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Research Article

Aging With Long-Term Mobility Impairment: Maintaining Activities of Daily Living via Selection, Optimization, and Compensation

Elena T. Remillard, MS,[1,*] Cara Bailey Fausset, PhD,[2] and Walter Brad Fain, PhD[3]

[1]Center for Assistive Technology and Environmental Access (CATEA), Georgia Institute of Technology, Atlanta. [2]Georgia Tech Research Institute, Atlanta. [3]Information and Communications Laboratory, Georgia Tech Research Institute, Atlanta.

*Address correspondence to Elena Remillard, MS, Center for Assistive Technology and Environmental Access (CATEA), Georgia Institute of Technology, 512 Means Street NW (Suite 300) Atlanta, GA 30318. E-mail: elena.remillard@design.gatech.edu

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Abstract

Background and Objectives: There is a growing number of adults with long-term mobility impairment aging into the older adult population. Little is known about the experiences of these individuals in maintaining activities of daily living (ADLs) and instrumental activities of daily living (IADLs) as they face age-related changes in addition to a pre-existing mobility impairment.

Research Design and Methods: Through in-home interviews with 21 participants (ages 52–86) with long-term mobility impairment, the present study employed a qualitative description design to explore perceptions of how and why select ADL/IADL routines (e.g., bed transfer, toileting) have changed over time. The selection, optimization, and compensation (SOC) model was used as a framework to organize participants' adaptations.

Results: Among the ADL/IADL routine changes mentioned, elective selection strategies, in which a person continues to work at maintaining a task, were more frequently endorsed than loss-based selection strategies, in which a person does a task less or gets help from someone. Findings suggest that this population is actively adapting their routines to preserve their involvement in, and frequency of doing, these ADLs/IADLs. Counter to expectation, perceived age-related changes underlying activity routine changes were subtle and generally did not include sensory and cognitive declines.

Discussion and Implications: Findings provide insights into the difficulties adults with long-term mobility impairment experience as they age, as well as the adaptations they employ to overcome those challenges. Results highlight the need for customizable, mobility supports (e.g., assistive technologies, home modifications) that can adjust to an individual's changing abilities across the life span.

Keywords: Disabilities, Function/mobility, Environment, Qualitative analysis

Individuals who have mobility impairment or "serious difficulty walking or climbing stairs" (American Community Survey, U.S. Census Bureau, 2014) are living longer than ever before (Institute of Medicine, 2007). Advances in rehabilitation and technology are supporting a growing population of older adults with long-term, and even lifelong, mobility impairment. A recent U.S. census report revealed that among the population of older adults with one or more disabilities, about two-thirds (66.5%) have mobility difficulty, affecting about 10 million people (U.S. Census Bureau, 2014). Despite the prevalence of mobility impairment among older adults, very little is known about the segment of older adults who acquired their mobility impairment in early or mid-life (Freedman, 2014; Putnam,

Molton, Truitt, Smith, & Jensen, 2016). In comparison to the majority of people with mobility impairment who have late-life onsets for relatively short periods of time, people with early or mid-life onset mobility impairment are subject to much longer durations of impairment (Verbrugge & Yang, 2002). This unique group of individuals, said to be "aging with disability," are likely to experience challenges above and beyond normative aging (LePlante, 2014; Verbrugge & Yang, 2002).

Normative age-related changes, such as declines in vision, hearing, strength, and balance, can impact an older adult's ability to carry out a range of everyday activities. Activities of daily living (ADLs) are considered the most basic, self-care tasks such as bathing, toileting, transferring; one's ability to complete these tasks independently is often used to determine need for additional support services (e.g., caregiving, long-term care housing; Katz, Ford, Moskowitz, Jackson & Jaffe, 1963). Instrumental ADL (IADLs) are also important activities for independent living, but are less essential for fundamental functioning. IADLs, such as preparing meals and housekeeping, require more advanced physical and cognitive capabilities (Lawton & Brody, 1969).

As suggested in Lawton's Environmental Press Theory, disability is not an inevitable outcome of having an impairment (Lawton & Nahemow, 1973; Lawton, 1985). Rather, a mismatch between one's competencies (e.g., physical functioning) and the demands of their environment (e.g., the home) creates disability. It can be expected that older adults with long-term mobility impairment are likely to have lower physical functioning resulting in higher environmental demands. Thus, supports to increase an individual's competencies and/or to reduce environmental demand are required. Given the overwhelming preference of older adults to age in place, it is essential for these individuals to achieve and maintain person-environment fit in their homes (Lien, Steggell, & Iwarsson, 2015). There is a need to identify the environmental characteristics of the home that enable individuals with mobility impairment to live as independently as possible across the life span. First, research must explore how individuals in this understudied population change over time.

