module. This question is a sample of multiple choice questions that the students were asked to answer after completing the required training materials for this topic.

Detailed Description: The screenshot shows an example of a practice question that was presented in the "Importance of Community Accessibility" topic. The question asks, "Did you catch the many environmental barriers that Zach faced during his quest for the rainbow bagel? Let's compare answers. Select the answers below that you either anticipated or identified during video clip." and lists the following answer options:

- Elevators were full
- Stairs to get to other elevators
- Stairs down to the subway
- No clear directions/ entrance to subway elevator
- Uneven sidewalks & curbs
- Metal guard rails sticking out onto sidewalk
- No ramp to board subway
- No accessible train to Brooklyn – had to take ferry
- Social stigma – difficult obtaining directions

Figure 9: Sample of practice questions from the Occupational Therapy Role topic

Brief Description: A screenshot of a practice question from the "Occupational Therapy Role" topic.

Essential Description: The figure shows a screenshot of a practice question from the "Occupational Therapy Role" topic included in the online training module. This question is a sample of multiple choice question that the students were asked to answer after completing the required training materials for this topic.

Detailed Description: The screenshot shows an example of one of the practice questions that were presented in the "Occupational Therapy Role" topic. The question states, "The Occupational Therapy Practice Framework (OTPF) 4th edition (https://doi.org/10.5014/ajot.2020.74S2001), is the main document that describes the scope of occupational therapy practice.

According to the OTPF, which of the following are aspects of the occupational therapy domain? (select all that apply)", and lists the following answer options:

- Occupation
- Contexts
- Performance Patterns
- Performance Skills
- Client Factors

Figure 10: Sample of practice questions from the Policy Impacting Community Accessibility topic

Brief Description: A screenshot of a practice question from the “Policy Impacting Community Accessibility” topic.

Essential Description: The figure shows a screenshot of a practice question from the “Policy Impacting Community Accessibility” topic included in the online training module. This question is a sample of multiple choice question that the students were asked to answer after completing the required training materials for this topic.

Detailed Description: The screenshot shows an example of one of the practice questions that was presented in the “Policy Impacting Community Accessibility” topic. The question states:

> *“What does it mean to be "covered" by the ADA? This means that the building and services needs to be accessible.*
>
> *Building*
>
> *To ensure that the building is accessible, the government (specifically the United States Access Board (https://www.access-board.gov/)) maintains standards called the 2010 Americans with Disabilities Act Standards for Accessible Design*
>
> *(https://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm). These are very specific standards that describe acceptable dimensions of common building elements.*
>
> *Here is an example of standards related to the toilet paper dispenser”.*

Then the question presents a sketch of the required dimensions for the placement of a toilet paper dispenser. The sketch shows the proper area to place the toilet paper dispenser with a rectangle of diagonal lines placed 7-9 inches in front of a toilet seat, with a minimum height of 15 inches and a maximum height of 48 inches.

Then, the question continue:

> *"This image describes that the toilet paper dispenser (specifically where the paper comes out) must be installed:*
>
> *7-9 inches from the front toilet*
>
> *15 - 48 inches off of the ground*
>
> *Services*
>
> *Services means that the activities in the building need to be accessible. Here is an example. A wheelchair user goes to a bar and is prevented from ordering at tall bar designed for standing people. Therefore the bartender should make the reasonable accommodation of taking the wheelchair users order in another manner, such as serving the wheelchair user at a table instead of a bar. What do you think is required of a public accommodation where the building was built prior to1990? (select all that apply)".*

The following answer options were presented:

- Services need to be accessible
- The building needs to be fully compliant to the ADA
- Easily removed barriers should be removed

Figure 11: Sample of practice questions from the Tools to Evaluate the Accessibility of Community Spaces topic

Brief Description: A screenshot of a practice question from the “Tools to Evaluate the Accessibility of Community Spaces” topic.

Essential Description: The figure shows a screenshot of a practice question from the “Tools to Evaluate the Accessibility of Community Spaces” topic included in the online training module. This question is a sample of a matching practice question that the students were asked to answer after completing the required training materials for this topic.

