Technology Adoption for Disaster Preparedness Among Older Adults and People with Disabilities

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Abstract. Despite the intuitive appeal of using emerging technologies for disaster preparedness, there is a lack of comprehensive research exploring their applications. This study employs a nationwide 2023 and 2024 survey on technology use for disaster preparedness by older adults and people with disabilities. The survey assessed respondents' frequency of use, willingness to use, use comfort, perceived usefulness, and attitude toward using technologies. Overall, there were 1696 responses from 2023 and 2024 surveys, with 85 respondents completing the survey in both years. Using the TAM model, PATH findings indicate comfort significantly influenced perceived usefulness but not attitude. Attitude did not significantly influence behavioral intention to use, however, perceived usefulness did influence behavioral intention.

Keywords: Emerging Technology, Disaster Preparedness, TAM. Older Adults, People with Disabilities

1 Introduction

Despite the intuitive appeal of using emerging technologies for disaster preparedness, there is a lack of comprehensive research exploring their applications. While studies recognize the potential of technologies like AI-enabled early warning systems (Abbasi et al., 2024), smart wearables (Cheng et al., 2020), Unmanned Aerial Vehicles (UAVs) or drones (Khan et al., 2022), geospatial technology (Handoyo et al., 2024), and mobile phones (Akinbi et al., 2021; Bennett Gayle et al., 2024; Cheng et al., 2020; Lai et al., 2018), researchers often highlight the limited scope and scarcity of research examining public acceptance of these technologies in disaster scenarios and the factors driving perceived usefulness, crucial aspects for their adoption. Additionally, considering social and behavioral factors is necessary for effectively implementing these technologies (Bean & Grevstad, 2023; Samaddar et al., 2012; Troy et al., 2008). Since the frequency and intensity of natural disasters are exponentially growing, this matter gains even more importance for disaster preparation, especially for groups in need of support (Smith, 2020). More specifically, older adults and people with disabilities require specific attention in preparedness efforts due to functional limitations, limited access, uncertainty about how to prepare, and dependence on others (Arimura et al., 2020; Finkelstein & Finkelstein, 2020; Koloushani et al., 2022; Kruger et al., 2018). In addition, the mortality rate of people with disabilities in natural disasters is up to four times higher than people without disabilities (NDC et al., 2023). As a result, these communities require developing targeted strategies that prioritize equitable access to address the disparities in vulnerability and resilience shaped by social systems (USGCRP et al., 2023). It is noteworthy that 43.9% of older adults have a high disability prevalence, which presents heightened challenges for disaster preparedness (CDC Data, 2024). One of the challenges these communities face is access to technologies that might push them to rely on traditional communication methods for their preparedness (Howard et al., 2017). While older adults embrace technology for activities like internet browsing, weather, maps and navigation, social media, communication, and shopping, they remain cautious about adopting newer technologies, especially those they perceive as complex or not designed for their needs (Kakulla, 2023b). However, they have shown motivation to engage with new technologies through clear demonstration, interaction, and understanding of benefits (Huygelier et al., 2019; Kakulla, 2023a; Molina et al., 2014). Considering accessibility and ease of use, ongoing support and training tailored to older adults and people with disabilities are fundamental in technology adoption for disaster preparedness of these communities (Chalghoumi et al., 2019; Murphy et al., 2022).

This study employs a nationwide 2023 and 2024 survey on technology use for disaster preparedness (Bennett Gayle et al., 2024). The recruitment focus is on older adults and people with disabilities through convenience sampling. A previous analysis of the 2023 survey revealed the willingness of older adults to use emerging technology for disaster preparedness despite the lack of comfort with it (Bennett Gayle et al., 2024). Older adults with disabilities show similar trends, highlighting the importance of training and integration of these technologies into existing and familiar contexts for increased adoption. We utilize the Technology Acceptance Model (TAM) to understand the factors influencing technology adoption by older adults and people with disabilities for disaster preparedness (Davis, 1989; Venkatesh et al., 2003, 2012; Venkatesh & Bala, 2008; Venkatesh & Davis, 2000). The survey assessed respondents' perceived disaster experience and preparedness, frequency of use, willingness to use, comfort, perceived usefulness, and attitude toward using technologies. Research suggests that while TAM and similar models such as UTAUT have been instrumental in understanding technology adoption generally, they may require tailoring to suit unique population needs and characteristics (Shachak et al., 2019). TAM posits that the helpfulness and ease of use of technologies for preparedness are primary drivers of their adoption by older adults and people with disabilities (Karanasios et al., 2020). They need to see the tangible benefits of using technology to bolster emergency preparedness in advance of an emergency, and to facilitate timely protective action responses during an emergency. For example, a study on using VR/AR for tsunami preparedness found that older adults were more likely to use the technology if they believed it provided clear and accurate information about evacuation routes and safety procedures (Surtiari et al., 2024). On the other hand, UTAUT incorporates these populations' social influences, including their experience and individual differences. Lack of support and training, in addition to accessibility barriers, are among these differences (Gagen & Jacelon, 2022).

By addressing interpersonal obstacles, leveraging social influence, tailoring education, facilitating usability, and emphasizing practical applications, we can move beyond the simplification of theories and achieve practical adoption.
Accordingly, this study examines technology adoption patterns among older adults and individuals with disabilities by analyzing key indicators: frequency of use, comfort with use, willingness to adopt, perceived usefulness, and overall attitudes toward technology. The following research questions guide this investigation:

RQ1: How are technology adoption indicators associated with device type across age and ability groups?

RQ2: Do technology adoption indicators vary for age and ability by year? If so, which types of technologies show significant differences?

RQ3: How did technology adoption indicators change between 2023 and 2024? What behavioral shifts can be observed among respondents?

RQ4: What is the interplay of the technology adoption indicators within the framework of the Technology Acceptance Model (TAM)?

This research can benefit multiple stakeholders. It can guide disaster researchers in developing more effective and useful technologies and features for older adults and people with disabilities. It can also help developers create tailored solutions for these communities' needs by focusing on their individual and collective experiences. It can also benefit first responders by providing situational awareness and reliance on technologies for emergency services. Lastly, it can assist policymakers in decision-making considerations for public training, messaging, and communication.

2 Literature Review

2.1 Smart Technology Use for Disaster Preparedness

The literature on the use of smart technology for disaster preparedness falls into categories of users (the public, emergency management, and emergency responders) and different phases of a disaster (mitigation, preparedness, response, and recovery). Currently, the literature includes smart technologies such as geographical information systems (GIS), social media, simulations, sensor technologies and smart spaces and cities, (Bessis & Asimakopoulou, 2013; Qadir et al, 2021), digital twins smartphones, apps, and IoT applications, (Ariyachandra, & Wedawatta, 2023), Unmanned Aerial Vehicles (UAVs) (Clark & Chongtay, 2020), and combinations of these technologies to form systems. With the exception of wearables for COVID-19 tracking, smart wearables are developed for first responders and other field personnel rather than laypersons (Alharthi, 2018; Kleiner, Behrens, & Kenn, 2006; Niswar et al., 2015). Most of this smart tech is reportedly used by disaster management professionals in training, as decision support tools, and for situational awareness, not by members of the public. This section focuses on technologies intended for public use to enhance risk awareness and preparedness levels.