Research has shown that people aging with long-term mobility impairment are at risk of developing a number of related secondary conditions and experiencing declines that mirror normative age-related changes, more rapidly, a phenomenon known as "accelerated aging" (Groah et al., 2012; Institute of Medicine (U.S.), 2007; McNalley et al., 2015; Stern et al., 2010). For example, among individuals aging with Spinal Cord Injury, high rates of obesity and marked declines in muscle mass and bone density are common and thought to be the result of years, and even decades, with limited to no standing or muscle activity (Groah et al., 2012). Accelerated aging has also been thought to occur among people with multiple sclerosis (MS), which is a progressive, neurological condition with symptoms including but not limited to: weakness, fatigue, pain, and declines in sensory and cognitive capabilities (Stern et al., 2010). Several symptoms of MS are similar to the normative age-related declines of older adults, yet affect individuals at a much younger age.

Many older adults with long-term mobility impairment are experienced in adapting to mobility-related challenges, utilizing supportive solutions such as mobility aids (e.g., wheelchairs, lifts), home modifications (e.g., grabs bars, ramps, widened doorways) and help from others (Cho, MacLachlan, Clarke & Mannan, 2016). However, as these individuals age and face increased biological and social losses, additional environmental and behavioral adaptations may be needed to enable successful performance of ADLs and IADLs and to maintain their independence (Agree, 2014). There is a need to further explore the challenges adults with long-term mobility impairment experience with ADLs/IADLs as they age and their strategies for adapting to them (Harrington, Mitzner, & Rogers, 2015).

The selection, optimization, and compensation (SOC) model provides a framework within which to organize the strategies and behaviors of older adults who must manage age-related changes in conjunction with long-term mobility impairment (Baltes, 1997). The SOC model describes how individuals adapt to developmental challenges across the life span via the processes of selection, optimization, and compensation. The process of selection can be elective such that an individual elects to pursue a goal or behavior and devotes available resources to achieving that goal or behavior (Freund & Baltes, 2002). Alternatively, selection can be loss-based such that an individual discontinues performing a task because he/she can no longer do the task (Freund, 2008). Optimization occurs when an individual continues to work at maintaining a goal or behavior (Baltes); perseverance and practice are examples of optimization. Additionally, optimization includes modifying the approach or altering the current design of the environment without bringing in new elements to maintain a goal or behavior. Lastly, compensation involves using new or additional processes (e.g., mobility aids) aimed at maintaining performance in the face of biological or social losses (Baltes). These processes operate in concert to maximize available resources and minimize losses.

The SOC model has been widely used to understand how older adults adapt to age-related declines (for a review see Freund, 2008). For example, Bourgeois (2001) used the SOC model to understand how older adults managed their daily activities and found that compensation was associated with successful management. In a study that examined how older adults (n = 248) with osteoarthritis managed their daily activities, optimization and compensation were the most frequently reported behavioral adaptations (Gignac, Cott, & Badley, 2002). The relationship between SOC processes and management of home maintenance activities was investigated by providing older adult focus groups with scenarios based on physical and

cognitive limitations (Kelly, Fausset, Rogers, & Fisk, 2014). The findings suggested that older adults endorsed compensatory strategies most frequently. In addition to adapting to normative age-related changes, the SOC model can be used as a framework to understand the interaction of these processes within the context of aging with a long-term mobility impairment and to help to identify unmet needs for this growing population.

The goal of this research was to understand how the ADL/IADL routines of older adults with long-term mobility impairment have changed over time. Additionally, we sought to understand their perceptions of why these routines have changed, with regard to underlying age-related changes with self. The SOC framework was used to organize the behavioral adaptations used to overcome challenges in maintaining ADLs/IADLs.

Method

Study Overview

The present study employed a qualitative description design to explore perceptions of how and why routines for select ADLs/IADLs have changed over time among adults with long-term mobility impairment. As described in Sandelowski (2000), qualitative description studies are designed to provide a comprehensive summary of events, wherein researchers obtain descriptions of phenomena via a data-driven approach. Interviews were conducted in the homes of participants so that they could discuss their ADL/IADL routines in the places where they naturally occur and have the contextual and environmental cues to support their descriptions.

Participants

To be eligible for this study, participants had to be at least 50 years old and have a mobility impairment that began prior to age 50. Participants were considered as having a mobility impairment if they self-identified with "having serious difficulty walking or climbing stairs" (ACS; U.S. Census Bureau, 2014). The minimum age was set at 50 years to include adults who may be experiencing "accelerated aging", which is an altered trajectory of aging in which health conditions occur much earlier and more frequently that has been correlated among people aging with mobility impairment (Groah et al., 2012; Stern et al., 2010).

Twenty-three older adults with long-term mobility impairment were recruited for this in-home study; data from 21 participants are presented. Data from two participants were excluded from analysis: one due to incomplete data and one who did not have a mobility impairment for a minimum of 10 years. Although duration of impairment was not an inclusion criterion for this study, the researchers felt it was important to establish a threshold for "long-term impairment" to ensure the sample was matched to a minimum criterion. After the data were collected, the researchers determined that the analysis would focus on participants who had their mobility impairment for at least 10 years. The sample was selected to represent a range of mobility impairment in terms of underlying cause as well as a mix of men and women. Participants were recruited from the Georgia Tech HomeLab database and through outreach at local disability resource organizations. All participants were compensated $60 for completing this 2-hour, in-home study.