Detailed Description: The screenshot shows an example of one of the practice questions that were presented in the “Tools to Evaluate the Accessibility of Community Spaces” topic. The question states, “Below are a list of tools and their descriptions. Please match the name of the tool to the description that best matches the assessment.”, and lists the following options:

Assessment tool based on the legal standards of accessible design	Americans with Disabilities Act Checklist
Assessment tool that measures the impact of the environment on a specific person	Craig Hospital Inventory of Environmental Factors
Identifies if a person with a mobility impairment can get in and out of the building and do what they need to do	Community Health Environment Checklist
App-based measurement of building accessibility for people with various disabilities	AccessTools

Figure 12: Sample of practice questions from the Community Accessibility Evaluation Process topic

Brief Description: A screenshot of a practice question from the "Community Accessibility Evaluation Process" topic.

Essential Description: The figure shows a screenshot of a practice question from the "Community Accessibility Evaluation Process" topic included in the online training module. This question is a sample of multiple choice question that the students were asked to answer after completing the required training materials for this topic.

Detailed Description: The screenshot shows an example of one of the practice questions that were presented in the "Community Accessibility Evaluation Process" topic. The question states, "The fourth step in the process is to evaluate the building using a standardized evaluation tool. Which of the following approaches should be used when administering a standardized evaluation tool?", and lists the following options:

- The evaluator should answer the questions in order as prompted by the evaluation
- The evaluator should skip around the assessment and answer the most important questions
- The evaluator should randomly pick and choose questions

Figure 13: Sample of practice questions from the Building Elements and Features topic

Brief Description: A screenshot of a practice question from the "Building Elements and Features" topic.

Essential Description: The figure shows a screenshot of a practice question from the "Building Elements and Features" topic included in the online training module. This question is a sample of multiple choice question that the students were asked to answer after completing the required training materials for this topic.

Detailed Description: The screenshot shows an example of one of the practice questions that were presented in the "Building Elements and Features" topic. The question states, "In the picture below, area A has a high resistance and area B has a lower resistance. Why is the resistance important?".

The question presents an image of a living room focusing on the floor. Two textboxes, with white background and red outline and font, are presented. One of the textboxes has the letter "A" and identifies the high resistance area, which is a carpet surface, and the other textbox has the letter "B" and identifies the lower resistance area, which is a hardwood floor. The following answer options are then listed:

- Higher resistance makes it more difficult for wheelchair users to propel their wheelchair
- Higher resistance is a tripping hazard
- Higher resistance is a fire hazard

Figure 14: Sample of practice questions from the Using AccessTools topic

Brief Description: A screenshot of a practice question from the “Using AccessTools” topic.

Essential Description: The figure shows a screenshot of a practice question from the “Using AccessTools” topic included in the online training module. This question is a sample of matching practice questions that the students were asked to answer after completing the required training materials for this topic.

Detailed Description: The screenshot shows an example of one of the practice questions that were presented in the “Using AccessTools” topic. The question asks to “Match the icon to its described purpose” and presents a screenshot of the AccessTools user interface. The presented screenshot focuses on the top part of the AccessTools user interface, where two narrow rectangles across the full width of the screenshot are presented at the top representing the headings for the evaluation.

The first rectangle from the top has a light blue background with white text centered listing the data and the completion percentage of the evaluation. In this screenshot, the presented text in the top rectangle is “FIU-A-Hobbiton-10-16-2020 (Evaluation 6% Complete)”. To the left, an icon of three white lines stacked on top of each other are shown, with the white arrow labeled as “A” is pointing toward this icon.

The second narrow rectangle underneath has a dark blue background with white text that is aliened to the left, and four icons that are aliened to the right. The text represent the name of the evaluation and the location in paratheses. In this screenshot the name of the evaluation is “Hobbiton” and the location is “3472 Maramata New Zealand”. The

four icons that appears to the right of this rectangle are white in color and listed side by side. The icons represent the available actions that the user can do with the evaluation. The first icon to the left is an arrow pointing down representing the download option. The next icon to the right is a two pages symbol and the white arrow labeled as “B” is pointing toward this icon. The third icon is an envelope symbol and the white arrow labeled as “C” is pointing toward this icon. The last icon to the right is a could symbol and the white arrow labeled as “D” is pointing toward this icon.