A key strategy for improving public uptake of technologies for disaster preparedness is to leverage ubiquitous technologies, as they are often already routinely used by the intended audience. This approach has been illustrated by the Wireless Emergency Alert (WEA) program in its use of cell phone technology to improve the reach of emergency alerts beyond television and radio broadcasts (Bush, 2006). Further, considerations are underway for how to incorporate on-device features of smartphones (e.g., GIS, video) to enhance the perceived relevance and accessibility, respectively, of the alert (FCC, 2025; FCC, 2024). Studies have confirmed the growth in WEA adoption by people with disabilities and older adults (LaForce et al., 2016; Bright & LaForce, 2022; LaForce & Bright, 2024). A nationwide study that evaluated the effectiveness of WEA after the 2023 national test study found that people received WEAs at similar rates, even when controlling for disability status (disability/no disability) (Parker et al. 2024). However, those 65 and older, people with hearing disabilities, and non-white participants received WEAs at lower rates (Ibid p.10). A study out of Southeast Asia found that smartphone users (compared to non-smartphone users) routinized the sharing of disaster information with family and friends (Lai, Chib, & Ling, 2018).

Another example of smart technologies used by the public for disaster preparedness and response is the use of smartphones and web applications (apps) for disaster preparedness. McAtee et al (2022) conducted a systematic review of apps used by emergency managers and laypersons to identify the highest quality apps. The article serves as an update to a 2015 study that focused on apps for disaster medicine. The 2015 review found 219 apps and narrowed that down to a top five (Bachman et al. 2015). Seven years later, 634 apps were included in the review, indicating a massive expansion of the disaster app industry. Layperson apps included apps for human-made and natural disaster preparedness information and response, first-aid (human and pet), personal medical information storage, public health information, natural disaster preparedness, weather and flood trackers, and locator apps (McAtee et al, 2022). However, disaster app availability and disaster app use have vastly different measures. Looking at disaster apps on the Apple Store and using the number of reviews as an indication of usage, as of June 6, 2025, usage rates range from 1-4.9M (Apple Store, 2025). So, a significant portion of laypersons have not adopted disaster apps even though 7.21 billion people worldwide own a smartphone (Kumar 2025). In the U.S., an estimated 91% of the population uses smartphones, with a lesser rate for people 65+ (79%); however, older adults' smartphone dependency is close to young adults (17% and 21%, respectively). Indicating they can become important tools for disaster risk reduction, but perhaps a native disaster preparedness app, as opposed to one users have to download, would increase usage rates.

2.2 Technology Acceptance, Older Adults, and People with Disabilities

Older adults and people with disabilities have generally adopted the use of newer technologies (Faverio, 2022; Kakulla, 2024; Orlofsky & Wozniak, 2022). The use of mobile phones has skyrocketed to near ubiquitous use, even among older adults. In 2021, an estimated 61% of older adults used smart phones. By 2025, 91% of adults 50 and older own smart phones, with their dependency mirroring that of younger adults (Kakulla, 2024). Similarly, social media use is up to 74%, smart TV 73%, smart home tech 63%, with older adults expressing perceived benefit in using technology for health-related, or life-saving measures (Kakulla, 2024). People with disabilities may have been even earlier adopters for some technology. As early as 2016, at least one nationwide study shows 71% use of smartphones by people with disabilities (Norris et al., 2016).

Evidence suggests there are benefits for using emerging technologies, such as virtual environments, for both older adults and individuals with disabilities. Virtual environments (VEs) can teach specific functions in a stress-free environment (Ghali et al., 2012). Training in VEs has emerged as a tool across many domains, including health maintenance, rehabilitation, education, workplace training, diversity and inclusion, and emergency management. Training in VEs increased the retention of information and task performance in both novices and more experienced workers (Manca et al., 2013), and in memory encoding and recall of newly learned routes in both older adults and young adults (Lokka et al., 2018). Further, it has been found to improve the interview skills of people with schizophrenia and increase the length of their employment (Smith et al., 2015). In the health domain, VE use with older adults has proven efficacious in the treatment of people who are fall risks (Rendon et al., 2012), improving cognitive functioning (Chan et al., 2010), and improving muscle strength and control (Kim et al., 2013), to name a few.

The primary barriers to use include privacy, ease of use, set up (training), cost, and value (Kakulla, 2024; Knight et al., 2022). In fact, at least one study noted that privacy concerns vary according to technology type and may cause methodological challenges when considering the connection between use of technology and privacy (Knight et al., 2022). The recent AARP surveys noted that there was one exception when older adults considered the benefit of using certain technologies (Kakulla, 2024). If the technology was made for lifesaving or health-related topics, there was an increase in willingness to use. Therefore, training, cost, and ease of use would likely become key to increasing adoption for disaster preparedness-related technologies.

3 Methodology

3.1 Nationwide Survey

This study uses data collected through an online nationwide survey in December 2023 and 2024 administered through Qualtrics. The study was approved by the University at Albany, SUNY, Institute Review Board, Study number 23X081. A convenience sampling approach was employed to capture older adults and people with disabilities. Overall, there are 1696 responses from 2023 and 2024 surveys, with 85 respondents completing both years' surveys. The similarity between the survey and census age distribution, along with the comparable percentage of participants with disabilities, supports the assumption that the survey data is representative of the U.S. population. Completing the survey took an average of 20 minutes, and responding to each question was voluntary. Completed surveys with 30% or more progression were included in the analysis. The survey questions were designed to assess technology adoption, with a particular focus on emerging technologies used in disaster preparedness. The 2024 survey included an additional question on the perceived usefulness of technologies for disaster preparedness, aligning with the indicators of the TAM model construct.

3.2 TAM

The Technology Acceptance Model (TAM) is widely used in information science as a framework to understand adoption and use of newer technologies by a specific population (German Ruiz-Herrera et al., 2023). The model includes perceived ease of use, perceived usefulness, attitude towards use, intention to use and actual use. As shown, external factors feed into the concept of perceived usefulness and ease of use of a particular technology which shapes one's willingness to use a particular technology as well as their intention to use said technology. In previous studies these factors have been primarily measured through survey design.