The mean age of the 21 participants was 61.9 years (standard deviation [*SD*] = 9.2; range 52–86). The average age of onset for mobility impairment was 13.2 (*SD* = 13.3), ranging from birth to age 39. On average, participants reported having their impairment for 48.7 years (*SD* = 15.4), ranging from 14 to 70.5 years. With regard to mobility capabilities, 15 participants reported being unable to walk at all, and 12 reported being unable to stand. The causes of mobility impairment among participants were categorized into the following groups: post polio syndrome (n = 10), spinal cord injury (n = 6), congenital condition (n = 3), and neurological disorder (n = 2). Twenty participants reported using a wheelchair at least some of the time. Other mobility aids used by participants included: canes (n = 2), crutches (n = 3), walker (n = 3), and scooter (n = 1). Two participants reported using leg brace orthotics. One participant reported using both arm and leg prostheses on occasion.

Thirteen of the 21 participants were female. Seventeen participants self-identified their race as white/Caucasian and four as black/African American. Participants represented annual household income levels ranging from less than $25,000 to more than $75,000, with nearly half reporting income less than $25,000 ($n$ = 10). Ten participants completed a bachelor's degree or higher, eight attended some college or vocational school, two completed high school/GED, and one had less than high school education. Housing situations varied across participants with types including single-family home (n = 10), apartment/condo (n = 10), and group home (n = 1). Six participants considered their home to be senior housing. Eight lived alone and 13 lived with another person. Fourteen reported having either a formal or informal caregiver. Regarding self-reported health, 19 participants rated their own health as good or better; 2 rated their health as fair. Comparing their health to other people their own age, 16 participants rated their health as good or better; 5 rated their health as fair or poor.

Procedure and Materials

A two-person research team conducted each home interview: One researcher led the interview, and the other was the note taker. Four total researchers were involved with data collection (two research scientists and two research assistants). After providing informed consent, participants were asked to guide the researchers around their home and answer questions about their daily routine.

A structured interview guide was developed to ensure that all participants responded to the same questions.

During the interview, participants were asked about their background, lifestyle, health, the nature of their mobility impairment, and their use of mobility aids. Participants were then prompted to discuss their process for the following ADLs: bed transfer, bathing, toileting, preparing food, moving around the home, and entering and exiting the home. The present study did not include the activity of self-feeding, which is widely considered a basic, self-care ADL (Katz et al., 1963). The research team was interested in understanding challenges and solutions for cooking and thus included food preparation, an IADL (Lawton & Brody, 1969). Activities were presented in this order to facilitate discussion of a "day in the life" routine, beginning with getting out of bed in the morning. For each activity, participants were asked if they require assistance from others, any items they use for assistance, and any changes they have made to their home. Participants were then asked to describe how and why their routine has changed over time as they have gotten older.

Following the daily activity interview, participants rated each activity on how much more challenging the activity has become with age. For example, participants were asked, "How much more challenging has it become to get in and out of bed?" Participants answered each question using a provided scale (1 = not at all, 2 = slightly, 3 = moderately, 4 = considerably, 5 = extremely) and were given the opportunity to share any comments. After the interview, participants were debriefed and compensated for their time.

Analysis

A qualitative content analysis was conducted, wherein participant responses were categorized and counted to identify patterns related to ADL/IADL routine changes and perceived age-related changes. Content analysis is a method commonly used to extract meaning from qualitative data by reducing complex texts to underlying categories via inductive (bottom-up) and deductive (top-down) content analysis (Elo & Kyngäs, 2008; Mitzner, Bixter, & Rogers, 2016). Although Elo and Kyngäs imply these processes are mutually exclusive, a blended approach was taken in analyzing the routine change data. Leveraging an existing coding scheme was deductive, but modifying the categories to align with this specific study context was inductive. The analysis focused on participants' responses to the following questions for all six activities: *How has your routine changed as you have gotten older? What has changed and why?* In addition, we reviewed any relevant comments provided in response to the activity rating question: *How much more challenging has [activity] become with age?* Any comments pertaining to routine changes or perceived age-related changes were also included in the analysis. Two researchers independently reviewed the data; each researcher identified and categorized unique items using coding schemes that were developed in past research (as in the routine change coding scheme) or derived from the data (as in the perceived age-related changes coding scheme).