Underneath the AccessTools screenshot, the following answer options are presented:

A	This icon will bring you back to the home page, allow you to start a new evaluation, return to an existing evaluation, or log out.
B	This icon will allow you to review the report deriving from your assessment.
C	This icon will allow you to send a copy of the assessment report via email.
D	This icon will synch and save your process in the assessment.

Figure 15: Sample of practice questions from Using the ADA Checklist topic

Brief Description: A screenshot of a practice question from the “Using the ADA Checklist” topic.

Essential Description: The figure shows a screenshot of a practice question from the “Using the ADA Checklist” topic included in the online training module. This question is a sample of matching practice questions that the students were asked to answer after completing the required training materials for this topic.

Detailed Description: The screenshot shows an example of one of the practice questions that were presented in the “Using the ADA Checklist” topic. The question states, “Below are the 4 answer criteria for the ADA Checklist. Match the criteria to its description”. The following answer options are presented:

Yes	The criteria is met and accessibility is indicated.
No	The criteria is not met and accessibility is not indicated.
Not applicable	The feature noted in the question is not relevant (e.g. an elevator in a 1-storybuilding)
Not examined	The criteria is unable to be answered based on the photo or video provided

Figure 16: Cross-over design and group assignment

Brief Description: A flowchart of the implemented cross-over design in the studies.

Essential Description: The flowchart presents the sequence of events that the two groups (Group 1: Trained, Group 2: Non-trained) went through in order to implement a cross-over design.

Detailed Description: The flowchart presents two arrows on top of each other pointing to the right. The arrows have a light orange background with six white textboxes and a black font text listing the sequence of events that each group went through in order to implement a cross-over design. The top arrow represents Group 1 (Trained group) and lists the following sequence of events: Pre-test quiz, Training, Post-lecture quiz, Building Evaluation, Post-lab quiz. The bottom arrow represents Group 2 (Non-Trained group) and lists the following sequence of events: Pre-test quiz, Building Evaluation, Post-lab quiz, Training, Post-lecture quiz.

Figure 17: Average "Somewhat Accessible" answer to applicable questions

Brief Description: A bar chart showing the average percentage of selecting the "Somewhat Accessible" answer from the total applicable questions answered across the three restaurants.

Essential Description: The bar chart shows the results of the follow up analysis that was performed on Study 3.1. It shows the average percentage of selecting the "Somewhat Accessible" answer from the total applicable questions of the root level questions at the 0, 1, and 2 branching levels across restaurants A, B, and C. The results show that the students selected the "Somewhat Accessible" answer between 25% to 38.5% on the first branching level (0 Branching), while this average dropped to 15.8% - 18.2% on the second branching level and to 4.2% - 6.9% on the third branching level.

Detailed Description: The bar chart shows three sets of three vertical rectangles representing the average percentage of selecting the "Somewhat Accessible" answer from the total number applicable questions of the root level questions. The vertical axis of the chart lists the percentages of selecting the "Somewhat Accessible" answer, while the horizontal axis lists the 0, 1, and 2 branching levels. In each branching level, a set of three vertical rectangles representing restaurant A (orange color), restaurant B (yellow), and restaurant C (green) are shown. At the 0 branching level, the results were 38.5%, 25.0%, and 36.4% for restaurants A, B, and C. At the 1 branching level, the results were 18.2%, 15.8%, and 16.7% for restaurants A, B, and C. At the 2 branching level, the results were 6.9%, 4.2%, and 4.3% for restaurants A, B, and C.

CURRICULUM VITAE

Qussai M. Obiedat

EDUCATION

2015 – 2022	University of Wisconsin – Milwaukee, Milwaukee, WI Degree: PhD in Health Sciences – Occupational Science & Technology
2015 – 2017	University of Wisconsin – Milwaukee, Milwaukee, WI Graduate Assistive Technology and Accessible Design Certificate
2010 – 2013	University of Wisconsin – Milwaukee, Milwaukee, WI Degree: Master of Science in Occupational Therapy
2002 – 2007	Jordan University of Science and Technology, Irbid, Jordan Degree: Bachelor's degree in occupational therapy

PROFESSIONAL DEVELOPMENT

- Full scholarship to participate in an NIH-sponsored Short Course in Adaptive Neurotechnologies, offered by the National Center for Adaptive Neurotechnologies (NCAN), July 7 – 27, 2019.
- Doctoral minor in Educational Statistics and Measurement.