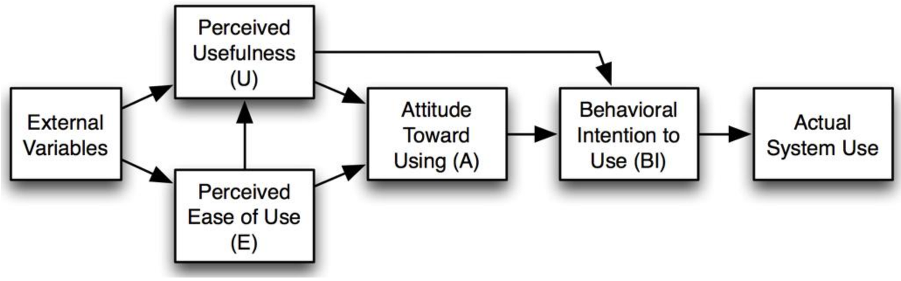

Fig. 1. Technology acceptance model (TAM) (Davis, 1989: cited in Timothy, 2009; Celik & Sever 2012).

3.3 Respondent Demographics

In 2023 and 2024, approximately 15% and 11% of respondents, respectively, were older adults (aged 65 or older). Additionally, around 24% in 2023 and 29% in 2024 identified as having a disability. Among older adults in the 2024 sample, the most commonly reported disabilities were deafblindness (30%), hearing impairments (37.5%), and lower body physical disabilities (33.3%).

In 2024, individuals with disabilities most frequently fell within the $50,000 to $75,000 income bracket. Most either lived alone or with one other adult in the household. Among respondents with disabilities, 68% of those who are blind and 57% of those who are deaf reported being caregivers themselves. In contrast, individuals with upper body physical disabilities and those with communication or speech limitations were more likely to need caregiving support, at rates of 80% and 84%, respectively.

For a detailed overview of the 2023 survey respondents, please visit the dataset report (Bennett Gayle et al., 2024).

4 Results

For all the analyses in this paper, age and ability variables were one-hot encoded into 0 (younger adults and people without disabilities) and 1 (older adults and people with disabilities).

4.1 Association Between Adoption, Age, and Ability

The association between technology adoption indicators, user attitudes, and device types was examined using chi-squared tests across age and ability groups in both 2023 and 2024 to answer Q1 (Figures 2-4).

2023

Device	Frequency of Use and Age	Frequency of Use and Ability	Comfortability and Age	Comfortability and Ability
Feature Phone	χ^2=135.1 p<.001	χ^2=11.29 p= .0459	χ^2=19.88 p=.0013	χ^2=8.28 p=.1413
Smart Headphones	χ^2=201.94 p<.001	χ^2=98.89 p<.001	χ^2= 15.91 p= .007	χ^2=62.36 p<.001
Smartphone	χ^2= 58.07 p<.001	χ^2= 33.84 p<.001	χ^2= 11.48 p= .0427	χ^2= 49.62 p<.001
Tablet	χ^2= 99.69 p<.001	χ^2= 75.47 p<.001	χ^2= 13.51 p= .0191	χ^2= 45.61 p<.001
Laptop	χ^2= 81.83 p<.001	χ^2= 43.73 p<.001	χ^2= 32.92 p<.001	χ^2= 31.08 p<.001
Desktop Computer	χ^2= 118.94 p<.001	χ^2=49.2 p<.001	χ^2= 15.55 p= .0083	χ^2= 35.68 p<.001
E-book Reader	χ^2= 59.73 p<.001	χ^2= 21.8 p<.001	χ^2= 5.24 p= .3878	χ^2= 11.13 p= .0488
Smart Wearable	χ^2= 147.2 p<.001	χ^2= 60.37 p<.001	χ^2= 14.96 p= 0.01	χ^2= 49.78 p<.001
Health Monitoring Devices	χ^2= 131.77 p<.001	χ^2= 59.03 p<.001	χ^2= 26.24 p<.001	χ^2= 83.92 p<.001
Smart Fitness Equipment	χ^2= 175.1 p<.001	χ^2= 78.4 p<.001	χ^2= 18.35 p= .0025	χ^2= 90.35 p<.001
Smart Home Appliances	χ^2= 88.38 p<.001	χ^2= 74.72 p<.001	χ^2=22.91 p<.001	χ^2= 31.04 p<.001
Smart Cleaning Devices	χ^2= 172.51 p<.001	χ^2=105.12 p<.001	χ^2=15.35 p= .009	χ^2=75.65 p<.001
Smart Security System	χ^2= 113.6 p<.001	χ^2= 39.27 p<.001	χ^2=10.87 p= 0.0541	χ^2= 33.63 p<.001
Smart Kitchen Appliances	χ^2= 164.55 p<.001	χ^2=107.42 p<.001	χ^2= 31.51 p<.001	χ^2= 28.22 p<.001
VR Headset	χ^2=179.56 p<.001	χ^2=76.91 p<.001	χ^2=48.36 p<.001	χ^2=28.87 p<.001
Robot	χ^2= 191.1 p<.001	χ^2= 64.24 p<.001	χ^2= 10.31 p= .0670	χ^2= 67.22 p<.001
Smart Car	χ^2= 206.68 p<.001	χ^2= 94.17 p<.001	χ^2= 27.88 p<.001	χ^2= 52.89 p<.001
Interactive Chat	χ^2= 238.22 p<.001	χ^2= 78.39 p<.001	χ^2= 29.91 p<.001	χ^2= 51.12 p<.001

2024

Device	Frequency of Use and Age	Frequency of Use and Ability	Comfortability and Age	Comfortability and Ability
Feature Phone	χ^2=137.34 p<.001	χ^2=81.05 p<.001	χ^2=3.25 p=.6613	χ^2=9.6384 p=.0862
Smart Headphones	χ^2=156.33 p<.001	χ^2=131.89 p<.001	χ^2= 65.14 p<.001	χ^2=72.65 p<.001
Smartphone	χ^2= 67.87 p<.001	χ^2=40.69 p<.001	χ^2=38.61 p<.001	χ^2=45.67 p<.001
Tablet	χ^2=95.69 p<.001	χ^2=66.33 p<.001	χ^2=28.28 p<.001	χ^2=22.03 p<.001
Laptop	χ^2=108.47 p<.001	χ^2= 68.42 p<.001	χ^2=28.1 p<.001	χ^2=30.66 p<.001
Desktop Computer	χ^2=88.74 p<.001	χ^2=53.29 p<.001	χ^2=51.76 p<.001	χ^2=37.91 p<.001
E-book Reader	χ^2=117.08 p<.001	χ^2=88.61 p<.001	χ^2=26.38 p<.001	χ^2=36.18 p<.001
Smart Wearable	χ^2=131.88 p<.001	χ^2=85.53 p<.001	χ^2=80.67 p<.001	χ^2=44.52 p<.001
Health Monitoring Devices	χ^2=172.71 p<.001	χ^2=100.82 p<.001	χ^2=40.42 p<.001	χ^2=57.7 p<.001
Smart Fitness Equipment	χ^2=219.17 p<.001	χ^2=122.24 p<.001	χ^2=42.82 p<.001	χ^2=76.45 p<.001
Smart Home Appliances	χ^2=82.09 p<.001	χ^2=80.91 p<.001	χ^2=31.9 p<.001	χ^2=35.98 p<.001
Smart Cleaning Devices	χ^2=199.01 p<.001	χ^2=95.66 p<.001	χ^2=52.43 p= .009	χ^2=44.38 p<.001
Smart Security System	χ^2=128.36 p<.001	χ^2=85.78 p<.001	χ^2=47.91 p<.001	χ^2=55.45 p<.001
Smart Kitchen Appliances	χ^2=137.69 p<.001	χ^2=114.14 p<.001	χ^2=21.79 p<.001	χ^2=60.18 p<.001
VR Headset	χ^2=177.04 p<.001	χ^2=104.05 p<.001	χ^2=73.63 p<.001	χ^2=41.16 p<.001
Robot	χ^2=159.63 p<.001	χ^2=100.16 p<.001	χ^2=42.73 p<.001	χ^2=75.84 p<.001
Smart Car	χ^2=159.52 p<.001	χ^2=87.55 p<.001	χ^2=33.49 p<.001	χ^2=45.22 p<.001
Interactive Chat	χ^2=158.97 p<.001	χ^2=59.29 p<.001	χ^2=74.16 p<.001	χ^2=50.93 p<.001