Routine Change Coding Scheme

The routine change coding scheme was developed iteratively to represent the range of unique participant responses (see Table 1). The scheme was based on the SOC scheme developed by Kelly et al. (2014) who investigated potential challenges older adults might face in performing home maintenance tasks. In their study, participants discussed potential solutions to overcome hypothetical difficulties in perception, mobility, physical, and cognition. The solutions were classified using the SOC framework. Routine changes were organized into the following SOC classifications: *Elective Selection with Compensation, Elective Selection with Optimization, Loss-based Selection with Compensation,* and *Loss-based Selection*. As previously stated, the SOC processes are not mutually exclusive; they work in concert. Thus, the combined SOC process categories reflect the orchestration of the processes (Freund & Baltes, 2000).

> The classification *Elective Selection with Compensation* denoted solutions in which a person chose to continue performing a task but accomplishes it through new means, such as using a tool or technology. *Elective Selection with Optimization* referred to instances where an individual chose to continue performing the task and managed it without bringing in any new means to assist. *Loss-based Selection with Compensation* referred to using compensation to complete tasks that the individual is no longer capable of performing but necessary to maintain the home (e.g., having someone else do the task). *Loss-based Selection* was defined as no longer doing certain tasks because of choice or because they were unable to do so (Kelly, Fausset, Rogers, & Fisk, 2014, p. 1029–1030).

Although *Elective Selection with Optimization* indicates that individuals do not rely on new means to assist in task completion, "means" refers to physical or observable tools or technologies and not to attitude or desire to complete the task.

Table 1 displays the coding scheme, wherein each routine change is described and categorized by type of behavioral adaptation and SOC classification. The table also provides illustrative quotes from the interviews that map onto the routine changes. Quotation marks indicate a verbatim quote from the participant; the absence of quotation marks indicates that the researcher paraphrased the participant's comments. The scheme from Kelly et al. (2014) was modified to include the following behavioral adaptations: "Practice" and "Task done less often." To ensure agreement, two researchers independently categorized each routine change. Prior to any discussion, the average percent agreement between researchers across activities was 80%.

Table 1. Routine Change Coding Scheme

Routine change (How has your routine changed as you've gotten older?)	Behavioral adaptation	SOC classification	Participant examples
Participant still does the task; however, it takes more effort and/or longer to complete.	Perseverance	Elective selection with optimization	Things take longer. Makes meals that are easier to prepare (e.g., foods that just to be heated up, fresh salads, and cooking enough to make leftovers) (Food prep) "Have to sit down more-didn't have to sit or use grab bars [before]." (Bathing)
Participant describes modifying his/her behavior that results in a change in overt action.	Overt action	Elective selection with optimization	Due to difficulty of transferring on/off toilet … In bed, she has urinals that she can use laying down. In the bathroom, she … goes to the bathroom in a plastic container while leaning on the toilet … Avoids bladder infections by using pads in public. Just doesn't drink much so she can go hours without going to the bathroom. (Toileting)
Participant mentions practicing a task such that less time and/or effort is required to complete the task or that the participant's confidence in completing the task is heightened.	Practice	Elective selection with optimization	"It hasn't gotten harder. I just periodically find easier ways to do things." (Toileting) "Gotten better with power assist wheelchair…" (Movement in the home)
Participant alters the current design of the residence without bringing in new elements.	Redesign	Elective selection with optimization	"Sometimes I have to arrange and make sure I have everything because you don't want to grab the joystick [of power wheelchair] with messy hands" (Food prep)
Participant uses any product(s) that could act as prostheses, supporting or enhancing abilities.	Tools and technologies	Elective selection with compensation	"My big thing is that I gained weight around 35. I used to be able to free-form transfer, but now I have to use a slide board" (Bed transfer)
Participant is still attempting to do some part of the task but uses assistance from another person.	Assistance from other	Elective selection with compensation	Son has started helping with canned goods because of numbness and strength loss in hands (Food prep)
Participant mentions a structural and permanent change to one's home.	Home modification	Elective selection with compensation	Before she got the ramps, someone would have to help her with the step to get out of the front door. (Enter/exit) Widened all doorways (doors removed throughout most of home). Installed "swing away" offset hinges on office, bathroom, and kitchen doors from (1.5"- 2" wider), which "makes it so much easier!" (Movement in the home)
Participant states the task is done less frequently.	Task done less often	Loss-based selection	"I move around my home less. I perch myself on the chair or sofa and wheel over the computer and work for hours. I pulled my TV out of my room and resisted getting a laptop because they keep me in bed too much…I'm trying to force myself to be normal." (Movement in the home)
Participant states that he/she no longer does the task and has someone else do the task.	Outsource	Loss-based selection with compensation	Misses cooking a lot. Used to manage restaurant in college … Now mainly gives direction and company to whoever is cooking. (Food prep)

Researchers then discussed discrepancies with a final percent agreement of 95% across activities.