EMPLOYMENT

Research Assistant **January 2022 – August 2022**

UWM, Rehabilitation Research Design & Disability Center.

Teaching Assistant **September 2020 – May 2021**

UWM, College of Health Sciences Teaching Assistantship Award.

Course: KIN 270 - Statistics in the Health Professions: Theory and Practice.

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Teaching Assistant **September 2017 - May 2019**

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Course: KIN 270 - Statistics in the Health Professions: Theory and Practice.

Lecturer **April 2013 – August 2015**

Jordan University of Science and Technology (JUST), Irbid, Jordan

A full-time lecturer at the department of Rehabilitation Sciences

Teaching Assistant **September 2007- August 2010**

Jordan University of Science and Technology (JUST), Irbid, Jordan

Teaching assistant at the department of Rehabilitation Sciences

PUBLICATIONS, PRESENTATIONS & PROCEEDINGS

Publications & Proceedings (Peer Reviewed):

- Obiedat, Q. M., Schwartz, J., Mendonca, R., Burns, S., Smith, R. O. (April, 2022). Studying the Educational Effect of a Self-paced Learning Protocol for Evaluating Community Environment Accessibility: A Preliminary Analysis. Proceedings of the 2022 American Occupational Therapy Association Annual Conference & Expo, San Antonio, TX.

- Obiedat, Q. M., Schwartz, J., Mendonca, R., Burns, S., Drake, M., O'Donnell, L., & Smith, R. O. (July, 2021). Using video recordings as a COVID-19 adaptation to study the inter-rater reliability of the AccessTools app. Scientific Paper at RESNA 2021 Annual Conference, Virtual Conference. https://www.resna.org/sites/default/files/conference/2021/ServiceDeliveryandOutcomes/112_Obiedat.html

- Burns, S., Schwartz, J., Mendonca, R., Obiedat, Q., & Smith, R. (2021). Access Ratings for Buildings: Feasibility Study and Implications for Interdisciplinary Training using the AccessTools App. Archives of Physical Medicine and Rehabilitation, 102(10), e14.

- Smith, R. O., Schwartz, J. K., Burns, S., Mendonca, R., Pickens, N., Drake, M. D., O'Donnell, L. M., Obiedat, Q. M. (2021). The Impact of Community Accessibility Assessment: A National Multisite Study. Proceedings of the 2021 Virtual OT Summit of Scholars. Retrieved from: https://uwm.edu/r2d2/wp-content/uploads/sites/438/2021/07/2021_OT_Summit_proceedings_23-to-25-June.pdf

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- Ardehali, M., Obiedat, Q., George, O., Follansbee, B., Smith, R. O. (September, 2020). Using a novel training paradigm for classification of Absolutely Volitional Covert Visuospatial Attention (AV-CVSA) direction through EEG signals: a pilot study. Scientific Paper at RESNA 2020 Annual Conference, Virtual Conference. https://www.resna.org/sites/default/files/conference/2020/StudentScientificPapers/NewAndEmergingTechnology/113Ardenhall.html

- Obiedat, Q., Ardehali, M., Follansbee, B., Smith, R. O. (June, 2019). The Integration of Brain-Computer Interface (BCI) as Control Module for Functional Electrical Stimulation (FES) Intervention in Post-Stroke Upper Extremity Rehabilitation. Scientific Paper at RESNA 2019 Annual Conference proceedings, Toronto, ON, Canada. https://www.resna.org/sites/default/files/conference/2019/emerging_technology/Obiedat.html

- Smith, R. O., Scherer, M., Cooper, R., Bell, D., Hobbs, D. A., Pettersson, C., Obiedat, Q.O, ... & Srinivasan, S. S. (2018). Assistive technology products: a position paper from the first global research, innovation, and education on assistive technology (GREAT) summit. Disability and Rehabilitation: Assistive Technology, 1-13.

- Obiedat, Q., Ardehali, M., Smith, R. O. (July, 2018). Next Generation of Assistive Social Robotics: Therapeutic Applications. Poster at RESNA 2018 Annual Conference, Arlington, VA.

- Ardehali, M., Obiedat, Q., Smith, R. O. (July, 2018). Research and Development Needs and the Role of Rehabilitation Engineering in Combining Therapy and Social Robot Applications. Poster at RESNA 2018 Annual Conference, Arlington, VA.