Fig. 2. The Association of frequency of use and comfort with use with different technology devices across age (older adults vs. younger adults) and ability (people with and without disabilities)

Significant associations were found between most device types and both frequency of use and comfort level across age and ability groups (Figure 2). However, there were exceptions. No significant association was found between comfort with feature phones and either age or ability in both years. Similarly, in 2023, no significant age-related association was observed for comfort with e-book readers, smart home security systems, and robots. In terms of frequency of use, smart headphones, smart cars, and interactive chat technologies showed a stronger association with age in 2023. In 2024, this pattern was more evident for smart fitness equipment and smart cleaning devices. For ability, a stronger association with frequency of use was observed for smart kitchen appliances and smart cleaning devices in 2023, and for smart headphones, smart fitness equipment, and smart kitchen appliances in 2024. Regarding comfort level, the strongest age-related association in 2023 was with VR headsets, while in 2024 it was with smart wearables. The strongest association between ability and comfort was found with smart fitness equipment in both years.

Most associations between willingness to use technologies and their perceived usefulness for disaster preparedness were significant across both age and ability groups (Figure 3). The only exception was the perceived usefulness of smart security systems across age groups in 2024. In terms of age, the strongest associations with willingness to use technology were found for virtual reality, robots, and smart cars in 2023, and for smartphones, virtual reality, and NOAA weather radios in 2024. For ability, the strongest associations in 2023 were with smart cars, smart speakers, and virtual reality, while in 2024 they were with smart speakers, virtual reality, and robots. In 2024, perceived usefulness showed a stronger relationship with age for NOAA weather radios, smart speakers, and smartphones. Among ability groups, this association was strongest for virtual reality, smart home appliances, and robots.

	2023: Willingness to Use and Age	2023: Willingness to Use and Ability	2024: Willingness to Use and Age	2024: Willingness to Use and Ability	2024: Usefulness and Age	2024: Usefulness and Ability
NOAA Weather Radio	χ^2=51.99 p<.001	χ^2=68.8 p<.001	χ^2=49.59 p<.001	χ^2=41.86 p<.001	χ^2=45.66 p<.001	χ^2=33.15 p<.001
Smartphone	χ^2=33.67 p<.001	χ^2=44.84 p<.001	χ^2=55.96 p<.001	χ^2=57 p<.001	χ^2=44.91 p<.001	χ^2=44.1 p<.001
Laptop/Tablet	χ^2= 30.58 p<.001	χ^2=54.05 p<.001	χ^2=38.65 p<.001	χ^2=35.15 p<.001	χ^2=28.09 p<.001	χ^2=16.4 p=.0058
Virtual Reality	χ^2= 70.19 p<.001	χ^2= 77.23 p<.001	χ^2=51.45 p<.001	χ^2=85.41 p<.001	χ^2=25.7 p<.001	χ^2=74.09 p<.001
Robot	χ^2= 61.51 p<.001	χ^2=71.58 p<.001	χ^2=46.06 p<.001	χ^2=76.52 p<.001	χ^2=43.45 p<.001	χ^2=65.42 p<.001
Interactive Chat	χ^2=29.02 p<.001	χ^2=55.74 p<.001	χ^2=21.49 p<.001	χ^2=60.67 p<.001	χ^2=25.01 p<.001	χ^2=51.29 p<.001
Smart Home Appliances	χ^2=32.98 p<.001	χ^2= 53.85 p<.001	χ^2=40.73 p<.001	χ^2=57.48 p<.001	χ^2=26.44 p<.001	χ^2=71.22 p<.001
Smart Wearable	χ^2=32.48 p<.001	χ^2=67.95 p<.001	χ^2=18.28 p=.0026	χ^2=47.64 p<.001	χ^2=21.15 p<.001	χ^2=36.56 p<.001
Smart Speaker	χ^2=46.70 p<.001	χ^2=97.18 p<.001	χ^2=46.70 p<.001	χ^2=97.18 p<.001	χ^2=45.3 p<.001	χ^2=58.75 p<.001
Smart Security System	χ^2=23.75 p<.001	χ^2=63.13 p<.001	χ^2=19.63 p= .0015	χ^2=38.82 p<.001	χ^2=9.18 p= .1019	χ^2=48.11 p<.001
Smart Car	χ^2=54.38 p<.001	χ^2=100.07 p<.001	χ^2=27.69 p<.001	χ^2=71.52 p<.001	χ^2=44.8 p<.001	χ^2=59.73 p<.001

Fig. 3. The Association of willingness to use different technology devices across age (older adults vs. younger adults) and ability (people with and without disabilities)

To assess participants' attitudes toward using technology, they were asked to rate their agreement with the following statements on a 6-point scale:

- Technology works the way the mind works (Technology Mind)
- Learning about technology feels like a burden on myself (Learning Burden Myself)
- Learning about technology feels like a burden on my family (Learning Burden Family)
- I have had bad experiences with technology (Bad Tech Experience)
- I am "tech-savvy" (Tech-Savvy)
- I would use technology more in my daily life if I knew how (Use Knowledge)
- I think that using new technology is not necessary (Not Necessary)
- Learning how to use new technologies has made my daily life more convenient (Use Convenience)

Significant associations between these attitudes and participant age and ability were found in both 2023 and 2024, with the exception of Use Knowledge and Use Convenience in 2024. The strongest associations in 2023 were for Technology Mind across both age and ability groups. In 2024, Learning Burden Myself showed the strongest association across age, while Technology Mind and Not Necessary had the strongest associations across ability.