Perceived Age-Related Changes Coding Scheme

We developed a coding scheme to analyze participant responses to "why" their ADL routines changed, which we refer to as perceived age-related changes with self. The category list represented a range of domains including changes in one's physical body (e.g., bruise easier, weight gain), sensations (e.g., pain, fatigue), condition and/or disease (e.g., MS, arthritis), as well as less explicit changes (e.g., age). The list was developed using a bottom-up approach; each unique response regarding a perceived age-related change with self was included. Some participants

did not report any perceived age-related changes and some reported multiple; only unique utterances were included in the analysis. For example, if a participant mentioned upper body weakness as a reason why a change has occurred for multiple activities, the participant was only counted once to prevent possible dilution of the data due to a few participants who repeated themselves. To keep the scope of the analysis focused on age-related changes within the individual, any reports of perceived changes due to environmental changes (e.g., moving) or external life events (e.g., accident-related injuries), were excluded from the analysis.

Results

Daily Activity Interview

Routine changes: How has your routine changed as you have gotten older?

Figure 1 shows the frequency count of the reported routine changes for each activity. The total frequency count is greater than the number of participants, as they were able to list multiple routine changes. It should be noted that although each participant was asked to discuss routine changes for each activity, responses were not always provided. There were some activities that did not apply for all participants. For example, with toileting, some participants used alternative methods of managing urination and bowel movements (e.g., catheter, colostomy). In these situations, participants answered the questions with regard to their own method and their responses were classified as toileting. The most routine changes were reported for bathing (23) and food preparation (23), with one or more routine changes reported by 15 and 17 participants, respectively. Nineteen routine changes were reported for bed transfer (n = 16), 19 for toileting (n = 15), and 15 for movement in the home (n = 8). Five routine changes were mentioned for entering and exiting the home (n = 4).

Figure 2 shows the frequency of behavioral adaptation responses to the question, "How has your routine changed as you have gotten older?" Perseverance (n = 34), overt action (n = 22), and tools and technologies (n = 18) were the top three most frequently reported routine changes.

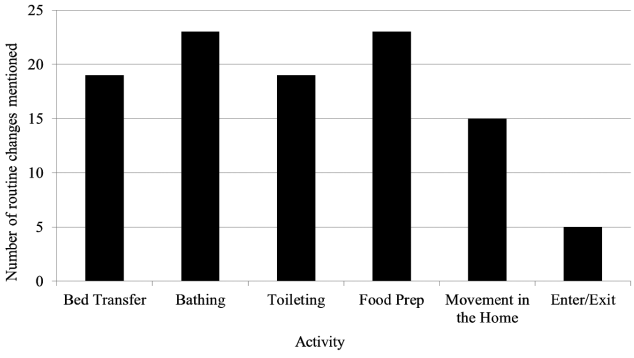

Figure 1. Frequency of routine changes mentioned for each activity of daily living.

The code "Perseverance" was applied when participants described their routine as more difficult or taking more time to complete, but they continue to do the task. Toileting (n = 10), bathing (n = 9), and food prep (n = 7) were the most frequently mentioned activities in which participants persevered. Participants also described completing tasks more cautiously or in a different or nontraditional manner; this was coded as "Overt action." Bathing (n = 8) and food prep (n = 6) were the most frequently mentioned activities in this category. Lastly, movement in the home (n = 6), bed transfer (n = 4), and toileting (n = 4) were the most frequently mentioned activities in which participants described using new or additional tools or technologies to complete their routines.

In Figure 2, behavioral adaptations are grouped by their respective SOC classification to also display the overall frequencies of endorsed strategies that older adults reported using. Elective selection with optimization was the most frequently endorsed strategy (n = 65); this classification includes Perseverance, Overt action, Practice, and Redesign behavioral adaptations. Elective selection with compensation (n = 32) was the next most frequently endorsed strategy which includes tools and technologies, assistance from other, and home modification. Task done less often and outsourcing, the loss-based selection strategies were endorsed least often (n = 7).

Routine Changes: What Has Changed and Why?

Table 2 shows the number of participants who mentioned each perceived age-related change across all of the activities. Sixteen out of the 21 participants reported some sort of weakness as a self-perceived age-related change underlying their ADL/IADL routine changes. Upper body weakness (n = 11), general weakness (n = 9), and weight gain (n = 7) were mentioned most frequently as the reasons why daily routines have changed.

Daily Activity Ratings

After the interview, participants rated how much more challenging each daily activity has become with age.

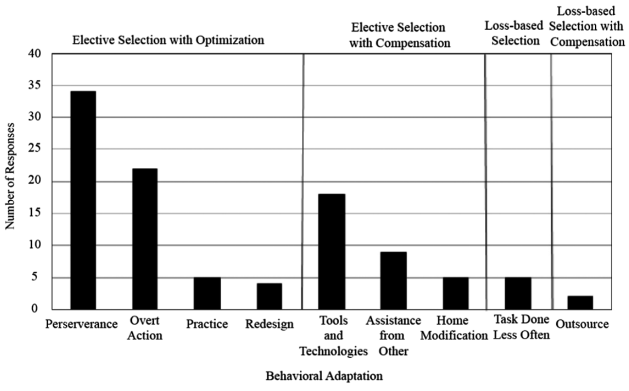

Figure 2. Frequency of behavioral adaptation responses grouped by respective SOC classification. This graph shows the frequency of each behavioral adaptation reported by participants in response to the question, "How has your routine changed as you have gotten older?"