- Obiedat, Q., Ardehali, M., Smith, R. O. (June,2017). EEG Brain-Computer Interface As An Assistive Technology: Adaptive Control And Therapeutic Intervention. Scientific Paper at RESNA 2017 Annual Conference proceedings, New Orleans, LA. https://www.resna.org/sites/default/files/conference/2017/emerging_technology/Obiedat.html

- Obiedat, Q., Ardehali, M., Smith, R. O. (October, 2016). EEG Brain-Computer Interface (BCI) Systems and Implications. Poster at the 95th Annual Wisconsin Occupational Therapist Association Conference, Brookfield, WI.

Presentations (Peer Reviewed):

- Obiedat, Q. M., Schwartz, J., Mendonca, R., Burns, S., Smith, R. O. (June, 2022). Comparing the Effects of Using Video-simulated to On-site Accessibility Assessment on Students' Gained Knowledge. Poster presentation at the 2022 Occupational Therapy Summit of Scholars Annual Conference, Madison, WI.

- Obiedat, Q., Ardehali, M., Smith, R. O. (April, 2019). Introduction to EEG-Based Brain-Computer Interface (BCI): A Closed-Loop Neurofeedback. Tech Day Session at AOTA 2019 Annual Conference, New Orleans, Louisiana.

- Ardehali, M., Obiedat, Q., Smith, R. O. (April, 2018). NAO Robot: An Occupational Therapy Activities Assistant. Tech Day Session at the 2018 American Occupational Therapy Association Annual Conference & Expo, Salt Lake City, UT.

- Obiedat, Q., Ardehali, M., Smith, R. O. (June, 2017). Introduction to EEG-BCI, Neurofeedback Systems, and Applications. Workshop at RESNA 2017 Annual Conference, New Orleans, LA.

- Smith R.O., Ardehali, M., Love, J., Obiedat, Q., Saha, A.K., Schuh, C. (October, 2016). AccessTools and AccessPlace Environmental Accessibility Apps. Presentation at the 95th Annual Wisconsin Occupational Therapist Association Conference, Brookfield, WI.

- Smith R.O., Ardehali, M., Love, J., Obiedat, Q., Saha, A.K., Schuh, C. (April, 2016). AccessTools and AccessPlace Environmental Accessibility Apps. Presentation at the 96th Annual American Occupational Therapy Association Conference, Chicago, IL.

Presentations (Non-Peer Reviewed):

- Smith, R. O., Drake, M., Obiedat, Q., (October, 2019). In-Depth Instruction on Access Ratings for Building Applications: AccessPlace and Access Tools. Course presented at the Wisconsin Occupational Therapist Association 2019 Annual Conference, Appleton, WI. Retrieved from https://www.wota.net/assets/docs/2019%20WOTA%20Conference%20Courses%20updated.pdf.

- Obiedat, Q., Ardehali, M., Smith, R. O. (December, 2018). A Closed Loop Neural Activity Triggered Stroke Rehabilitation Using an EEG-Based Brain-Computer Interface. Podium presentation at the Occupational Science & Technology Research Lectureship, University of Wisconsin-Milwaukee. Milwaukee, WI. Retrieved from https://uwm.edu/healthsciences/wp-content/uploads/sites/129/2018/12/OST-research-lectureship-proceedings.pdf

- Ardehali, M., Obiedat, Q., Smith, R. O. (December, 2018). A Review of Electroencephalogram Brain-Computer Interface (EEG-BCI) Systems and Applications in Occupational Therapy and Neurorehabilitation. Podium presentation at the Occupational Science & Technology Research Lectureship, University of Wisconsin-Milwaukee. Milwaukee, WI. Retrieved from https://uwm.edu/healthsciences/wp-content/uploads/sites/129/2018/12/OST-research-lectureship-proceedings.pdf

- Obiedat, Q., Ardehali, M., Smith, R. O. (December, 2018). Next Generation of Assistive Social Robotics: Therapeutic Applications. Poster presentation at the Occupational Science & Technology Research Lectureship, University of Wisconsin-Milwaukee. Milwaukee, WI. Retrieved from https://uwm.edu/healthsciences/wp-content/uploads/sites/129/2018/12/OST-research-lectureship-proceedings.pdf