	2023 Age	2023 Ability	2024 Age	2024 Ability
Technology Mind	χ^2=91.11 p<.001	χ^2=65.8 p<.001	χ^2=36.7 p<.001	χ^2=47.29 p<.001
Learning Burden Myself	χ^2=24.48 p<.001	χ^2=46.12 p<.001	χ^2=22.29 p<.001	χ^2=32.76 p<.001
Learning Burden Family	χ^2=17.74 p= .0033	χ^2=19.12 p= .0018	χ^2=45.81 p= .0033	χ^2=17.41 p=.0038
Bad Tech Experience	χ^2= 29.01 p<.001	χ^2=19.74 p= .0014	χ^2=22.51 p<.001	χ^2=20.56 p=.001
Tech-Savvy	χ^2=39.19 p<.001	χ^2=40.86 p<.001	χ^2=13.71 p= .0175	χ^2=20.92 p<.001
Use Knowledge	χ^2=23.97 p<.001	χ^2=35.16 p<.001	χ^2=10.76 p= .0564	χ^2=35.27 p<.001
Not Necessary	χ^2=31.05 p<.001	χ^2=30.79 p<.001	χ^2=36.28 p<.001	χ^2=47.21 p<.001
Use Convenience	χ^2=22.82 p<.001	χ^2=46.15 p<.001	χ^2=7.92 p=.1604	χ^2=19.51 p= .0015

Fig. 4. The Association of attitudes toward using technology across age (older adults vs. younger adults) and ability (people with vs. without disabilities)

4.2 Differences in Adoption of Technologies by Older Adults and People with Disabilities

To answer Q2 and Q3, we compared the participants who completed the 2023 and 2024 surveys, which totaled 170. Prior to performing the analyses, we examined the normality assumption and found that the data were not normally distributed. Thus, we used non-parametric tests.

Frequency of Use.

A series of Mann-Whitney tests were conducted to compare the frequency of device use for disaster preparation among younger and older adults across 2023 and 2024. As shown in Table 1, younger adults reported significantly more frequent use of several devices than older adults. Devices with consistent significant difference across both years include Smart Headphones, Smartphones, Health Monitoring Devices, Smart Home Fitness Equipment, Smart Home Cleaning, Smart VR, Robots, Smart Cars, and Generative AI. Additionally, Smart Kitchen Appliances were significant in 2023, while Feature Phones reached significance only in 2024.

People with disabilities also reported significantly different usage patterns compared to those without disabilities, with many devices showing consistent significance across both years. These devices are Feature Phones, eBook Readers, Smart Headphones, Smartphones, eBook Readers, Health Monitoring, Smart Home Fitness Equipment, Smart Home Cleaning Devices, Kitchen Appliances, Smart VR Headsets, Robots, Smart Cars, and Generative AI. Only Smart Wearable Devices and Smart Home Appliances reached significance in 2023 but were not significant in 2024.

Table 1. Comparison of Variables for frequency of use in 2023 and 2024 between Age and Ability using Mann-Whitney U Tests.

	2023		*2024*	
Variables/Devices	*Z*	*Z*	*Z*	*Z*
	p	*p*	*p*	*p*
	Age	**Ability**	**Age**	**Ability**
Feature Phones	-1.764	-5.101	-3.812	-4.327
	.078	<.001*	<.001*	<.001*
Smart Headphones	-4.076	-4.946	-3.81	-4.832
	<.001*	<.001*	<.001*	<.001*
Smartphone	-2.011	-4.221	-3.841	-3.869
	.044	<.001*	<.001*	<.001*
Tablet	-0.854	-0.332	-0.625	-0.024
	.393	.74	0.532	.981
Laptop	-1.364	-0.014	-1.321	-2.78
	.173	.989	0.187	.781
Desktop Computer	-0.097	-0.605	-0.738	-0.047
	.923	.545	0.461	.962
eBook Reader	-0.878	-2.87	-0.774	-3.671
	.38	.004	0.439	<.001
Smart Wearable Device	-0.946	-2.987	-0.479	-0.929
	.344	.003	0.632	.353
Health Monitoring Devices	-3.204	-4.108	-3.257	-4.588
	.001*	<.001*	0.001*	<.001*
Smart Home Fitness Equipment	-3.287	-5.263	-3.39	-5.464
	.001*	<.001*	<.001*	<.001*
Smart Home Appliance	-0.355	-1.536	-1.085	-0.375
	.723	<.001*	.278	.708
Smart Home Cleaning Devices	-2.9	-4.331	-3.043	-4.414

	.004	<.001*	.002*	<.001*
Smart Home Security Systems	-1.17	-1.142	-0.094	-0.222
	.242	0.253	.925	.824
Smart Kitchen Appliances	-2.179	-3.506	-1.361	-4.227
	.029	<.001*	.174	<.001*
VR Headset	-3.216	-5.453	-4.507	-5.365
	.001*	<.001*	<.001*	<.001*
Robots	-4.165	-5.478	-4.248	-5.509
	<.001*	<.001*	<.001*	<.001*
Smart Cars	-3.162	-3.128	-3.187	-2.938
	.002	.002	.001*	.003*
Generative AI	-2.544	-4.273	-3.184	-2.892
	.011	<.001*	.001*	.004*

Comfort Level.

The Mann-Whitney U tests revealed significant differences in comfort levels with various technologies across both age groups and ability status in 2023 and 2024 (see Table 2). For age-related differences, both 2023 and 2024 data indicated that younger and older adults differed significantly in comfort level with Smart Headphones, Smartphones, Tablets, and VR Headsets. Additional age-related differences were identified in 2023 for Laptops, Smart Wearables, Smart Home Appliances, and Smart Home Security Systems; and in 2024 for Desktop Computers, Robots, Smart Cars, and Generative AI.

For participants with and without disabilities, the 2023 data showed significant differences in comfort with Smart Headphones, Smartphones, Tablets, Laptops, Smart Wearables, Smart Home Appliances, and Smart Security Systems. In 2024, significant differences in comfort levels were observed with a broader range of devices, including Feature Phones, Smart Headphones, Smartphones, Health Monitoring Devices, Smart Home Fitness Equipment, Smart Cleaning Devices, Smart Kitchen Appliances, VR Headsets, Robots, Smart Cars, and Generative AI. **Table 2.** Comparison of Variables for comfort level in 2023 and 2024 between Age and Ability using Mann-Whitney U Tests.