Descriptive statistics (i.e., median and frequency counts) were used to analyze the ratings. Participants only provided ratings for activities that they currently do; if they did not do the activity, their rating was marked as "Not Applicable (N/A)." Figure 3 displays the frequency counts of participant ratings for how much more challenging each activity has become with age. Among the activities, entering/exiting, and movement around the home received the highest number of "not at all more challenging" ratings, with 11 and 9, respectively. The most "extremely more challenging" ratings were for bed transfer (5). Bed transfer, bathing, toileting, and food preparation had median ratings of 3 ("This activity has become moderately more challenging with age"). The remaining activities, movement in the home, and entering/exiting the home, had median ratings of 2 (slightly more challenging) and 1 (not at all more challenging), respectively.

Table 2. Number of Unique Participants Mentioning Each Perceived Age-Related Change With Self

Perceived (age-related) changes with self	Number of participants (%)
Upper body weakness	11 (50.0)
General weakness	9 (42.8)
Weight gain	7 (33.3)
Age	5 (22.7)
Balance problems	4 (18.2)
Numbness/lack of sensation	4 (18.2)
Disease-related/disease progression	4 (18.2)
Arthritis/stiffness	3 (13.6)
Fatigue	3 (13.6)
Muscle soreness/cramps	2 (0.09)
Bruises easier	1 (0.05)
Pain	1 (0.05)
Vision loss	1 (0.05)

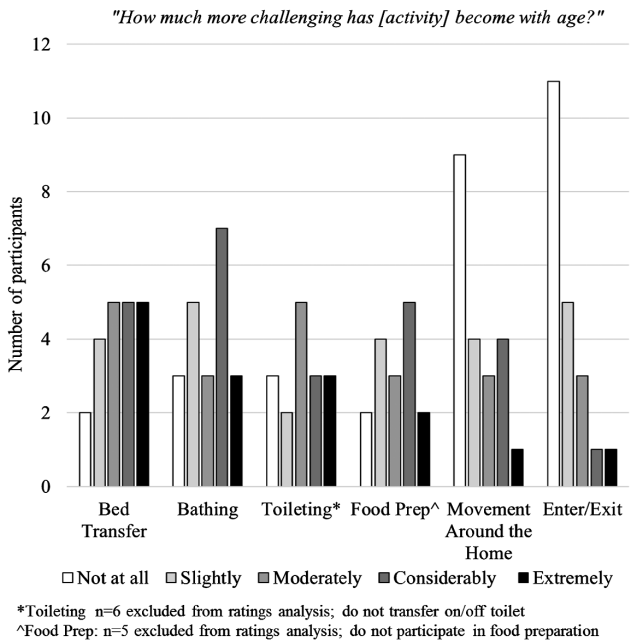

Figure 3. This column graph displays the frequency counts of participant ratings for how much more challenging each activity has become with age.

Implications

Older adults with long-term mobility impairment are experienced in adapting to challenges with everyday activities. However, age-related changes, such as declines in vision, hearing, strength, and balance, can present new obstacles to performing ADLs, essential tasks for maintaining independence and aging in place (Harrington, Mitzner, & Rogers, 2015; Lawton, 1990). The SOC model provides a framework to describe how older adults faced with such declines can modify their behaviors to enable them to successfully carry out everyday activities (Baltes, 1997). In this research, the SOC model was used as a framework to understand the interaction of these processes within the context of aging with a long-term mobility impairment. The goals of this research were to investigate how and why the daily routines of this population have changed over time and self-perceptions of age-related changes.

Routine Changes, Perceived Age-Related Changes with Self, and Daily Activity Ratings

Participants reported routine changes over time for each of the daily activities investigated in this study; bathing and food preparation had the most routine changes reported, whereas entering and exiting the home had the fewest changes mentioned. These findings map onto participant ratings of how much more challenging each activity had become with age. Participants' ratings reflected that bed transfer, bathing, toileting, and food preparation had become moderately more challenging with age. The remaining activities, movement in the home and entering/exiting the home, were rated lower (or less challenging). These results suggest that, in comparison to activities like bed transfer, bathing, toileting, and food prep, older adults with long-term mobility impairment experience relatively fewer challenges and reactive routine changes with movement around the home and entering/exiting the home.