- Ardehali, M., Obiedat, Q., Smith, R. O. (December, 2018). Research and Development Needs And The Role Of Rehabilitation Engineering In Combining Therapy And Social Robot Applications. Poster presentation at the Occupational Science & Technology Research Lectureship, University of Wisconsin-Milwaukee. Milwaukee, WI. Retrieved from https://uwm.edu/healthsciences/wp-content/uploads/sites/129/2018/12/OST-research-lectureship-proceedings.pdf

Under-review/Accepted Publications:

- Book chapter: Obiedat, Q., Sindhu, B. S., Wang, Y. (Under-review). Fundamentals of Anatomy and Physiology for Rehabilitation Engineers and Assistive Technology Specialists. CRC Press. Boca Raton, Florida.

- Obiedat, Q., Ardehali, M., George, O., Follansbee, B., Smith, R. O. (Accepted, not presented due to COVID-19). Investigating a new EEG-based BCI Data Collection paradigm for the classification of Absolutely Volitional Covert Visuospatial Attention (AV-CVSA) direction: a pilot study. Occupational Therapy Summit of Scholars, Fort Collins, CO.

- Ardehali, M., Obiedat, Q., George, O., Follansbee, B., Smith, R. O. (Accepted, not presented due to COVID-19). Using a Novel Analysis Paradigm for Classification of Absolutely Volitional Covert Visuospatial Attention Direction through EEG Signals: A Pilot Study. Occupational Therapy Summit of Scholars, Fort Collins, CO.

HONORS/AWARDS

- 2021-2022 – UWM Chancellor's Graduate Student Award – Rehabilitation Sciences & Technology Department in the College of Health Sciences

- 2021-2022 – UWM Chancellor's Graduate Student Award - Health Sciences PhD Program in the College of Health Sciences

- 2020-2021 – UWM Graduate Student Excellence Fellowship (GSEF) award

- 2020 – Runners-up award of the 2020 Rehabilitation Engineering and Assistive Technology Society of North America (RESNA) Student Scientific Paper Competition.

- 2020, Fall – UWM Chancellor's Graduate Student Award - Occupational Science & Technology Department in the College of Health Sciences

- 2020, Fall – UWM Chancellor's Graduate Student Award - Health Sciences PhD Program in the College of Health Sciences

- 2020, Summer – UWM Chancellor's Graduate Student Award - Occupational Science & Technology Department in the College of Health Sciences

- 2020, Spring – UWM Chancellor's Graduate Student Award - Occupational Science & Technology Department in the College of Health Sciences

- 2019, Fall – UWM Chancellor's Graduate Student Award - Occupational Science & Technology Department in the College of Health Sciences

- 2019, Fall – UWM Chancellor's Graduate Student Award - Health Sciences PhD Program in the College of Health Sciences
- 2018, Fall – The College of Health Sciences Student Research Grant Award (SRGA)
- 2018, Fall – UWM Chancellor's Graduate Student Award - Health Sciences PhD Program in the College of Health Sciences
- 2018, Summer – Graduate Student Travel Award to present research at the Rehabilitation Engineering and Assistive Technology Society of North America in Arlington, VA.
- 2018, Spring – Graduate Student Travel Award to present research at The American Occupational Therapy Association Annual Conference in Salt Lake City, UT.
- 2017, Fall – UWM Chancellor's Graduate Student Award - Occupational Science & Technology Department in the College of Health Sciences
- 2017, Summer – Graduate Student Travel Award to present research at the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA 2017 Annual Conference) in New Orleans, LA.
- 2017, Spring – UWM Chancellor's Graduate Student Award - Occupational Science & Technology Department in the College of Health Sciences
- 2016, Fall – UWM Chancellor's Graduate Student Award - Occupational Science & Technology Department in the College of Health Sciences
- 2016, Fall – UWM Chancellor's Graduate Student Award - Health Sciences PhD Program in the College of Health Sciences
- 2016, Spring – UWM Chancellor's Graduate Student Award - Health Sciences PhD Program in the College of Health Sciences
- 2011, Spring – UWM Chancellor's Graduate Student Award - Occupational Science & Technology Department in the College of Health Sciences
- 2005-2006 – Listed on the Deanship's list of honor for distinguished academic achievement at Jordan University of Science and Technology