	2023		*2024*	
Devices/Variables	*Z* *p*	*Z* *p*	*Z* *p*	*Z* *p*
	Age	**Ability**	**Age**	**Ability**
Feature Phones	-1.727	-1.161	-0.993	-2.335
	0.084	0.245	0.32	0.02
Smart Headphones	-0.187	-2.267	-2.475	-3.974
	0.852	0.023	0.013	<.001*
Smartphone	-421	-3.065	-3.045	-2.998
	0.674	0.002	0.002	0.003
Tablet	-0.769	-2.743	-2.613	-1.552
	0.442	0.006	0.009	0.121
Laptop	-0.8	-2.198	-1.802	-1.078

	0.424	0.028	0.072	0.281
Desktop Computer	-0.258	-1.599	-2.653	-1.761
	0.796	0.11	0.008	0.078
eBook Reader	-0.07	-1.483	-1.112	-1.248
	0.944	0.138	0.266	0.212
Smart Wearable Device	-1.496	-2.647	-1.114	-0.336
	0.135	0.008	0.265	0.737
Health Monitoring Devices	-0.395	-1.248	-1.567	-3.791
	0.693	0.212	0.117	<.001*
Smart Home Fitness Equipment	-1.183	-0.751	-1.852	-4.887
	0.237	0.452	0.064	<.001*
Smart Home Appliance	-0.813	-2.123	-1.15	-0.663
	0.416	0.034	0.25	0.507
Smart Home Cleaning Devices	-0.516	-0.407	-1.925	-3.156
	0.606	0.684	0.054	0.002
Smart Home Security Systems	-1.164	-2.041	-0.225	0.918
	0.245	0.041	0.822	0.359
Smart Kitchen Appliances	-0.647	-1.864	-0.697	-3.845
	0.517	0.062	0.486	<.001*
Smart VR Headset	-2.17	-1.256	-2.635	-4.114
	0.03	0.209	0.008	<.001*
Robots	-0.347	-0.318	-2.962	-5.053
	0.729	0.75	0.003	<.001*
Smart Cars	-0.053	-1.616	-2.412	-2.706
	0.957	0.106	0.016	0.007
Generative AI	-0.036	-1.521	-2.368	-2.012
	0.971	0.147	0.018	0.044

Willingness to Use.

The Mann-Whitney test was conducted to assess differences in willingness to use various technical devices for disaster preparedness between older and younger adults, as well as between individuals with and without disabilities, across 2023 and 2024 (see Table 3). In 2023, significant age-related differences were found for Smartphones and Laptops/Tablets. Among participants with and without disabilities, significant differences were found for Smartphones, Laptops/Tablets, and VR Headsets. In 2024, significant differences by age were found for NOAA Weather Radio, Smartphones, Laptops/Tablets, VR Headsets, and Robots. For participants with disabilities in 2024, significant differences were observed for Smartphones, VR Headsets, Interactive Chat, Wearable Devices, and Smart Cars.

Table 3. Comparison of Variables for willingness to use technology in 2023 and 2024 between Age and Ability using Mann-Whitney U Tests.

	2023		*2024*	
Variables/Devices	*Z*	*Z*	*Z*	*Z*
	p	*p*	*p*	*p*
	Age	**Ability**	**Age**	**Ability**

NOAA Weather Radio	-1.201	-0.394	-2.325	-0.341
	0.23	0.694	0.02	0.732
Smart phones	-2.501	-0.3858	-3.308	-3.361
	0.012	<.001*	<.001	<.001*
Laptop/Tablet	-2.549	-3.506	-3.466	-1.907
	0.011	<.001*	<.001	0.057
VR	-1.793	-2.268	-2.393	-3.932
	0.073	0.023	0.017	<.001*
Robot	0.065	-1.081	-2.424	-3.242
	0.948	0.28	0.015	0.001*
Interactive Chat	-0.415	-1.625	-0.317	-1.978
	0.678	0.104	0.752	0.048
Smart Home Appliance	-1.032	-0.766	0.301	-2.689
	0.302	0.444	0.763	0.007*
Wearable Device	-0.57	-0.2	-0.411	-2.155
	0.569	0.841	0.681	0.031*
Smart Speakers	-0.284	-0.598	-0.587	-1.866
	0.777	0.55	0.557	0.062
Smart Security Speakers	-1.232	-1.202	-0.584	-0.693
	0.218	0.229	0.559	0.488
Smart Car	-0.65	-0.084	-1.544	-2.662
	0.515	0.933	0.123	0.008*

Attitude Toward Using.

Table 4 presents the Mann-Whitney test results for attitudes toward technology adoption in 2023 and 2024. Among older and younger adults, significant differences were found in 2023 for agreeing with the "technology mind" statement and that technology is "not necessary". In 2024, while the difference for "not necessary" remained significant, the difference in "technology mind" was not statistically significant.

For people with and without disabilities, significant differences were observed in both years. In 2023, "technology mind" and "user knowledge" statements were associated with differing agreements. In 2024, the significance of the "technology mind" statement increased, and the belief that technology is "not necessary" was also significant, showing consistent patterns over time.

Table 4. Comparison of Variables for attitude/behavior toward technology in 2023 and 2024 between Age and Ability using Mann-Whitney U Tests.

	2023		*2024*	
Attitudes	*Z* *p*	*Z* *p*	*Z* *p*	*Z* *p*
	Age	**Ability**	**Age**	**Ability**
Technology Mind	-2.329	-2.104	-1.793	-3.377
	0.02	0.035	0.073	<.001
Learning Burden Myself	-0.443	-0.394	-0.738	-0.303
	0.658	0.694	0.461	0.762

Burden Family	-1.483	-1.369	-1.937	-0.912
	0.138	0.171	0.053	0.362
Bad Technology Experience	-1.355	-0.665	-0.058	-0.324
	0.176	0.506	0.954	0.746
Tech Savvy	-1.347	-1.382	-0.47	-0.72
	0.178	0.167	0.639	0.472
Use Knowledge	-0.235	-2.301	-0.612	-0.652
	0.814	0.021	0.541	0.515
Not Necessary	-2.676	-1.899	-2.063	-2.388
	0.007	0.058	0.039	0.017
Use Convenience	-1.571	-1.961	-0.859	-1.808
	0.116	0.05	0.391	0.071

4.3 Changes in Adoption of Technologies from 2023 to 2024

Table 5 presents the results of the Mann-Whitney U test comparing participants' responses from 2023 and 2024 regarding technology use. The results show no significant differences in frequency of use or behavior between the two years across all device categories (p > .05). However, there was a significant difference in comfort level for three devices: Smartphones, Laptops, and Desktop Computers, indicating that participants' comfort in using these technologies between 2023 and 2024. This change is also evident in Figure 5, showing an increase in comfort level for using these technologies among older adults and people with disabilities. For all other devices, no significant differences were observed in either frequency of use or comfort level (p > .05).