We hypothesize that the barriers to moving in, out, and around the home might be the most salient, urgent activities addressed as soon as the mobility impairment began. Participants' mobility impairment was caused by either progressive conditions (e.g., MS) or injuries resulting in permanent paralysis (e.g., spinal cord injury). With any improvement in mobility unlikely, it can be expected that reactive behavioral and environmental adaptations (e.g., installing a ramp, widening doorways) were implemented as long-term solutions to make the home accessible. Although bed transfer, bathing, toileting, and food preparation were

likely impacted at the onset of the mobility impairment, participants may have been able to overcome the challenges of performing those tasks throughout youth and middle age. It is also important to note that toilet transfer ratings did not include six participants who no longer use the toilet (e.g., catheterized, colostomized). It is likely these participants did experience challenges in toileting transferring prior to using alternative methods; thus, we recognize that results may not tell the whole story for difficulty in toilet transfer among the sample.

With regard to participants' self-perceived age-related changes, upper body weakness, general weakness, and weight gain were the top three most frequently reported reasons for routine changes. It is interesting to note that most participants mentioned having upper body or general weakness, suggesting that weakness is the most apparent and common age-related change for older adults with mobility impairment. Consistent with the literature on aging with spinal cord injury, several participants attributed their upper body weakness to years of overusing upper body limbs to compensate for their lower body mobility impairment, resulting in "shoulder burnout" and injuries (Groah et al., 2011). We expected participant responses to reflect what the literature refers to as normative age-related changes (e.g., declines in vision, hearing, strength, memory; American Psychological Association 2016). Although loss of strength and balance were reported, only one participant mentioned vision loss, and no one reported declines in hearing or cognition. One explanation of this is that mobility difficulty is more common among U.S. older adults with disability than vision, hearing, or cognitive difficulty (U.S. Census Bureau, 2014). Another possibility is that individuals with long-term mobility impairment, and particularly wheelchair users, are more likely to experience mobility-related changes (e.g., weight gain, stiffness, numbness) as a consequence of living a sedentary lifestyle (Groah et al., 2012).

Many participants struggled to identify the exact age-related change that caused a change in their routine. In response to the question, "Why did the routine change occur?", five participants mentioned it was just "age." The difficulty in recognizing age-related changes may be attributed to the slow and subtle nature of how many of these changes manifest. People are continuously adjusting to their own changing abilities and demands of their environment, often without conscious awareness. Similarly, some participants were unable to determine if their age-related changes were indeed age-related or rather a symptom of the condition underlying their mobility impairment. For instance, fatigue and weakness are symptoms of both post polio syndrome and MS but could also be considered age-related changes (McNalley et al., 2015; Stern et al., 2010). Although many of these secondary health conditions among people aging with mobility impairment may be attributed to limited physical activity, it is also possible that the cumulative stress on the body from propelling a wheelchair could accelerate certain conditions such as arthritis in the hands and shoulders. In line with prior research, the present study found that even the young-old participants (age 50–65), reported experiencing age-related changes with their routine and themselves suggesting an accelerated aging trajectory (Groah et al., 2012; Stern et al., 2010). Therefore, normative age-related changes among people with long-term mobility impairment might have to be defined on an individual level of analysis and impairment status.

The Role of Selection, Optimization, and Compensation

The SOC model was used as a framework to guide the analysis of behavioral adaptations used by older adults with long-term mobility impairment to maintain performance of select ADLs/IADLs as they age. To capture the range and diversity of behavioral adaptations, the coding scheme developed by Kelly and colleagues (2014) was used. Elective selection with optimization was the most frequently endorsed strategy to manage daily activity challenges followed by elective selection with compensation. Loss-based selection and loss-based selection with compensation were endorsed much less frequently. Specifically, perseverance and overt action, both classified as elective selection with optimization, were the top two most frequently reported behavior changes followed by tools and technologies, classified as elective selection with compensation.

These findings are consistent with the literature: In a study that examined how older adults (n = 248) with osteoarthritis managed their daily activities, optimization and compensation were the most frequently reported behavioral adaptations (Gignac, Cott, & Badley, 2002). Bourgeois (2001) found that compensation was associated with successful management of ADLs in a community sample of 142 older adults. Kelly, Fausset, Rogers, & Fisk, (2014) investigated the strategies that older adults would use to accomplish home maintenance tasks given various scenario-based physical and cognitive limitations. This study, which included the coding scheme used in the present study, found that compensatory strategies were most frequently reported followed by optimization. Furthermore, all of these studies found that older adults reported greater elective selection than loss-based selection behaviors. This finding suggests that despite limited resources, older adults are focused on maintaining their daily activities as independently as possible.

The present study found that older adults with long-term mobility impairments infrequently endorsed loss-based selection (task done less often) and loss-based selection with compensation (outsourcing) behavioral adaptations. Of the seven loss-based selection adaptations mentioned, all but one regarded food preparation. As food preparation was the only IADL activity we investigated and, being less essential than ADLs, the activity could be completed less frequently or outsourced. Specifically, a person could

reduce food preparation by cooking larger portions to be consumed throughout the week or outsource food preparation entirely by having someone else cook (e.g., spouse, food delivery). ADLs, on the other hand, require the person to be directly involved in the activity (e.g., toileting, bed transfer) and cannot be reduced or outsourced. This finding is consistent with Kelly et al. (2014) in that few participants endorsed loss-based selection strategies and suggests that loss-based selection is not an adaptive strategy for essential activities. Individuals who are adapting to their changing capabilities must employ compensatory and/or optimizing behaviors.

The older adults in this study all have been subject to challenging life events (e.g., injuries, conditions/illnesses) that caused their mobility impairment, yet they continue to persevere, and in many cases flourish, despite the difficulties. In line with other research on aging with disability, the behavioral adaptations identified in this study demonstrate the resiliency of older adults with long-term mobility impairment (Silverman et al., 2015). Future research should investigate the relationship between resilience and the use of SOC. We expect a strong positive correlation between resilience and the number of SOC strategies endorsed. It would also be interesting to investigate resilience and the use of SOC and their relationship to the duration of the impairment, regardless of age.

Moreover, it is likely that this sample employs greater use of SOC as compared to a non–mobility-impaired older adult sample. This group has managed challenges for decades and are therefore quite adept at adapting. The resourceful and creative adaptations of the long-term mobility impairment population could potentially offer solutions to adults experiencing normative age-related changes, especially with respect to declines in mobility. For example, home modifications such as installing ramps, replacing flooring, and adjusting doorways, were employed by most participants in this study (Gonzalez, Fausset, Foster, Cha, & Fain, 2015). Future research should explore and compare the use of SOC between long-term impairment (e.g., mobility, vision, hearing) and nonimpaired aging populations.

A few limitations of this study must be noted. First, although the sample represented a mix of mobility impairment in terms of causes (e.g., spinal cord injury, MS) and functional abilities, the conditions included are by no means comprehensive. Future research should incorporate other conditions underlying long-term mobility impairment, such as ALS and arthritis, which have distinct symptoms and can manifest differently in individuals. Another limitation is that researchers visited the home only once. A longitudinal study in which researchers observe performance of ADLs/IADLs at different points in time would be useful in better understanding the trajectory of change and behavioral adaptations over time.

Due to the 2-hour time constraint, the interview did not cover the range of daily activities and routine changes that many participants wanted to discuss (e.g., laundry, dressing, driving/transportation, working/using computers, communication, leisure activities, and travelling). Future research should explore routine changes among this population with the full range of IADLs. The analysis of why ADL/IADL routine changes occurred focused solely on perceptions of age-related changes with self. Environmental changes (e.g., moving, renovations, structural damage, accumulation of clutter) could also prompt routine changes and should be included in future research. Lastly, the present study did not explore how availability of resources impacts participants' strategies for overcoming ADL/IADL challenges in the home. Factors such as income, insurance coverage, and family support likely plays an important role in how these individuals are adapting their routines.

The in-home interview setting used in this study enabled the collection of rich, qualitative data about routine changes. By discussing each activity in the location where it occurs, participants were exposed to environmental cues that helped them describe supports they use, do not use, or perhaps use in an unexpected way, to complete each activity; such details are more likely to be left out or forgotten if the interviews took place outside the home or over the phone. Another strength of this study was that activities were presented in a "day in the life" sequence, starting with getting out of bed in the morning, using the toilet, and so on to prompt discussion of activities as they might typically occur.

Conclusion

This study represents the first to explore views from older adults with long-term mobility impairment about how and why they have changed their routines for managing ADLs and IADLs in the home over time. The SOC model was used as a framework to organize their behavioral adaptations in managing their daily routines. We were able to successfully apply a framework that was developed to describe how older adults manage normative age-related changes to a sample of older adults aging with a long-term mobility impairment. This study illustrates the flexibility of the SOC model and how it can be applied to any individual's development across the life span.

This research demonstrates that many adults with long-term mobility impairment experience complex challenges with ADLs/IADLs as they age. Despite challenges, this population is actively adapting their routines to maintain ADLs/IADLs and preserve their involvement in, and frequency of doing, these activities. For older adults with long-term mobility impairment, age-related changes underlying ADL/IADL routine changes are often subtle and can be difficult for individuals to identify and articulate about themselves. More research is necessary to understand the aging trajectories among this understudied population. Results highlight the need for customizable, supports (e.g., assistive technologies, home modifications) that can adjust

to an individual's changing abilities across the life span to promote independence at home.

Innovations in design and technology hold great potential to empower individuals aging with mobility impairment to maintain everyday activities and thrive. However, access to supportive devices, equipment, and housing remains a barrier for many individuals in this population. Income and insurance coverage are just a few of the factors that could limit one's options for overcoming ADL/IADL challenges in the home. There is a need for convergence among aging and disability services, which tend to operate in silos, serving older adults, or people with disabilities; this divide is echoed in how supportive devices and equipment are accessed, delivered, and paid for in terms of eligibility and insurance. By moving from a model that emphasizes aging or disability, to one that addresses impairment as a spectrum, practitioners, and policy makers can better meet the needs of a diverse older adult population (Putnam, 2014).

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Conflict of Interest

None reported.

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