Table 5. Comparison of frequency of use and comfort level of technologies between 2023 and 2024 Groups Using Mann-Whitney U Tests

Devices	*Frequency*		*Comfort Level*	
	Z	*p*	*Z*	*p*
Feature Phones	-0.28	0.779	-0.592	0.554
Smart Headphones	-0.819	0.413	-0.486	0.627
Smartphone	-0.788	0.43	-3.699	<.001*
Tablet	-1.828	0.067	-1.018	0.309
Laptop	-0.041	0.967	-3.753	<.001*
Desktop Computer	-0.804	0.421	-3.702	<.001*
eBook Reader	-0.625	0.532	-0.478	0.632
Smart Wearable Device	-1.439	0.15	-0.914	0.361
Health Monitoring Devices	-0.038	0.97	-0.787	0.431
Smart Home Fitness Equipment	-0.917	0.359	-1.102	0.27
Smart Home Appliance	-1.398	0.162	-1.237	0.216
Smart Home Cleaning Devices	-0.462	0.644	-1.287	0.198
Smart Home Security Systems	-0.289	0.772	-1.711	0.087
Smart Kitchen Appliances	-1.598	0.11	-1.003	0.316
Smart VR Headset	-0.518	0.604	-1.485	0.138
Robots	-0.165	0.869	-1.811	0.07
Smart Cars	-0.695	0.487	-0.681	0.496
Generative AI	-1.418	0.156	-0.57	0.569

While most technologies show minimal year-over-year change in both frequency of use and comfort level, some notable trends emerge among older adults and people with disabilities. In terms of frequency of use, there are slight increases for several technologies, particularly among people with disabilities. However, comfort levels show more pronounced shifts, with changes approaching two full units for some technologies. Notably, there is a consistent decline in comfort with emerging technologies, such as robots, Smart Fitness Equipment, and Health Monitoring Devices, especially among people with disabilities.

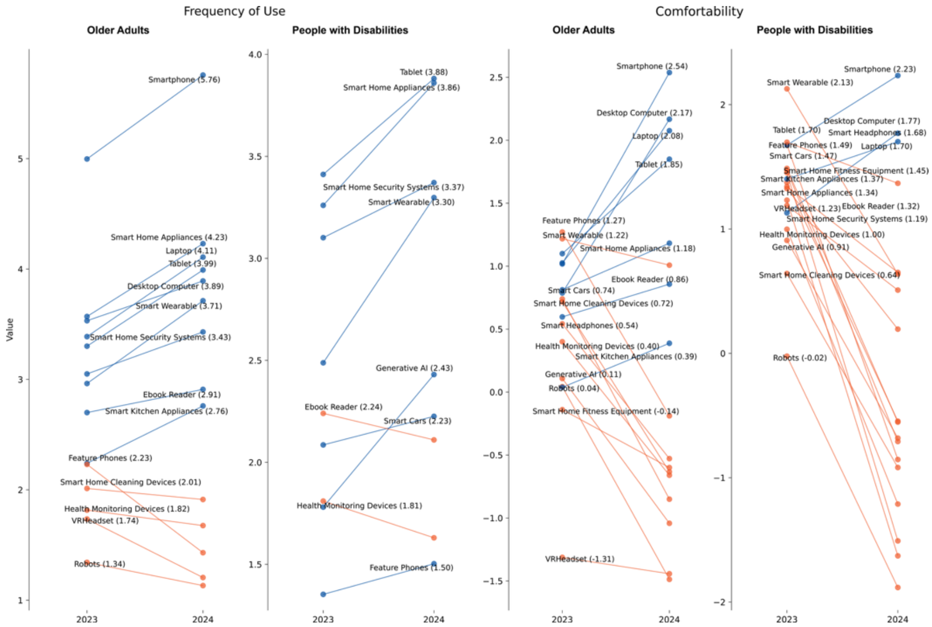

Fig. 5. Changes of frequency of use and comfort with use from 2023 to 2024

Table 7 presents the Mann-Whitney U test results for willingness to use technologies for disaster preparedness. Significant differences were found for Interactive and Smart Security Systems among participants who completed the surveys in 2023 and 2024. However, no other technologies showed significant differences between years. Figure 6 illustrates these changes among older adults and people with disabilities between 2023 and 2024. Overall, a declining trend is more prevalent across both groups, particularly for Smart Cars, Smart Home Appliances, and Robots. These patterns support the Mann-Whitney U results

Table 6. Comparison of Variables to determine difference in willingness to use between 2023 and 2024 Groups Using Mann-Whitney U Tests

Variables	*Willingness to use*	
	Z	*p*
NOAA Weather Radio	-0.653	0.514
Smartphone	-0.033	0.974
Tablet or Laptop	-1.724	0.085
Virtual Reality	-1.337	0.181
Robot	-1.011	0.312
Interactive Chat	-2.217	0.027
Smart Home Appliances	-2.923	0.003
Wearable Device	-0.48	0.631
Smart Speakers	-0.602	0.547
Smart Security Systems	-2.376	0.018
Smart Cars	-1.338	0.181

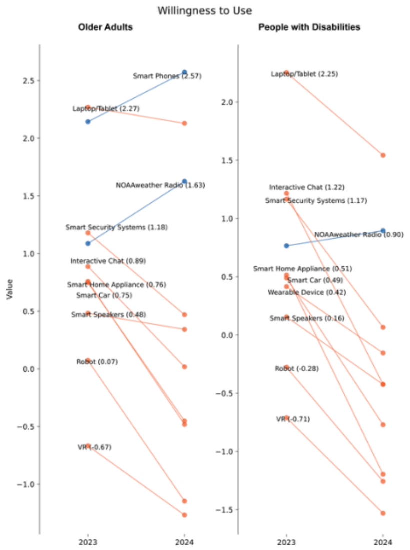

Fig. 6. Changes of willingness to use toward using from 2023 to 2024

Table 7 shows the Mann-Whitney U test results for participants' behavior toward technology. None of the variables reached statistical significance (all p > .05), indicating no meaningful behavioral differences between the 2023 and 2024 participants. Figure 7 illustrates the minor changes in behavior among older adults and people with disabilities and considering the magnitude of the mean changes, it visually supports the statistical results reported in Table 7.

Table 7. Comparison of Variables to determine difference in attitude/behavior between 2023 and 2024 Groups Using Mann-Whitney U Tests

Variables	*Behavior*	
	Z	*P*
Technology Mind	-0.352	0.725
Burden on Myself	-1.183	0.237
Burden on My Family	-0.551	0.582
Bad Technology Experience	-0.503	0.615
Tech Savvy	-1.705	0.088
Use Knowledge	-0.565	0.572
Not Necessary	-0.504	0.614
Use Convenience	-0.105	0.916

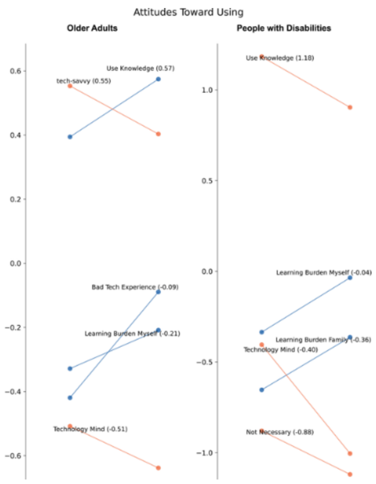

Fig. 7. Changes of attitudes toward using from 2023 to 2024

4.4 Causal Relationships in the TAM Indicators

To examine relationships among indicators within the TAM framework, we conducted a path analysis using the Semopy library in Python, with a sample of 2024 participants who identified as having a disability and/or as older adults. The model posits directional paths from Use Comfortability of Emerging Technologies (Perceived Ease of Use, PEU) to both Perceived Usefulness (PU) and Attitude Toward Using Technologies (ATU). PU and ATU, in turn, predict Willingness to Use Emerging Technologies (Behavioral Intention to Use, BIU), which then leads to Actual System Use (ASU). Technologies such as feature phones and NOAA weather radios were excluded before computing grouped emerging technology variables, which were calculated as the mean across relevant technologies or attitudes. The model equations are as follows:

$$PU = \beta_1 . PEU + \varepsilon_1 (1)$$

$$ATU = \beta_2 . PU + \beta_3 . PEU + \varepsilon_2 (2)$$

$$BIU = \beta_4 . PU + \beta_5 . ATU + \varepsilon_3 (3)$$

$$ASU = \beta_6 . BIU + \varepsilon_4 (4)$$

Assumptions of path analysis were verified prior to model estimation. Multicollinearity was assessed using Variance Inflation Factors (VIF), all of which were below 2.0, indicating acceptable levels. Residuals were inspected to ensure approximate normality and linearity with occasional heavy tails. The constructs were treated as observed variables and assumed to be measured without error.

Table 13 presents the standardized path coefficients. PU was significantly predicted by PEU ($\beta = 0.48$, $p < .001$), and in turn, PU significantly predicted ATU ($\beta = 0.21$, $p < .001$) and BIU ($\beta = 0.89$, $p < .001$). However, the direct paths from PEU to ATU and ATU to BIU were not significant ($p > .05$). BIU significantly predicted ASU ($\beta = 0.48$, $p < .001$), supporting the final hypothesized link.

Indirect effects were calculated to evaluate mediation pathways. PEU exerted a significant indirect effect on BIU and ASU through PU, and PU indirectly influenced ASU through BIU, supporting a cascade of influence from perceived ease to actual use.

The overall model fit was not optimal, as indicated by a significant chi-square test, $\chi^2(5) = 82.13$, $p < .001$, and poor RMSEA (0.296). Other fit indices also suggested weak to marginal fit (CFI = 0.813; GFI = 0.806; TLI = 0.589). These results suggest that the specified model may not adequately capture the observed relationships, and further model refinement may be necessary.

A path diagram illustrating the model and standardized coefficients is presented in Figure 9.

Table 13. Path estimates for TAM framework indicators

lval	op	rval	Estimate	Std. Err	*z*-value	*p*-value
PU	~	PEU	0.476585	0.062582	7.615419	<.001
ATU	~	PU	0.213506	0.055781	3.827557	<.001

ATU	~	PEU	0.025108	0.053514	0.469194	0.639
BIU	~	ATU	-0.03437	0.065033	-0.52852	0.597
BIU	~	PU	0.890472	0.044425	20.04445	<.001
ASU	~	BIU	0.476666	0.063738	7.478482	<.001
ATU	~~	ATU	0.348579	0.037054	9.407444	<.001
BIU	~~	BIU	0.261263	0.027772	9.407444	<.001
PU	~~	PU	0.632924	0.067279	9.407444	<.001
ASU	~~	ASU	0.658951	0.070046	9.407444	<.001

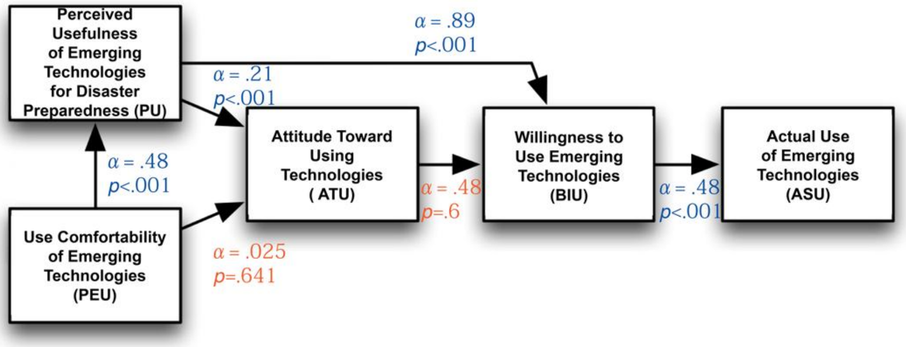

Fig. 1. Path Analysis of Technology Adoption Indicators

5 Discussion and Conclusion

Not surprisingly significant associations were found between all device types and both frequency of use across age and ability groups from both surveys in 2023 and 2024. With comfort, there were significant associations between most device types across age or ability groups in 2023 and 2024. No significant relationship was found between the feature phone and comfort across ability for both years and across age in 2024. In 2023, e-reader, smart security systems and robots were also not significant across age, with regards to comfort. However, in 2024, significance was found. For technologies typically used for disaster preparedness, there was a significance found between willingness to use all technology across age and ability in 2023 and 2024. Usefulness of the technology was only surveyed in 2024, where there was an insignificance found between usefulness and age regarding smart home security systems.

For certain technologies, there was little to no difference in the frequency of use by the age of respondents. This was true across both years. However, the adoption for one technology, generative ai, increased for younger adults in one year. In 2023, both age groups showed similar use of generative ai, where in 2024 use among younger adults increased to nearly 50%. Regarding ability, there was a difference in use, where respondents without disabilities used technologies more. However, there was one technology which had an inverse finding, robots. Robots were most frequently used by respondents with disabilities in 2024.

The frequency of use with technology increased the most among older adults and people with disabilities between 2023 and 2024. Only a few technologies have decreased in comfort and use. Interestingly, over the same time, comfort for most technologies decreased among both groups. Willingness to use technologies generally decreased over the year. The findings also indicate that there were mixed results regarding their attitudes towards using technologies, in general.

As the path analysis shows, the perceived usefulness of emerging technologies was significantly related to the attitude respondents had for using the technologies and their willingness to use the technologies. Comfort of emerging technologies also likely influenced respondents' perceived usefulness. However, while willingness to use emerging technologies was significantly related to actual use of emerging technologies, their attitude toward using technologies was not significantly related to willingness to use them. Similarly, comfortability was not significantly related to attitude towards emerging technologies. This is a very important finding. At least for disaster preparedness, the findings show that uncomfortability does not necessarily mean there will be a negative attitude toward using the technologies. Furthermore, a negative attitude towards technology may not necessarily indicate an unwillingness to use the technology for purposes of disaster preparedness.

Previous literature confirms an increase in adoption and use of technologies among the older adult population and people with disabilities. However, the drastic decrease in willingness to use technology and comfort with technology should be studied by future research. Especially given the increase in frequency of use. Perhaps an increased awareness of privacy and security concerns can explain this change in one year (Kakulla, 2025; Knight et al., 2022). Comfort, however, is not necessarily related to the attitude of technology, nor attitude related to willingness to use. Therefore, developers may want to consider the potential influence perceived ease of use has toward willingness to use and overall behavioral intention. Similarly, training related to leveraging technology to improve disaster preparedness may be necessary from the developers or perhaps from the emergency management (and related) practitioner community.

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